February 18, 2021

Via Online Submission and Email

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Dear Mr. Smith:

Earthjustice and the Sierra Club submit these comments on the scope for the environmental impact statement ("EIS") for the Department of Ecology's ("the Department" or "Ecology") proposed collection and disposal of aqueous film forming foam ("AFFF") containing per- and polyfluoroalkyl substances ("PFAS"). We appreciate the Department's decision to prepare an EIS on its proposed AFFF disposal plan, which has potentially significant impacts on human health and the environment.

PFAS are a highly toxic, persistent, and ubiquitous class of chemicals, found not only in firefighting foam but also in cookware, clothing, food packaging, and a range of other products. PFAS have contaminated drinking water, air, and soil across the country, including in several communities in Washington State. Because of the strength of their carbon-fluorine chemical bond, PFAS are very difficult to destroy, and unsafe disposal methods such as incineration threaten to generate additional PFAS and other toxic combustion byproducts. Ecology is right to be concerned about the potential release of PFAS, not only from the use but also the disposal of AFFF and other PFAS-containing products and wastes.

The U.S. Environmental Protection Agency ("EPA") recently acknowledged that the effects of PFAS incineration are "not well understood" and that "[a]dditional research is needed to minimize or eliminate data gaps or current uncertainties."[1] Yet, to the best of our knowledge, no federal or state agency has ever previously prepared an EIS before authorizing the incineration of AFFF.

Ecology's EIS presents an opportunity for a much needed analysis of the impacts of PFAS disposal. We appreciate this opportunity to comment on the scope of the EIS, and we urge Ecology to use its State Environmental Policy Act ("SEPA") analysis to determine and select the most health-protective means of AFFF disposal, including the use of interim storage until adequate studies of different disposal methods have been conducted.

[1] EPA, *Interim Guidance on the Destruction and Disposal of Perfluoroalkyl and Polyfluoroalkyl Substances and Materials Containing Perfluoroalkyl and Polyfluoroalkyl Substances* ("*PFAS Disposal Guidance*") at 6, 41 (Dec. 18, 2020), https://beta.regulations.gov/document/EPA-HQ-OLEM-2020-0527-0002.

I. Ecology Should Broadly Define the Proposed Action as the Safe Storage or Disposal of AFFF

Ecology's Determination of Significance and Request for Comments states that "[t]he EIS will consider the environmental impacts, alternatives, and mitigation of the collection, transport, and disposal of PFAS-containing firefighting foam."[2] We believe that is an appropriate scope for the EIS. Ecology should consider the full range of storage and disposal options on equal footing, and should not identify a preferred alternative until after that analysis has been completed.

This is preferable to Ecology's prior project description, which "determined that the preferred method of disposal was incineration" and relegated all other disposal options to a cursory discussion of alternatives in a SEPA Checklist.[3] As described in our comments on Ecology's since-withdrawn Determination of Non-Significance, PFAS incineration is a dangerous practice that threatens to exacerbate and spread PFAS contamination.[4] There is no evidence that PFAS can be safely incinerated in any commercial incinerator, and EPA has not approved the test methods needed to evaluate the full range PFAS emissions from the incineration process.[5]

Ecology's SEPA Handbook states that "[a]gencies are encouraged to describe a proposal as an objective," as opposed to a particular means to an outcome.[6] Consistent with that guidance, Ecology should define its proposed action in the EIS as the safe storage or disposal of PFAS-containing firefighting foam. This broader project scope "encourages the consideration of a wider range of alternatives" and is likely to result in a more informed decision.[7]

II. Ecology Should Conduct Expanded Scoping That Involves the U.S. EPA

Ecology's SEPA regulations provide that "the lead agency may expand the scoping process" by, among other options, "[i]nviting participation of agencies with jurisdiction or expertise from various levels of government, such as regional or federal agencies."[8] Ecology should conduct expanded scoping for the proposed project, and should consult with EPA concerning the impacts of PFAS incineration and other methods of PFAS disposal.

EPA recently issued *Interim Guidance on the Destruction and Disposal of Perfluoroalkyl and Polyfluoroalkyl Substances and Materials Containing Perfluoroalkyl and Polyfluoroalkyl*

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[2] Wash. Dep't of Ecology, *Determination of Significance and Request For Comments on Scope of Environmental Impact Statement: AFFF Collection/Disposal Program* at 2 (Jan. 19, 2021), https://apps.ecology.wa.gov/separ/Main/SEPA/Record.aspx?SEPANumber=202100276.

[3] *Id.* at 1; Wash. Dep't of Ecology, *Determination of Non-Significance: Aqueous Film Forming Foam Collection Program* (Sept. 1, 2020), https://apps.ecology.wa.gov/separ/Main/SEPA/Record.aspx?SEPANumber=202004521.

[4] *See* Comments of the Sierra Club and Earthjustice on Aqueous Film Forming Foam Collection, Transport, and Incineration Program (Oct. 1, 2020), https://apps.ecology.wa.gov/separ/Main/SEPA/Document/DocumentOpenHandler.ashx?DocumentId=101366. A copy of those comments are attached as **Exhibit A** and incorporated by reference.

