Report to the Joint Standing Committee on Environment and Natural Resources

Review of Requirements for Outdoor Wood Boilers

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I. Introduction

A. Purpose of this Report

This report is submitted to the Joint Standing Committee on Environment and Natural Resources pursuant to S.P. 181 – L.D. 400, "Resolve, Directing the Department of Environmental Protection to Examine Setback Requirements for Outdoor Wood Boilers" which directed the Department of Environmental Protection (Department) to review laws governing outdoor wood boilers, including the Maine Revised Statutes (M.R.S.), Title 38, Section 610-B, and rules adopted by the Department related to emission standards, stack height requirements, and setback requirements for new installations of outdoor wood boilers and report back to the Committee by January 5, 2024.

Specifically, the resolve directed the Department to determine if stack height and setback requirements for new installations of outdoor wood boilers should be amended, taking into consideration the more stringent emission standards of the most recent models of outdoor wood boilers. This report is in response to the Committee's directive and includes the Department's findings and recommendations.

B. Outdoor Wood Boiler Background Information

Outdoor wood boilers (OWBs), also known as residential hydronic heaters, central heaters, or forced-air furnaces, are freestanding, wood-fired heaters that are usually housed within a small, insulated shed. OWBs are used to heat water by burning wood or wood pellets and piping the heated water (or other fluid) to heat a nearby residence, commercial structure, pool, or spa. Manufacturers design OWBs to burn large amounts of wood over long periods of time. OWBs vary in design heat output capacities, with a range averaging from 115,000 British thermal units (Btu) per hour (Btu/hr) up to 1 million Btu per hour (MMBtu/hr) for residential units.[1] Top-load industrial units can have design heat output capacities of 4 MMBtu/hr or greater. OWB suppliers and owners determine the appropriate size of an OWB based on the climate of the OWB's intended location and the square footage of the space to be heated.

Inside the OWB is a large firebox that can accommodate large loads of wood fuel. Firebox volumes vary with each unit but tend to range in volume from 20 cubic feet up to 150 cubic feet. A water jacket surrounds the firebox, continuously pumping and heating water. The heated water then moves through underground, insulated pipes to the area to be heated.

Based on a 2006 Northeast States for Coordinated Air Use Management (NESCAUM) report, *Assessment of Outdoor Wood-fired Boilers*, the cost of purchasing and installing an OWB varies depending on the size and model of the unit. Costs can range between $6,000 and $15,000, not including installation fees.[2]

[1] For comparison, an oil or gas-fired residential furnace typically has a heat output capacity of less than 200,000 Btu/hr.

[2] NESCAUM (March 2006; Revised June 2006), Assessment of Outdoor Wood-fired Boilers, Report; https://www-f.nescaum.org/documents/assessment-of-outdoor-wood-fired-boilers/2006-1031-owb-report_revised-june2006-appendix.pdf/.

According to the report, OWBs tend to be more common in rural areas where there is an adequate supply of wood but can also be found in urban areas. The NESCAUM report also found that an increase in the price of heating fuels such as oil, natural gas, and propane correlated with an increase in the number of OWBs installed. Of the more than 155,000 OWBs sold nationwide since 1990 (through 2006), the report indicated that 95% were sold in the northeastern quadrant of the United States.

C. Public Health Concerns

An Environmental Law Institute (ELI) report released in 2021, titled *Indoor Wood Burning Policies to Reduce Emissions and Improve Public Health*, found that "people are exposed to wood-burning pollutants indoors – even in households that do not burn wood."[3] The report states that ambient (outside) air pollution can enter homes through cracks, windows, and other building openings. Smoke that goes out of a chimney can reenter the same home and the homes of neighbors. In the Department's experience in responding to complaints, emissions from OWBs can have a noticeable impact on local neighborhoods. An issue unique to OWBs is that they are generally located some distance away from the building being heated (so, generally closer to a neighboring property than an indoor heating device would be), and OWBs are typically supplied with a relatively short stack (10 feet in height, or less) from the manufacturer. Shorter stacks do not provide as much dispersion of air pollutants as do taller stacks.

The 2021 ELI report goes on to say that wood smoke from residential wood burning produces several air pollutants, including particulate matter, carbon monoxide, nitrogen oxides, and toxic compounds such as benzene, formaldehyde, and polycyclic aromatic hydrocarbons. Each of these pollutants is linked to adverse health effects. Most prominently, particulate matter is linked to cardiovascular disease, respiratory disease, cancer, and other systemic health effects. More mild effects can include irritated eyes, throat, and sinuses as well as headaches. A portion of the population is susceptible or at increased health risk from exposure to wood smoke due to factors including age, geographic location, and pre-existing health conditions.

The small particle component of wood smoke plays a large role in the observed health effects associated with wood burning. A 2006 NESCAUM study, *In-Field Ambient Fine Particle Monitoring of an Outdoor Wood Boiler: Public Health Concerns*, found that particulate matter from residential wood burning is largely comprised of submicron particles with average mass diameters between 0.1 and 0.6 microns or micrometers (μm).[4] Fine particles that are 2.5 μm or less in diameter are referred to as $PM_{2.5}$. To put that to scale, an average human hair is about 70 μm in diameter. $PM_{2.5}$ particles are small enough to become suspended in the air, or aerosolized, and inhaled into the lungs.