[5] *Id.* at 1–2.

[6] Wash. Dep't of Ecology, *State Environmental Policy Act Handbook* at 35 (2018), https://ecology.wa.gov/DOE/files/4c/4c9fec2b-5e6f-44b5-bf13-b253e72a4ea1.pdf.

[7] *Id.*

[8] Wash. Admin. Code § 197-11-410(1)(f) (1984).

Substances, a document which "provides information on the current state of the science and the associated uncertainties for current commercially available [PFAS] disposal … technologies."[9] This guidance was mandated by the National Defense Authorization Act for Fiscal Year 2020,[10] and it addresses the risks and uncertainties associated with the incineration of AFFF and other PFAS-containing wastes. In the course of preparing that guidance, EPA conducted stakeholder outreach, reviewed the available literature, and identified key data gaps that required additional research and analysis. In particular, EPA called for "continue[d] research activities investigating incineration of PFAS" in order to "determine whether thermal treatment devices and their associated post-combustion control devices are adequately controlling [products of incomplete combustion,] especially fluorinated PICs."[11] Ecology should make use of EPA's research and expertise by involving EPA in an expanded scoping process and working with EPA to determine key data and uncertainties related to PFAS incineration.

III. Ecology Should Consider Off-Site Storage As an Interim Disposal Option

In recognition of the serious data gaps surrounding PFAS disposal technologies and the need for additional study and analysis, EPA's PFAS disposal guidance recommends that "interim storage may be an appropriate strategy until identified uncertainties are addressed and appropriate destruction and disposal technologies can be recommended."[12] In particular, "EPA encourages the safe storage of PFAS and PFAS-containing materials as needed, following manufacturers' recommended best management practices as well as in accordance with any relevant industry, federal, state, or local requirements or guidelines."[13]

In its EIS, Ecology should consider off-site storage at a permitted hazardous waste storage facility as a temporary disposal option. EPA is currently pursuing a serious of short-term (1–2 years) and long-term (3+ years) research and development initiatives related to PFAS disposal, which are intended to enable decision-makers "to make informed decisions about the tradeoffs between different risk management solutions, leading to better environmental outcomes."[14] Interim storage would enable Ecology to consider the results of this pending research and to make a more informed choice among disposal options. Moreover, the hazardous waste facility that Ecology had previously proposed for the incineration of its AFFF (Clean Harbors' Aragonite incineration facility) is also permitted to store PFAS and hazardous waste. In considering interim storage, Ecology should also consider the risks that are posed by leaving AFFF on site at fire stations and other locations across the state, as well as measures that could be taken to mitigate those risks by consolidating storage in a central repository or by taking other steps to prevent the use and release of AFFF.

IV. Ecology Must Consider a Range of Emerging Disposal Technologies

[9] *PFAS Disposal Guidance*, *supra* note 1, at 1.
[10] Pub. L. No. 116-92, § 7361, 133 Stat. 1198 (enacted Dec. 20, 2019).
[11] *PFAS Disposal Guidance*, *supra* note 1, at 49.
[12] *Id.* at 3.
[13] *Id.*
[14] *Id.* at 93–97.

EPA and the Department of Defense are investing in the development of advanced destruction technologies that could provide fundamentally safer methods to address PFAS wastes.[15] EPA's PFAS Innovative Treatment Team is actively exploring four advanced technologies—electrochemical oxidation, mechanochemical degradation, pyrolysis and gasification, and supercritical water oxidation. It currently has published research briefs on each of the issues, and is pursuing research to gauge the success in destroying PFAS.[16] Some of these technologies have been previously used to destroy chemical warfare agents, PCBs, and halogenated chemicals, and other persistent organic pollutants. Alternative disposal technologies with contained systems would also allow operators to measure the success of destruction before releasing wastes into the environment, a fundamental improvement compared to incineration, where periods of non-compliance can spew harmful materials into impacted communities and the environment. In its EIS, we urge Ecology to consider these emerging technologies as an alternative to incineration, and to consider interim storage of AFFF while the development and testing of these alternatives proceeds.

V. Ecology Must Consider the Health Effects From PFAS and Non-PFAS Products of Incomplete Combustion

Under SEPA, the obligation to evaluate "environmental impacts" encompasses "[r]eleases or potential releases to the environment affecting public health, such as toxic or hazardous materials."[17] PFAS incineration has the potential to generate and release a range of toxic materials. The Department of Defense has found that such incineration is "likely" to produce "environmentally unsatisfactory … or toxic" byproducts, including hydrogen fluoride (a strong respiratory toxin), fluoroacetates (a type of poison used in rodenticides), or perfluoroisobutylene (a chemical warfare agent).[18] In addition, if PFAS incineration does not completely destroy the carbon-fluorine bond, it can result in the formation and release of additional PFAS, which themselves can result in a range of serious health effects. In other to measure the impacts of PFAS incineration, Ecology must determine the full range of chemicals generated and released during the incineration process. This analysis may depend on EPA's continued development and approval of "methods for sampling and analyzing PFAS in air emissions and ambient air to enable monitoring of the environment and testing effectiveness of PFAS control technologies."[19] To the extent that quantification of health effects is not possible using existing methodologies, Ecology must "make clear that such information is lacking or that substantial uncertainty exists."[20] Ecology should also "weigh the need for the action with the severity of possible adverse impacts which would occur if the agency were to decide to proceed