[3] Environmental Law Institute (April 2021), Indoor Wood-Burning Policies to Reduce Emissions and Improve Public Health, Report; https://www.eli.org/sites/default/files/eli-pubs/wood-burning-report-april-2021.pdf.
[4] NESCAUM (2006), In-Field Ambient Fine Particle Monitoring of an Outdoor Wood Boiler: Public Health Concerns, Study; https://www.nescaum.org/documents/johnson_owb-public-health_hera_2006.pdf.

Despite the known health risks of PM exposure, residential wood burning continues to be popular and is one of the largest sources of $PM_{2.5}$ emissions to the atmosphere in North America. Studies in both urban and rural regions have found wintertime residential wood burning emissions can contribute significantly to, and even be, the primary contributor to ambient concentrations of $PM_{2.5}$ and of volatile organic compounds. Areas subject to persistent temperature inversions, located in valleys, or having a high percentage of residential wood-burning devices can be at increased risk.

D. Environmental Concerns

OWBs emit significantly more particulate matter than other residential wood-burning devices and other fuel-burning heating appliances such as oil-fired, natural gas-fired, and propane-fired units. The 2006 report by NESCAUM stated that the average $PM_{2.5}$ (grams/hour) emissions from one OWB is equivalent to the emissions from 22 United States Environmental Protection Agency (EPA)-certified wood stoves, 205 oil furnaces, or as many as 8,000 natural gas furnaces. OWBs have several unique issues that contribute to higher emission rates.

OWBs are made to provide heat and hot water year-round. Most of the use occurs in the winter months, but they may also be used in the summer months to heat domestic hot water and swimming pools or spas. In the summer months, smoke may be less likely to disperse due to lower flue velocities from the stack.

Operating procedures, such as firing well-seasoned wood as opposed to green wood, can heavily influence the efficiency of and emissions from OWBs. During seasons of lower heating demand, operating an OWB by completely filling the firebox and "turning it down" by limiting air intake for combustion creates a smoldering fire that burns inefficiently. When an OWB is "off" and does not need to generate heat, the air damper closes to cut off the air supply to the firebox. This creates an environment where the fire will smolder, creating creosote. Creosote then condenses on the internal walls of the OWB and is burned off when the fire is rekindled. Creosote is then directly emitted through the stack, resulting in additional smoke, since it is not fully combusted.

The burning of inappropriate materials is also a problem, since the firebox of these units is large enough to burn a variety of materials that could not be burned in an indoor woodstove or fireplace.[5]

II. Background Regarding Laws and Regulations Applicable to Outdoor Wood Boilers

Outdoor wood boilers are currently regulated by both state and federal programs.

[5] The burning of trash, tires, railroad ties, and other potentially toxic substances has been found to be a problem for enforcement programs.

A. Maine State Laws and Regulations

In 2007, the Maine Legislature enacted 38 M.R.S. Section 610-B, establishing particulate matter emission standards for outdoor wood boilers, granting authority to the Department to define nuisance conditions in relation to the operation of outdoor wood boilers, providing emergency powers to the Commissioner to take such action as may be necessary to address outdoor wood boilers that are creating nuisance conditions or creating a danger to public health and safety, and requiring the Department to adopt a rule to implement the law.

The Department subsequently adopted *Control of Emissions from Outdoor Wood Boilers*, 06-096 Code of Maine Rules (C.M.R.), ch.150 (Chapter 150) with an effective date of November 9, 2007. Chapter 150 established: 1) applicability criteria; 2) defined *nuisance* and other terms; 3) particulate matter emission standards along with certification and labeling requirements; 4) setback and stack height requirements; 5) fuel requirements along with a list of prohibited fuels; and 6) visible emission standards for these units.

Emission Standards

Chapter 150 phased-in particulate matter emission standards for outdoor wood boilers beginning April 1, 2008:

> Phase 1: No person shall distribute or sell, lease, import, supply, or install an outdoor wood boiler after April 1, 2008, or an outdoor pellet boiler after April 1, 2009, unless it has been certified to meet a particulate matter emission limit of 0.60 lb/MMBtu heat input. [06-096 C.M.R. ch. 150(3)(E)] Outdoor wood boilers and outdoor pellet boilers meeting the Phase I limit must be installed according to the applicable setback and stack height requirements. [06-096 C.M.R. ch. 150(3)(B)-(C)]
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> Phase 2: No person shall distribute or sell, lease, import, supply, or install an outdoor wood boiler or outdoor pellet boiler after April 1, 2010, unless it has been certified to meet a particulate matter emission limit of 0.32 lb/MMBtu heat output. [06-096 C.M.R. ch. 150(3)(E)] Outdoor wood boilers and outdoor pellet boilers meeting the Phase II limit must be installed according to the applicable setback and stack height requirements. [06-096 C.M.R. ch. 150(3)(B)-(C)]
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> Voluntary Technology-forcing Particulate Emission Standard: An outdoor wood boiler meeting a particulate matter emission limit of 0.06 lb/MMBtu heat output is not subject to a setback requirement under this Chapter if it meets the stack height requirements. [06-096 C.M.R. ch. 150(3)(C)(3)]

Site Setback Requirements

Site setback requirements depend on the unit's emission rating, with reduced setbacks allowed for cleaner-burning OWB models. Minimum setback distances are based on distance from the nearest property line OR distance from the nearest dwelling that is not on the same property as the outdoor wood boiler. [06-096 C.M.R. ch. 150, Table 1]

Table 1: OWB Setbacks based on Emission Ratings	
OWB Emission Rating (In pounds per million Btus, lb/MMBtu)	**Minimum Setback Distances** From property line OR from Dwelling
0.32 lb/MMBtu	50 feet OR 70 feet
0.60 lb/MMBtu	100 feet OR 120 feet
>0.60 lb/MMBtu (Including uncertified OWBs)	250 feet OR 270 feet
0.06 lb/MMBtu	20 feet OR 40 feet

Minimum Stack Height Requirements

The minimum stack height for all OWB units is at least 10-feet above the ground. However, the stack height must be extended at least two feet higher than the peak of the building served by the OWB (or the nearest building in the case of a pool heater) if either of the following are met:

1) If an OWB, installed after 11/9/07, with a particulate emission rating greater than 0.60 lb/MMBtu (or an uncertified OWB), is within 500' of any abutting residence; or

2) If an OWB, installed after 11/9/07, with a particulate emission rating of 0.60 lb/MMBtu or less, is within 300' of any abutting residence.

If a residence is built on abutting property after the OWB is installed, the stack height will have to be increased to meet the criteria described above. Additional stack height requirements may be necessary in conditions where topography or other buildings restrict the dispersion of smoke and create a nuisance condition per Chapter 150.

Sales of OWBs

In Maine, retailers must provide buyers with a copy of Department Rule Chapter 150, in addition to the owner's manual and other written information. [38 M.R.S. § 610(B)]

Used OWBs that have been owned by an individual and were in use in the State of Maine prior to November 9, 2007, may be distributed or sold to another individual for personal use. The OWB is still subject to applicable setbacks and stack height requirements.

Any person intending to install or operate an OWB larger than 350,000 Btu/hr and all OWBs for commercial applications must have an engineering analysis conducted to determine several factors to identify proper boiler size, stack height, and other items specific to the installation and particular site.

All new OWBs supplied, distributed, sold, leased, offered for sale, or installed in the State of Maine must be certified pursuant to the EPA Outdoor Wood-Fired Hydronic Heater Program.

New OWBs are to be labeled in accordance with the EPA Outdoor Wood-Fired Hydronic Heater Program's requirements.[6]

Fuel Types

Only clean wood or wood pellets from clean wood can be burned in OWBs. (Clean wood has no paint, stain, or other types of coating or treatments with preservatives of any type.) Home heating oil, propane, or natural gas may be used as auxiliary fuel in dual-fired OWBs designed to burn those types of fuel.

Chapter 150 contains a long list of prohibited fuels, including materials such as garbage, tires, yard waste, plastics, rubber, paints, and chemicals to name a few.

Visible Emission Standards and Nuisance Conditions

No OWB, regardless of the date of installation, may cause or allow a smoke plume with opacity of 30% or greater for more than two six-minute periods in any three-hour period. This is determined through visual evaluation by an EPA- or DEP-certified smoke reader--someone who has received training and been tested for accuracy in visually quantifying the opacity of emissions. Opacity is a measure of the "thickness or density of the smoke" emitted from a stack. If an OWB produces emissions of 30% or greater opacity, its operating practices must be modified to comply with this visible emission standard.

No OWB, regardless of the date of installation, is allowed to operate when conditions cause any visible smoke plume to cross onto adjacent owner's land and buildings for 12 minutes or more in any hour. Sending smoke on adjacent land or buildings for 12 minutes or more is a nuisance and a violation of the regulation. Chapter 150 prohibits the operation of an OWB in such a manner as to create a nuisance.

No rain caps are allowed on the stack unless required by the manufacturer's specifications. Rain caps can restrict the flow of air and help to create a nuisance condition.

B. Federal Regulations

Section 111 of the Clean Air Act (CAA) requires the EPA to list categories of stationary sources that, in the EPA's judgment, cause or contribute significantly to air pollution that may reasonably be anticipated to endanger public health or welfare. The EPA then issues standards of performance for each category, also known as New Source Performance Standards (NSPS).

Residential wood heaters were originally listed under CAA section 111(b) in 1987 and the first NSPS addressing this sector promulgated in 1988 (*Standards of Performance for New Residential Wood Heaters*, 40 C.F.R. Part 60, Subpart AAA).[7] In 2014, the EPA proposed revisions to the NSPS that went into effect in 2015. The 2015 NSPS updated the wood heater

[6] EPA's Burnwise Website: Choosing the Right Hydronic Heater; https://www.epa.gov/burnwise/choosing-right-hydronic-heater.