[15] EPA, "PFAS Innovative Treatment Team (PITT)," https://www.epa.gov/chemical-research/pfas-innovative-treatment-team-pitt (last visited Feb. 16, 2021); DOD, *Briefing to Congress on Best Practices for Cleanup Technologies and Disposal of Soils, Filters, and Aqueous Film Forming Foam Containing Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoic Acid (PFOA), and Required Additional Research* (Nov. 1, 2019) (describing "current SERDP/ESTCP Research on Cleanup and Disposal, and PFAS Chemicals").
[16] *Id.*
[17] Wash. Admin. Code § 197-11-444(2)(a)(iii) (1984).
[18] Department of Defense, *AFFF Disposal Solicitation*, Topic No. AF17B-T001 (Apr. 21, 2017), https://www.sbir.gov/sbirsearch/detail/1254657.
[19] *PFAS Disposal Guidance*, *supra* note 1, at 92.
[20] WAC § 197-11-080(2).

in the face of uncertainty,"[21] and should consider deferring any final decisions related to PFAS disposal until additional information is available.

VI. Ecology Should Consider and Minimize the Environmental Justice and Tribal Impacts Associated With All Disposal Options

Last September, the Washington State Environmental Justice Task Force recommended that "[e]nvironmental justice considerations should be incorporated into a range of state environmental laws," including SEPA.[22] Consistent with that recommendation, and with Ecology's "commit[ment] to making decisions that do not place disproportionate burdens on disadvantaged communities" and "to lift the weight of pollution and contamination borne by those communities," Ecology's EIS should evaluate the impacts of its PFAS disposal options on communities of color, tribal populations, and other disproportionately burdened communities.[23]

Nationwide, "higher exposures [to PFAS] are more likely to occur in communities of color and low-income communities."[24] A September 2017 report issued by the Department of Ecology described data showing that tribal fish consumption levels of resident fish, especially in Western Washington, exceed Washington Department of Health safe consumption limits.[25] Moreover, the Utah incinerator initially proposed for use by Ecology is located approximately 30 miles northwest of the Skull Valley Indian Reservation, home to the Skull Valley Band of Goshute Indians of Utah. As the Skull Valley Tribe is likely to suffer disproportionate impacts from any PFAS incineration at Clean Harbors' Aragonite incinerator, it is critical that Ecology consider those impacts in its EIS, along with the heightened impacts on PFAS-contaminated communities and populations from the potential release of additional PFAS into the environment.

VII. Ecology Should Consider the Endangered Species Impacts Associated With All Disposal Options

In addition to their human health impacts, PFAS exposures threaten endangered species and other ecological resources.[26] It is critical that Ecology evaluate these impacts as well, particularly given the existence of more than 40 threatened or endangered species—and more than 160 "sensitive species" that "warrant special attention and management to keep them from becoming listed in the future"—in Utah, where Ecology had initially proposed shipping its PFAS

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[21] *Id.* § 197-11-080(3)(b).
[22] Environmental Justice Task Force, *Final Report: Recommendations for Prioritizing EJ in Washington State Government* at 46– 47 (2020), https://healthequity.wa.gov/Portals/9/Doc/Publications/Reports/EJTF%20Report_FINAL(1).pdf.
[23] Wash. Dep't of Ecology, *Environmental Justice at Ecology*, https://ecology.wa.gov/About-us/Accountability-transparency/Environmental-Justice (last visited Feb. 18, 2021).
[24] Center for Science and Democracy, *Abandoned Science, Broken Promises* at 13(Oct. 2019), https://www.ucsusa.org/sites/default/files/2019-10/abandoned-science-broken-promises-web-final.pdf.
[25] National Tribal Toxics Council, *Comments on Per- and Polyfluoroalkyl Substances (PFAS) Docket ID EPA-HQ-OW-2018-0270* at 3 (Sept. 28, 2018), http://www.zendergroup.org/docs/nttc/10).pdf.
[26] *See* SERDP, "Approach for Assessing PFAS Risk to Threatened and Endangered Species," (May 2020), https://www.serdp-estcp.org/Program-Areas/Environmental-Restoration/ER18-1653 ("As PFAS do not degrade in the environment and have been measured in aquatic and terrestrial wildlife, their potential toxicity to wildlife is a concern.").

for incineration.[27] Many of these species have habitat in and around the Great Salt Lake, which is located less than 30 miles from the previously proposed incinerator. The Strategic Environmental Research and Development Program—a partnership between EPA, the Department of Defense, and the Department of Energy, has prepared *Guidance for Assessing the Ecological Risks of PFASs to Threatened and Endangered Species at Aqueous Film Forming Foam-Impacted Sites*.[28] Ecology should use that guidance, and adapt it as necessary, to evaluate the impacts to threatened, endangered, and other vulnerable species from its PFAS incineration.

Conclusion

We applaud Ecology's decision to evaluate the impacts of its PFAS disposal in an EIS. This analysis is sorely needed, and it positions Washington State not only to make a more informed decision about the fate of its AFFF but also to assume a leading role on the issue for local, state, and federal agencies across the nation. To make the most of this opportunity, we encourage Ecology to consider the foregoing comments, to collaborate with impacted communities and other expert agencies, and to ensure that any forthcoming PFAS disposal decisions are protective of human health and the environment.

Respectfully submitted,

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[27] U.S. Bureau of Land Management, "Utah Threatened and Endangered Species," https://www.blm.gov/programs/fish-and-wildlife/threatened-and-endangered/state-te-data/utah.
[28] SERDP, *Guidance for Assessing the Ecological Risks of PFASs to Threatened and Endangered Species at Aqueous Film Forming Foam-Impacted Sites* (Jan. 2020), https://www.serdp-estcp.org/content/download/49882/491435/file/ER18-1614%20Guidance%20Document.pdf.

Exhibit A

October 1, 2020

Submitted via electronic mail to sean.smith@ecy.wa.gov

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Re: Comments on the September 1, 2020 Aqueous Film Forming Foam Collection, Transport, and Incineration Program by Washington Department of Ecology

On behalf of the Sierra Club and Earthjustice, we thank the Department of Ecology for the opportunity to comment on its proposed plans for the management of Aqueous Fire Fighting Foams (AFFF) made from per- and polyfluoroalkyl substances (PFAS).

We commend the Department's leadership in addressing the threat of PFAS chemicals broadly and the significant resources the state has committed to getting PFAS-based AFFF out of use and removed from fire stations. Washington's investment in timely containment of AFFF is a model that we hope other states follow.

Yet we have serious concerns about Ecology's proposal to send its collected AFFF to an out-of-state hazardous waste incinerator for combustion. Our review of the scientific literature suggests that, instead of destroying PFAS, incineration risks redistributing these highly persistent chemicals and breakdown products into the atmosphere and back into circulation in the environment. This would simply transfer the harmful chemicals in AFFF from the firehouses of Washington to the air of Utah and beyond.

The environmental and health impacts from incineration are not fully addressed in Ecology's State Environmental Policy Act (SEPA) analysis or its proposed Determination of Nonsignificance (DNS). However, there is an available alternative that would realize the Department's objectives of PFAS collection and management without the adverse effects of incineration. We urge Ecology not to incinerate its collected AFFF but to instead arrange for limited-term storage of that foam at a permitted storage facility while safer disposal technologies are developed and validated to be used nationally. Our specific concerns and recommendations are discussed in more detail below.

1. Using Incineration Technology for PFAS Is Dangerous and Poorly Studied.

Existing incineration technologies are not proven to destroy PFAS chemicals and there is significant evidence that they lead to releases of dangerous products. Moreover, there are not yet

basic methods to reliably determine what is released from an incinerator after PFAS chemicals are put through it.

The United State Environmental Protection Agency (EPA) recently acknowledged risks and data gaps related to PFAS incineration that cast doubt upon the conclusion that incinerators will destroy PFAS compounds:[1,2]

- PFAS incineration studies are incomplete due to the lack of necessary measurement methods;
- The effectiveness of PFAS incineration and type of combustion byproducts generated are not well understood;
- Fluorinated compounds are more likely than other halogenated compounds to recombine during the incineration process to form products of incomplete combustion.

The Department of Defense (DOD) has acknowledged a similar set of issues. In a 2017 grant solicitation for research into alternative destruction methods, DOD cited key challenges with incineration that included "… no precedent to predict products of pyrolysis or combustion, temperatures at which these will occur, or the extent of destruction that will be realized," and cautioned that, "many likely byproducts will also be environmentally unsatisfactory -- e.g., any volatile perfluoroalkane will be a greenhouse gas -- or toxic… ."[3]

While there is a compelling need to collect PFAS-based AFFF to prevent exposures and further releases, the lack of validated methods to destroy the chemicals presents challenges for states like Washington. The need for effective destruction methods is widely recognized. EPA recently announced a design challenge to speed the development of non-incineration methods to destroy unused AFFF.[4] For its part, the Department of Defense has been actively funding research into non-incineration destruction techniques for PFAS-based fire fighting foams for years.

The EPA also claims to be working to develop and validate the analytical methods that will allow it and others to reliably measure PFAS and breakdown products in air and other media. Such tools are essential to allow regulators to determine whether the extremely strong carbon-fluorine bonds in PFAS can be broken in the conditions of a hazardous waste incinerator, and whether emissions controls can trap and remove byproducts. Until these methods are available there is no way to substantiate that incinerators like Clean Harbors Aragonite can effectively destroy the compounds.

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[1] EPA, *Per- and Polyfluoroalkyl Substances (PFAS): Incineration To Manage PFAS Waste Streams Technical BRIEF: Innovative Research for a Sustainable Future* (Feb. 2020), https://www.epa.gov/sites/production/files/2019-09/documents/technical_brief_pfas_incineration_ioaa_approved_final_july_2019.pdf?wpmobileexternal=true.