[7] 40 C.F.R., Part 60, Subpart AAA, Standards of Performance for New Residential Hydronic Heaters and Forced-Air Furnaces; https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-60/subpart-AAA.

NSPS emission limits, eliminated exemptions over some residential wood-fueled devices, and updated test methods and the wood heater certification process. EPA's 2015 action also included the addition of a new NSPS subpart that covers new wood-burning residential OWBs and new forced-air furnaces.

The NSPS for outdoor wood boilers contained in Title 40 Code of Federal Regulation (C.F.R.), Part 60, Subpart QQQQ, *Standards of Performance for New Residential Hydronic Heaters and Forced-Air Furnaces*, (Subpart QQQQ), established applicability criteria, defined certain terms, and established phased-in particulate matter emission standards, fuel requirements along with a list of prohibited fuels, testing, certification, labeling, and owner's manual requirements for manufacturers.[8] It is important to note that the federal regulations do not include any specific setback or stack height requirements for outdoor wood boilers.

Under the 2015 OWB NSPS, after May 15, 2015, no person is permitted to manufacture, import into the United States, or sell at retail a residential hydronic heater unless it has been certified to meet Phase 1 emission standards. Residential OWBs manufactured before May 15, 2015, were still able to be imported or sold at retail until December 31, 2015. Phase 1 PM emission standards are a maximum of 0.32 pounds per million (Btu) heat output, with a cap of 18 grams per hour for individual test runs.

In 2020, the EPA issued final amendments to the NSPS for New Residential Wood Heaters and New Residential Hydronic Heaters and Forced Air Furnaces, Subparts AAA and QQQQ. These rules do not affect existing units currently in use by homeowners. After May 15, 2020, retailers may only sell wood heating devices that comply with Phase 2 emission standards. Phase 2 imposes a particulate matter emission limit of 0.10 lb/MMBtu heat output for each burn rate, or the alternate limit of 0.15 lb/MMBtu heat output as certified by the EPA, depending on the test method used. The final rule also makes clear the EPA's decision to not allow a sell-through period for Phase 1-certified residential wood heating devices manufactured before May 2020.

Federal regulations also impose chip wood fuel requirements, pellet fuel requirements, and a list of prohibited fuel types. Both chip wood fuel and pellet fuel are limited to types specified in the owner's manual of the hydronic heater. Pellet fuels must also be graded under a licensing agreement with a third-party organization approved by the EPA. Federal regulations for residential wood heaters have a long list of prohibited fuels under Section 111 of the CAA, similar to the list of prohibited fuels contained in Chapter 150.

In addition to meeting certification requirements imposed on the manufacturers, affected wood heaters equipped with a catalytic combustor must be equipped with a temperature sensor that can monitor combustor gas stream temperatures within or immediately downstream of the catalytic combustor surface. A user must operate an outdoor residential hydronic heater, indoor residential hydronic heater, residential forced-air furnace, or other affected central heater in a

[8] 40 C.F.R., Part 60, Subpart QQQQ, Standards of Performance for New Residential Hydronic Heaters and Forced-Air Furnaces; https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-60/subpart-QQQQ.

manner consistent with the owner's manual. The owner's manual must clearly specify that operation in a manner inconsistent with the owner's manual would void the warranty.

Comparison of State and Federal Regulations

The State of Maine regulations are more stringent than federal regulations with respect to setback requirements, stack height requirements, visible emission standards, prohibition of nuisance conditions, and notice to buyers. The State of Maine meets the federal standard for prohibited fuel types, third-party sales, labeling requirements, and certification processes. Chapter 150 would need to be updated regarding the particulate matter emission standards to be consistent with the newer federal emission standard as listed in 40 C.F.R., Part 60, Subpart QQQQ.[9]

C. Other Northeastern State Regulations

Other northeastern states have adopted regulations specific to outdoor wood boilers that are comparable to Maine's Chapter 150. A table comparing emission standards, setback requirements, and stack height requirements contained in federal regulations and state regulations of Maine, New Hampshire, Vermont, and New York can be found in Appendix A.

III. Public Health Concerns Due to Wood Smoke

Wood smoke emitted from wood-burning devices, including outdoor wood boilers, is a public health concern. Setback and stack height requirements can help mitigate the impacts from outdoor wood boilers. According to EPA, wood smoke is made up of a complex mixture of gases and fine particles. Wood smoke contains several toxic air pollutants, including benzene, formaldehyde, acrolein, and polycyclic aromatic hydrocarbons (PAHs).[10] Outdoor wood boilers that are designed to meet lower emission standards, properly maintained, and efficiently operated create less emissions and less wood smoke.