[2] Marc Mills et al., *Thermal Treatment of PFAS in Environmental Media: A Review of the State-of-the-Science* (Feb. 25, 2020), https://cfpub.epa.gov/si/si_public_record_Report.cfm?dirEntryId=348571&Lab=CESER.

[3] SBIR, Department of Defense, *Solicitation Number DoD 2017.B STTR: AFFF Disposal*, Topic No. AF17B- T001 (Apr. 21, 2017), https://www.sbir.gov/sbirsearch/detail/1254657.

[4] EPA, *EPA, U.S. Department of Defense, and State Partners Launch Technical Challenge Seeking Innovative Ways to Destroy PFAS in Firefighting Foam* (Aug. 25, 2020), https://www.epa.gov/newsreleases/epa-us-department-defense-and-state-partners-launch-technical-challenge-seeking.

2. Existing Data Shows the Formation of Dangerous Byproducts From PFAS Incineration.

We reviewed published studies related to PFAS breakdown at high heat. Scientists are plagued by measurement challenges—studies have unacceptably high detection limits and/or analyze for just a limited number of potential breakdown products. Even so, several of the studies Ecology cites as proof of justification for incineration actually detected the formation of potent greenhouse gases, carbon tetrafluoride and hexafluoroethane.[5,6]

We have identified the shortcomings of industry-sponsored incineration research and available evidence from other peer-reviewed experimental studies. Collectively, the data suggest that some PFAS can break down at high heat but more sensitive methods will be needed to ensure that incineration results in a high level of thermal destruction.[7] The PFAS form a wide range of fluorochemicals with varied physical and chemical qualities. In addition to the one- and two-carbon greenhouse gases, these also include fluorinated acetic acids, dioxins and furans. Even complete destruction or "mineralization" of PFAS would convert all fluorine to hydrogen fluoride which is highly caustic and corrosive, in addition to being acutely toxic to people.

Much of the published incineration research for PFAS has been done at bench scale using just milligrams of starting materials, and in optimized temperature and handling protocols. These findings must be replicated at an operational scale.

See Appendix A for a detailed review of the peer reviewed literature relating to the safety and effectiveness of thermal treatments to destroy PFAS chemicals.

3. Commercial Hazardous Waste Incinerators Like Clean Harbors Aragonite Will Not Achieve the Idealized Conditions of Experimental Studies.

The facility that the Department of Ecology has proposed to use for PFAS incineration has a history of operational and compliance issues, and the operating parameters proposed by the Department are beyond the permitted capability of this facility.

Commercial hazardous waste incinerators are plagued by compliance violations and safety issues. The Clean Harbors Aragonite facility is no exception, with several recent permit violations that should raise red flags.

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[5] Philip Taylor & Tak Yamada, *Final Report – Laboratory-Scale Thermal Degradation of Perfluoro-Octanyl Sulfonate and Related Precursors* (May 2003), https://clu-in.org/download/contaminantfocus/pfas/UDR-TR-03-00044.pdf.

[6] Tak Yamada et al., *Thermal Degradation of Fluorotelomer Treated Articles and Related Materials*, 61 Chemosphere 974–84 (Nov. 2005), https://doi.org/10.1016/j.chemosphere.2005.03.025.

[7] Tasha Stoiber, et al., *Disposal of products and materials containing per- and polyfluoroalkyl substances (PFAS): A cyclical problem*, 260 Chemosphere. (Sept. 2020), https://www.sciencedirect.com/science/article/pii/S0045653520318543

Ecology shared the results of the most recent safety inspection, in which Aragonite was cited for mishandling of harmful compounds like mercury and PCBs, and violations related to bypassing the emissions control equipment.[8]

Even the design parameters for the proposed facility are outside what is already established to be a minimum requirement for any treatment for PFAS.

The temperature and holding times that Ecology will mandate for incineration of PFAS wastes are at the outer edge of operating conditions for the Aragonite incinerator. In its Determination of Nonsignificance, Ecology says it will require Clean Harbors to "expose the PFAS foam to temperatures in excess of 1000°C with hold times of two seconds or more."[9] However, in a September 2020 meeting Ecology indicated it will require temperatures of 1300°C and a two-second residence time in the afterburner. EPA indicates that temperatures in excess of 1400°C are needed to destroy carbon tetrachloride, which is a potent greenhouse gas.[2,10]

Our technical consultant suggests that it could require a change to the facility's operating permit to achieve temperatures of 1300°C, as Ecology suggests it will require. Aragonite's operating permit indicates that the facility has been granted a waiver to operate at lower temperatures when incinerating PCBs, which causes further concern.[11] EPA has waived the requirement of a temperature of 1200°C (2192°F) at the afterburner exit to "allow a waste feed cutoff if the temperature drops to less than [1092°C] for more than 60 seconds."[12]

4. Incineration Poses a Threat to the Adjacent to the Skull Valley Goshute Reservation.

The Aragonite incinerator is also located adjacent to tribal lands of the Skull Valley Goshute Reservation. Residual PFAS and toxic byproducts in waste ash will be shipped to the Grassy Mountain hazardous waste landfill south of the incinerator and reservation for perpetual storage and management. The region is heavily impacted by toxic industries, including a nerve agent storage site. Ecology has not considered the tribal impacts and environmental justice implications of its actions.

5. The Department's Proposed PFAS Incineration Requires Additional SEPA Analysis

When enacting SEPA, the state legislature declared the protection of the environment to be a fundamental state priority.[13] SEPA provides that "[t]he legislature recognizes that each person

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[8] EPA Enforcement and Compliance History Online, Facility Report for Clean Harbors Aragonite, LLC, https://documents.deq.utah.gov/waste-management-and-radiation-control/facilities/clean-harbors/aragonite/DSHW-2014-018229.pdf (last visited October 1, 2020).

[9] Washington Dep't of Ecology, *SEPA Determination of Nonsignificance* (Sept. 1, 2020), https://apps.ecology.wa.gov/separ/Main/SEPA/Record.aspx?SEPANumber=202004521.

[10] Washington Ecology, *Per- and polyfluoroalkyl Substances (PFAS) Disposal Considerations* (June 30, 2020).

[11] Clean Harbors Aragonite, LLC, *Permit Module 5 – Incineration* (Apr. 1, 2020), https://documents.deq.utah.gov/waste-management-and-radiation-control/facilities/clean-harbors/aragonite/DSHW-2019-004179.pdf.

[12] Clean Harbors Aragonite, LLC, *Attachment 17: Waste Management Plan for Polychlorinated Biphenyls* (June 19, 2013), https://documents.deq.utah.gov/waste-management-and-radiation-control/facilities/clean-harbors/aragonite/DSHW-2013-008874.pdf.

[13] Wash. Rev. Code § 43.21C.010.

has a fundamental and inalienable right to a healthful environment and that each person has a responsibility to contribute to the preservation and enhancement of the environment."[14] This policy statement "indicates ... the basic importance of environmental concerns to the people of this state."[15] At the heart of SEPA is a requirement to fully analyze the environmental impact of government decisions that have a significant impact on the environment.[16]

Under SEPA, an environmental impact statement (EIS) is required if a government action has a significant effect on the quality of the environment.[17] An action has a significant environmental effect, and thus requires an EIS, if it presents a "reasonable likelihood of more than a moderate adverse impact on environmental quality."[18] To determine whether an EIS is needed, agencies make a "threshold determination" of environmental significance, often guided by a SEPA checklist.[19] If, in reviewing a project, the agency concludes that there "will be no probable significant adverse environmental impacts from a proposal," it may issue a Determination of Nonsignificance (DNS) and proceed without further review.[20] In contrast, if a threshold determination concludes that the project "may have a probable significant adverse environmental impact," the agency must mitigate that impact or conduct a full EIS.[21]

Here, Ecology prepared a SEPA checklist and proposed a DNS for its AFFF Collection Program. However, the record does not support that determination. First, Ecology concedes that it lacks sufficient information to adequately evaluate the effects of PFAS incineration. Second, the limited information that is available indicates a reasonable likelihood of serious impacts from PFAS incineration. Finally, while Ecology compared PFAS incineration to two alternatives (land disposal and indefinite, on-site stockpiling of AFFF), Ecology failed to consider temporary, off-site storage at its selected disposal facility—an available alternative that would achieve the objectives of Ecology's proposed action with far fewer adverse environmental impacts. Ecology should pursue that commercial storage alternative, which would avoid the significant impacts associated with incineration and obviate the need for an EIS.

A. Ecology lacks sufficient information about PFAS incineration to support its DNS

As previously described, Ecology lacks sufficient information about the effects of PFAS incineration to meaningfully evaluate the consequences of its AFFF Collection Program and to make a Determination of Nonsignificance. EPA—the federal agency charged with regulating the incinerator at issue—has warned that "the effectiveness of incineration to destroy PFAS compounds and the tendency for formation of fluorinated or mixed halogenated organic byproducts is not well understood."[1] The absence of this information is the result of inadequate testing; to date, "[f]ew experiments have been conducted under ... conditions representative of field-scale incineration," and the studies that do exist "have been incomplete due to lack of necessary measurement methods suitable for the comprehensive characterization of fluorinated

[14] *Id.* § 43.21C.020(3).
[15] *Leschi Imp. Council v. Wash. State Highway Comm'n*, 84 Wash. 2d 271, 279–80 (Wash. 1974).
[16] Wash. Rev. Code § 43.21C.031(1).
[17] Wash. Admin. Code § 197-11-330.
[18] *Id.* § 197-11-794(1).
[19] Wash. Rev. Code § 43.21C.033.
[20] Wash. Admin. Code § 197-11-340(1).
[21] *Id.* § 197-11-360(1).