The greatest health threat from wood smoke is from fine particles, particulate matter of 2.5 micrometers in diameter or less, also called $PM_{2.5}$. These microscopic particles can get into someone's eyes and respiratory system, where they may cause burning eyes, runny nose, and illnesses such as bronchitis. Fine particles can make asthma symptoms worse and trigger asthma attacks. Fine particles can also trigger heart attacks, stroke, irregular heart rhythms, and heart failure, especially in people who are already at risk for these conditions.

Wood smoke can affect everyone, but the populations known to be at greater risk include children, teenagers, older adults, people with lung diseases such as asthma and COPD, people with heart disease, outdoor workers, and disadvantaged persons including those who are homeless and/or with limited access to medical care. Research indicates that obesity or diabetes may also increase the risk from wood smoke inhalation. Finally, new, or expectant mothers may also want to take precautions to protect the health of their babies, because some studies indicate they may be at increased risk.

[9] All units sold in Maine (and nationwide) must meet the federal new source performance standards.

[10] EPA website titled "Wood Smoke and Your Health"; https://www.epa.gov/burnwise/wood-smoke-and-your-health.

IV. Nuisance Conditions Caused by Outdoor Wood Boilers

In addition to having public health impacts, emissions from outdoor wood boilers may also result in nuisance conditions experienced by neighbors of residences or businesses utilizing outdoor wood boilers to provide heat and hot water for home or business. Emissions from outdoor wood boilers may cause smoke and/or odors that may prevent nearby neighbors from conducting and enjoying activities on their own properties.

Chapter 150 defines "nuisance" as emissions of air contaminants to the outdoor atmosphere of such quantity, characteristic, or duration that may be injurious to human, plant, or animal life or to property, or that unreasonably interferes with the comfortable enjoyment of life or property. Chapter 150 contains a standard for nuisance conditions, prohibiting operation of an outdoor wood or pellet boiler that produces visible emissions, measured as any opacity totaling 12 minutes in any hour, that cross onto any land or buildings immediately adjacent to a dwelling or commercial building not owned by the owner of the outdoor wood boiler. Opacity is determined pursuant to EPA Method 22, *Visual Determination of Fugitive Emissions from Material Sources and Smoke Emissions from Flares* (40 C.F.R. Part 60, Appendix A).

V. NESCAUM Study

In March of 2021, the Northeast States for Coordinated Air Use Management (NESCAUM), released a report titled *Assessment of EPA's Residential Wood Heater Certification Program.*[11] The report details the results of a study conducted in collaboration with the Alaska Department of Environmental Conservation (ADEC) reviewing the EPA's program to certify that new residential wood stoves and central heaters, including outdoor wood boilers, meet air pollution standards in accordance with the applicable NSPS regulation. The study found systematic failures of the entire certification process for the over 250 certified wood heaters reviewed, including failures in EPA's oversight and enforcement of the certification requirements. Wood heater manufacturers and the EPA-approved test laboratories used for certification testing were found to often deviate from test method requirements and manufacturers' owner's manual instructions.

The conclusion of the report was that EPA's certification program to ensure new wood heaters meet NSPS requirements lacks federal oversight and is easily manipulated by manufacturers and testing laboratories.[12] The study found that starting in 1988 when EPA first adopted air pollution standards for new wood stoves, it has never conducted a single audit to verify that a wood heater performs consistent with its certification test results—a span of over 30 years.

[11] NESCAUM (March 2021), Assessment of EPA's Residential Wood Heater Certification Program, Report; https://www.nescaum.org/documents/nescaum-review-of-epa-rwh-nsps-certification-program-rev-3-30-21.pdf.

[12] A report issued by EPA's Office of Inspector General (OIG) confirms many of the NESCAUM report findings. OIG Report, The EPA's Residential Wood Heater Program Does Not Provide Reasonable Assurance That Heaters Are Properly Tested And Certified Before Reaching Consumers, Report No. 23-E-0012 (February 23, 2023); https://www.epaoig.gov/sites/default/files/documents/2023-03/_epaoig_20230228-23-E-0012_2.pdf.

This raises serious concerns for state and local air quality and public health agencies. These agencies rely on a robust and credible certification program to address air pollution problems and public health harms caused by residential wood combustion. In efforts to reduce public health impacts, many state agencies have adopted and implemented policies to incentivize cleaner wood burning devices in communities with higher levels of wood combustion pollution. This includes providing financial incentives for the exchange of older devices with cleaner, new wood-burning heaters. If EPA's program for certifying wood heaters is not assuring that new devices are, in fact, cleaner than the ones they are replacing, then these efforts may be providing no health benefits and wasting scarce resources.

The report states that at its core, EPA's current program allows for the continued sale and installation of high-emitting wood-burning devices, many of which will be in homes located in overburdened communities already suffering from environmental and other inequities. Once installed, these units will likely remain in use, emitting higher levels of pollution than they are supposed to for decades to come.

VI. OWB Related Complaints in Maine

Citizen complaints are handled on a case-by-case basis taking the location and nature of the grievance into consideration. Complaints are received by regional offices of the Department of Environmental Protection and passed along to the respective compliance staff persons.