and mixed halogenated organic compounds."[1] The Department of Defense—the nation's largest user of AFFF—has similarly warned that "there is no precedent to predict products of [AFFF] combustion."[3] Yet Ecology did not attempt to fill these data gaps before proposing the incineration of more than 30,000 to 40,000 gallons of AFFF, the effects of which Ecology admits are "not well studied."[22]

These data gaps are fatal to Ecology's DNS, which must be "based on information sufficient to evaluate the proposal's environmental impact."[23] SEPA thus requires agencies to gather necessary information, so their decisions are "shape[d] … by deliberation, not default.'"[24] Because Ecology lacks sufficent information to determine the likely byproducts of its PFAS incineration—which, as described above, may include toxic chemicals and potent greenhouse gasses—it cannot support a DNS and must prepare a full EIS. Although SEPA permits agencies to proceed despite the absence of certain information where "the costs of obtaining [the missing information] are exorbitant" or "the means to obtain it are speculative or not known," Ecology has not made either of those findings in its DNS.[25] Nor has Ecology provided a "worst case analysis" to compensate for the absence of information, as required by its SEPA regulations.[26] Instead, Ecology improperly presumes the absence of impacts from the absence of information and proposes a DNS that its analyses cannot support.

B. PFAS incineration presents a reasonable probability of significant environmental impacts

The limited information that is available on PFAS incineration confirms the existence of risks that preclude the issuance of a DNS. Under SEPA, Ecology can issue a DNS only if it "determines there will be no probable significant adverse environmental impacts from a proposal."[27] Here, Ecology cannot make that finding, because its SEPA checklist confirms the "reasonable likelihood of more than a moderate adverse impact on environmental quality."[28]

According to Ecology, AFFF incineration "can produce air emissions" which "deposit[] upon the land and surface water."[22] "The deposition can then be taken up by biota including humans, potentially negatively impacting their growth and development."[22] The potential emissions from PFAS incineration include carbon tetrafluoride (a potent greenhouse gas with more than 6,000 times the global warming potential of carbon dioxide), fluoroform (a potent greenhouse gas with more 12,000 times the global warming potential of carbon dioxide), perfluoroisobutylene (a toxic chemical that has been used as a chemical warfare agent), hydrogen fluoride (a highly toxic chemical that can damage lung tissue and cause severe burns), and other PFAS chemicals.[22,3]

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[22] Washington Dep't of Ecology, *SEPA Environmental Checklist: Ecology AFFF Collection Program* (July 2016), https://apps.ecology.wa.gov/separ/Main/SEPA/Record.aspx?SEPANumber=202004521.
[23] *Coal. to Protect Puget Sound Habitat v. Pierce Cty.*, 2012 WL 3577481, at *9 (Wash. Shore. Hrg. Bd. July 13, 2012); *see also Pease Hill Cmty. Grp. v. Cty. of Spokane*, 62 Wash. App. 800 (Wash. Ct. App. 1991).
[24] *Klickitat Cty. Citizens Against Imp. Waste v. Klickitat Cty.*, 122 Wash. 2d 619, 640 (Wash. 1994), amended 866 P.2d 1256 (Wash. 1994) (citation omitted).
[25] Wash. Admin. Code § 197-11-080(3).
[26] *Id.*
[27] *Id.* § 197-11-340(1).
[28] *Id.* § 197-11-794.

Ecology does not dispute that the emission of greenhouse gasses, toxic chemicals, or PFAS would have "more than a moderate adverse impact on environmental quality."[29] Therefore, the only question is whether those incineration byproducts are "reasonably likely," as opposed to "merely speculative."[30] Ecology does not answer that question, but the Department of Defense has stated that PFAS incineration is "likely" to produce "environmentally unsatisfactory … or toxic" byproducts.[3] Moreover, the Environmental Protection Agency recently affirmed the "need for new non-thermal technologies that destroy PFAS, without generating hazardous byproducts" and established a prize for the development of alternatives to incineration.[4] The existence of that incentive itself is a further acknowledgment of the risks associated with PFAS incineration.

Instead of measuring the likelihood that PFAS incineration would result in environmental harm, Ecology erroneously asserts that "[i]ncineration is the only technology available now that can under appropriate conditions, process large volumes of AFFF foam [and] destroy the foam's PFAS molecule."[22] As described above, there is no evidence that incineration "destroys" PFAS chemicals, as opposed to altering their chemical structure and emitting new PFAS as byproducts of incomplete combustion. Moreover, PFAS incineration would require an EIS even if it were the best available treatment technology (and it is not), since the threshold determination under SEPA turns solely on the impacts of the proposed action, which here are likely to be significant. Therefore, if Ecology proceeds with the AFFF Collection Program in its current form, it must prepare an EIS.