Since January 1, 2018, the Department has received 38 complaints pertaining to OWBs and one call for technical assistance by a homeowner. Complaints were broken down into three categories: burning prohibited materials, odor or smoke, and neighbor concerns/other. In general, calls for technical assistance and general questions are not normally tracked.

Table 2: Maine OWB Complaints

Complaint Category	Number of Complaints (Since 2018)
Burning Prohibited Materials	7
Odor or Smoke	20
Neighbor Concerns and Other	11

Table 3: Maine OWB Complaints by Regional Office

Complaint Location	2018	2019	2020	2021	2022	2023	Total Complaints (By region)
Southern Maine (SMRO)	1	1	1	2	6	1	12
Eastern Maine (EMRO)	1	4	1	2	4	0	12
Northern Maine (NMRO)	3	0	2	0	5	1	11

Central Maine (CMRO)	1	1	0	1	0	0	3
Total Complaints (By year)	6	6	4	5	15	2	38

Compliance staff have reported that a common complication when responding to complaints is the stack height of the OWB in question. Meeting stack height requirements with a small diameter stack on a standalone unit can be difficult for homeowners to achieve in addition to site setback requirements.

VII. Assessment of New Outdoor Wood Boilers

Under Chapter 150, any outdoor wood boiler sold or installed after April 1, 2010, must be certified to meet a PM emission standard of 0.32 lb/MMBtu on a heat output basis. Federal regulation 40 C.F.R., Part 60, Subpart QQQQ, requires that any residential hydronic heater manufactured or sold on or after May 15, 2015, must be certified to meet a PM emission standard of 0.32 lb/MMBtu on a heat output basis. As of May 15, 2020, the federal regulation requires that any residential hydronic heater manufactured or sold must be certified to meet a PM emission standard of either 0.10 lb/MMBtu or 0.15 lb/MMBtu on a heat output basis, depending on the test method used during certification (depending on the fuel used during the test, either dimensional lumber or cordwood). The federal regulation requires that any small or large residential forced-air furnaces manufactured or sold on or after May 15, 2020, must be certified to meet a PM emission standard of 0.15 lb/MMBtu on a heat output basis. With EPA's adoption of the PM emission standards for OWBs that became effective in 2020, a national benchmark was established for all new OWBs no matter where they are sold in the United States.

Even the newest generation of outdoor wood boilers emit significantly more particulate matter than fossil-fuel fired units. According to EPA's *Compilation of Air Pollutant Emission Factors* (AP-42), a typical, modern, residential oil-fired furnace emits filterable PM at a rate of approximately 0.4 lb/1,000 gallons of heating oil.[13] This is equivalent to less than 0.003 lb/MMBtu on a heat input basis and less than 0.004 lb/MMBtu on a heat output basis assuming an overall efficiency of 80% for a residential oil-fired furnace. This is on the order of 25 times lower than the lowest PM emission standard applicable to the newest outdoor wood boilers.

Typically, a residential oil-fired furnace is vented through a chimney or stack that extends above the peak of the roof of the residence being heated, similar to the stack height requirements contained in Chapter 150 for an OWB.[14] The set-back requirements contained in

[13] EPA's Compilation of Air Pollutant Emission Factors (AP-42). Website: https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emissions-factors.

[14] For example, the International Residential Code requires chimneys to be at least 2' higher than any portion of a building within 10', but not less than 3' above the highest point where the chimney passes through the roof. https://codes.iccsafe.org/content/IRC2021P2/chapter-10-chimneys-and-fireplaces#:~:text=Chimneys%20shall%20extend%20not%20less,chimney%20passes%20through%20the%20roof.

Maine's Chapter 150 for newer units are very similar to New Hampshire's set-back requirements and less stringent than either Vermont's or New York's set-back requirements. Chapter 150 also provides some easement of its set-back requirements for OWBs that can achieve a lower, technology-forcing PM emission standard of 0.06 lb/MMBtu. In addition, if certain stack height requirements are met for these lower-emitting OWBs, Chapter 150 requires no set-back distances. The set-back requirements contained in Chapter 150 provide some level of protection of the public health impacts to neighbors of OWB installations; however, the Department continues to receive complaints about smoke and odor caused by OWBs even when the units comply with stack height and set-back requirements contained in Chapter 150.

VIII. Potential OWB Control Strategies

NESCAUM's 2006 OWB Report cited several control strategies to reduce OWB emissions and maintain public health protections. Since then, the Department promulgated 06-096 CM.R. ch. 150 *Control of Emissions from Outdoor Wood Boilers* rule to support these goals. Chapter 150 sets standards for emissions, operating procedures, education requirements, zoning rules, nuisance rules, opacity rules, and fuel prohibitions. In addition to Chapter 150, there are strategies that could be utilized to reduce emissions and improve public health. NESCAUM's report discussed the benefits and downfalls of several strategies.

The State of Maine does not require the mandatory removal of OWBs that are not certified. The removal of older model OWBs would reduce particulate emissions from older units but would come at a great cost to homeowners and would be diffcult to enforce.

"No-burn days" could be a useful strategy during poor air quality days. However, this control strategy does not help improve the day-to-day pollution from OWBs. No-burn days are also unacceptable in cold climates like Maine. OWBs usually burn for long periods of time, so there would be an increase in the number of start-ups and shutdowns to comply with no-burn days. This would be difficult to implement and enforce statewide. Further, the transitions through start-ups and shutdowns could result in increased emissions from these units, a result counterproductive to the overall goal.

Removal of OWB units prior to the sale or transfer of property would require a compliance program or process to ensure follow-through. It could include requiring a certification that, prior to the completion of the sale or transfer on or after a certain date, the uncertified OWB would be required to be replaced or removed. This strategy would come at a cost to the homeowner and rely heavily on home inspectors to enforce.

The State of Maine does not currently have any voluntary programs or incentives to invest in cleaner OWBs. A change-out program provides incentives to discard old, inefficient OWBs for newer certified OWBs. A program like this would require significant oversight to ensure that replacement units meet state and federal requirements.

IX. Conclusions and Recommendations

Many Maine families rely on wood heating in the winter as a cost-effective method to keep their homes warm. At the same time, wood heating can cause significant public health, environmental, and quality of life impacts. Implementing additional control strategies as well as maintaining or making more stringent emission standards, stack height requirements, and set-back requirements have benefits for the environment and public health.

This report serves to provide policymakers with an assessment of the appropriateness of current stack height and set-back requirements contained in Chapter 150 given concerns relating to the use of OWBs and the presumably lower emissions from new installations. The use of OWBs in populated areas represents a potential public health problem in the Northeast because of the severity of health effects associated with residential wood smoke inhalation. The use of OWBs is of concern to state environmental agencies because cumulative stack emissions from these appliances can be much higher than from indoor wood-burning, oil-fired, and gas-fired (natural gas and propane) heating appliances.

In the Department's experience in dealing with complaints pertaining to emissions from outdoor wood boilers over many years, factors such as how well a boiler is operated and maintained, the quality of the fuel being burned, how close the boiler is to neighboring properties, and the height of the stack in relation to nearby structures and residences can make a big difference in whether or not neighbors complain about health impacts and nuisance conditions related to emissions from an OWB.

Although the set-back and stack height requirements contained in Maine's Chapter 150 may not prevent all complaints regarding emissions from outdoor wood boilers, the Department finds that they are important in helping to reduce potential health and nuisance impacts to neighbors of OWB installations and are largely consistent with set-back and stack height requirements contained in other Northeastern state regulations. Maine's Chapter 150 contains reduced setback requirements for OWBs that meet the voluntary, technology-forcing PM emission standard of 0.06 lb/MMBtu, or lower, a standard that many wood pellet burning OWBs should be able to meet. Based on review of reports and studies referenced in this report as well as the Department's experience in responding to and investigating complaints regarding OWBs in Maine, the Department does not recommend any relaxation of the set-back or stack height requirements either for existing or new OWBs contained in Chapter 150 at this time.

Appendix A

Chart comparing Maine's OWB emission standards, set-back requirements, and stack height requirements to those of other New England states and federal requirements.

(SEE ATTACHED 11" X 17" SHEET)

Appendix A: Comparison of Outdoor Wood Boiler Emission Standards and Property Set-back and Stack Height Requirements

Maine's Chapter 150, *Control of Emissions from Outdoor Wood Boilers*			New Hampshire			Vermont			New York			Federal Regulation 40 CFR Part 60, Subpart QQQQ, *Standards of Performance for New Residential Hydronic Heaters and Forced-Air Furnaces*	
PM Emission Standard	**Set-back Requirements**	**Stack Height Requirements**	**PM Emission Standard**	**Set-back Requirements**	**Stack Height Requirements**	**PM Emission Standard**	**Set-back Requirements**	**Stack Height Requirements**	**PM Emission Standard**	**Set-back Requirements**	**Stack Height Requirements**	**PM Emission Standard**	**Stack Height/Set-back Requirements**
Uncertified units or units certified to meet a PM standard higher than 0.60 lb/MMBtu installed on or after 11/9/2007, but prior to 4/2/2008	At least 250 feet from the nearest property line or at least 270 feet from the nearest dwelling that is not on the same property as the outdoor wood boiler	10' above ground level if there are no abutting residences within 500' 2' higher than the structure being served by the unit if an abutting residence is within 500'	Uncertified units installed on or after 8/10/2008, but prior to Phase I requirements	Uncertified units must be located at least 200' from the nearest abutting residence	Stack must extend 2' higher than the peak of the roof of a residence or place of business not served by the unit if located within 300' of the unit	Uncertified units installed prior to Phase I requirements that also do not meet the standards and requirements contained in federal regulation, 40 CFR Part 60, Subpart QQQQ	Units must be located more than 200' from any residence, school, or health care facility that is neither served by the unit nor owned by the owner or lessee of the unit	Stack must extend higher than the peak of the roof of the structure being served by the unit if any residence not owned by the owner of the unit is more than 200' but less than 500'	Uncertified units commencing operation prior to 4/15/2011	No minimum set-back requirements	No minimum stack height requirements	Residential Hydronic Heaters manufactured, imported, or sold on or after 5/15/2015 must be certified to meet a PM standard of 0.32 lb/MMBtu on a heat output basis	The federal regulations contain no specific minimum stack height or property set-back requirements, only that the owner's manuals contain guidance on proper installation information, including stack height, heater location and achieving proper draft.
Phase I units certified to meet a PM standard of 0.60 lb/MMBtu on a heat output basis installed after 4/1/2008	At least 100 feet from the nearest property line or at least 120 feet from the nearest dwelling that is not on the same property as the outdoor wood boiler	10' above ground level if there are no abutting residences within 300' 2' higher than the structure being served by the unit if an abutting residence is within 300'	Phase I units certified to meet a PM standard of 0.60 lb/MMBtu on a heat input basis	Phase I units must be located at least 100' from the nearest property line	Stack must extend 2' higher than the peak of the roof of a residence or place of business not served by the unit if located within 300' of the unit	Phase I units certified to meet a PM standard of 0.44 lb/MMBtu on a heat input basis	Phase I units must be located more than 200' from any residence, school, or health care facility that is neither served by the unit nor owned by the owner or lessee of the unit	None	Residential-size unit (heat output of 250,000 Btu/hr or less) commencing operation on or after 4/15/2011 must meet a PM standard of 0.32 lb/MMBtu on a heat output basis	Units must be located no less than 100' from the nearest property boundary line	Stack must be 18' above ground level or 2' above the peak of any roof structure within 150' of the unit when necessary to adequately disperse smoke	Residential Hydronic Heaters manufactured, imported, or sold on or after 5/15/2020 must be certified to meet a PM standard of either 0.10 or 0.15 lb/MMBtu on a heat output basis depending on the test method used	The federal regulations contain no specific minimum stack height or property set-back requirements, only that the owner's manuals contain guidance on proper installation information, including stack height, heater location and achieving proper draft.
Phase II units certified to meet a PM standard of 0.32 lb/MMBtu on a heat output basis installed after 4/1/2010	At least 50 feet from the nearest property line or at least 70 feet from the nearest dwelling that is not on the same property as the outdoor wood boiler	10' above ground level if there are no abutting residences within 300' 2' higher than the structure being served by the unit if an abutting residence is within 300'	Phase II units certified to meet a PM standard of 0.32 lb/MMBtu on a heat output basis	Phase II units must be located at least 50' from the nearest property line	None	Phase II units certified to meet a PM standard of 0.32 lb/MMBtu on a heat output basis	Phase II units must be located more than 200' from any residence, school, or health care facility that is neither served by the unit nor owned by the owner or lessee of the unit	None	Commercial-size unit (heat output of greater than 250,000 Btu/hr) commencing operation on or after 4/15/2011 must meet a PM standard of 0.32 lb/MMBtu on a heat output basis	Units must be located no less than 200' from the nearest property boundary line, no less than 300' from a property boundary line of a residentially zoned property, and no less than 1,000' from a school	Stack must be 18' above ground level or 2' above the peak of any roof structure within 150' of the unit when necessary to adequately disperse smoke	Small residential forced-air furnaces manufactured or sold on or after 5/16/2016, but prior to 5/15/2020 must be certified to meet a PM standard of 0.93 lb/MMBtu on a heat output basis	The federal regulations contain no specific minimum stack height or property set-back requirements, only that the owner's manuals contain guidance on proper installation information, including stack height, heater location and achieving proper draft.
Units certified to meet a PM standard of 0.06 lb/MMBtu on a heat output basis (this is a voluntary, technology-forcing standard)	At least 20 feet from the nearest property line or at least 40 feet from the nearest dwelling that is not on the same property as the or outdoor pellet boiler; or No set-back requirements apply if the stack height requirements described in Section 3(C)(3) of Chapter 150 and indicated to the right are met	If the unit does not meet the stack height requirements below, the set-back requirements must be met 10' above ground level if there are no abutting residences within 100' 2' higher than the structure being served by the unit if an abutting residence is within 100'				Units certified to meet federal PM emission standards contained in 40 CFR Part 60, Subpart QQQQ	Federally certified units must be located more than 200' from any residence, school, or health care facility that is neither served by the unit nor owned by the owner or lessee of the unit	None				Large residential forced-air furnaces manufactured or sold on or after 5/15/2017, but prior to 5/15/2020 must be certified to meet a PM standard of 0.93 lb/MMBtu on a heat output basis	The federal regulations contain no specific minimum stack height or property set-back requirements, only that the owner's manuals contain guidance on proper installation information, including stack height, heater location and achieving proper draft.
												Small and Large residential forced-air furnaces manufactured or sold on or after 5/15/2020 must be certified to meet a PM standard of 0.15 lb/MMBtu on a heat output basis	The federal regulations contain no specific minimum stack height or property set-back requirements, only that the owner's manuals contain guidance on proper installation information, including stack height, heater location and achieving proper draft.