C. Ecology failed to consider the reasonable alternative of commercial PFAS storage

There is a readily available alternative that could avoid the significant impacts associated with PFAS incineration and eliminate the need for an EIS, while still realizing the core objections of Ecology's AFFF Collection Program. Instead of incinerating its PFAS-containing foam, Ecology could collect unused foam from fire stations across the state and temporarily store it at a permitted hazardous waste storage facility, such as the Clean Harbors Aragonite facility. In addition to its incineration capacity, that facility has "ample on-site storage capacity," including "a bulk liquid tank farm (sixteen ~30,000 gallon tanks); container storage areas (~12,000 55-gallon drum capacity); direct burn tanker storage areas (~30,000 gallons total capacity); sludge storage tanks (~38,000 gallon total capacity); and bulk solids storage tanks (~1100 yd3 total capacity)."[31] Use of that storage capacity would reduce the risk of accidental releases while Ecology, EPA, and others evaluate long-term treatment alternatives. Temporary commercial storage of AFFF is thus a "[r]easonable alternative," which Ecology failed to consider in its SEPA Checklist.[32]

In its review of the AFFF Collection Project, Ecology did reject the alternative of "hold[ing] stockpiles [of AFFF] indefinitely until there is more research and consensus on how to best

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[29] *Id.*
[30] *Id.* §§ 197-11-060(4)(a), 197-11-782.
[31] Clean Harbors, "Aragonite Incineration Facility," https://fr.cleanharbors.com/node/1156 (last visited Oct. 1, 2020); Utah Dep't of Envtl. Quality, "Aragonite Permit: Clean Harbors, LLC," https://deq.utah.gov/waste-management-and-radiation-control/aragonite-permit-clean-harbors-llc (last updated Aug. 20, 2020).
[32] Wash. Admin. Code § 197-11-786 (defining "reasonable alternative" as "an action that could feasibly attain or approximate a proposal's objectives, but at a lower environmental cost or decreased level of environmental degradation").

dispose of PFAS waste streams" because incineration alternatives "are not yet feasible at a large scale."[22] But the storage of AFFF need not be indefinite, and it can be conducted under controlled conditions that minimize the likelihood of a PFAS release. Moreover, commercial storage would allow EPA and others to develop additional information about the effects of PFAS incineration and alternative disposal technologies. EPA has stated that it plans to release a new method to measure PFAS air emissions over the coming months, and that it will release refined methods to measure products of incomplete PFAS combustion in the third quarter of 2021.[33] That soon-to-be-released information would help Ecology better understand the impacts of PFAS incineration and make an informed decision concerning different disposal options. There is no reason to rush into a poorly reviewed incineration alternative that presents a serious threat to public health and the environment.

6. Conclusion

For the foregoing reasons, we urge the Department of Ecology to temporarily store, as opposed to incinerate, the PFAS collected under the AFFF Collection Project.

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[33] EPA, *Status of EPA Research and Development on PFAS*, https://www.epa.gov/chemical-research/status-epa-research-and-development-pfas#methods (last updated July 17, 2020).

Appendix A

A careful review of the scientific literature reveals gaps in assessing each of these outcomes for the incineration of PFAS waste. To ensure safe destruction of PFAS we need answers to three questions:

1. **Are the original PFAS chemicals destroyed by the technology?**
2. **What do they turn into?**
3. **Does the output from the destruction process release any harmful chemicals into the environment?**

Are the original PFAS destroyed in incinerators?
Washington Ecology cites several studies as proof of thermal breakdown of PFAS chemicals

- "[S]tudies in 2005 and 2014 showed that perfluorooctanoic acid (PFOA) was not measured at detectable levels after a 2 second residence time at 1000°C." (Wash Ecology 2020 citing: Yamada 2005, Taylor 2014)

- "Additionally, research by 3M found that properly operating incineration systems do not release PFOS and C8 perfluorosulfonamides into the environment." (Wash Ecology 2020 citing: Taylor 2003)

Both studies lack the sensitivity to ensure a high level of thermal destruction. Destruction efficiencies of 99.9999% are required for highly toxic wastes, like PCBs (USEPA 2019a). The 2003 and 2005 studies didn't detect PFOS and PFOA, but had a detection limit of 0.1%, which means concentrations of up to 1,000 parts per million of PFOS or PFOA in air would not be detected under the conditions of this study.

A 0.1% failure rate could result in pounds of PFAS escaping into the air from the 30,000 to 40,000 gallons of PFAS fire fighting foam that Washington seeks to incinerate.

EPA is developing methods to measure individual PFAS chemicals at a higher level of sensitivity in air samples (USEPA 2020a).

What are the potential byproducts of PFAS incineration?

The existing data fall short in assessing the types and quantities of chemicals formed during thermal treatments, and the hazard they may pose toward people and the environment.

Like other aspects of PFAS disposal, ensuring safety is challenging due to methodological limitations. As many scientists state, "There are no proven analytical technologies which have

been demonstrated to detect all potential fluoro-organic by-products," (Horst 2020). Of particular concern are PFAS that get volatilized or transformed into volatile organofluorine compounds and escaped detection (Watanabe 2018).

Independent studies detect a range of concerning breakdown products in bench scale incineration studies. They include:

Greenhouse gases - The original studies promoted by Washington Ecology and others as proof of incineration effectiveness both measured several potent greenhouse gases and other breakdown products (Taylor 2003, Yamada 2005). In Taylor (2003) PFOS byproducts include: fluorobenzene, one- and two- carbon fluoroalkanes (tetrafluoromethane, fluoroform, and hexafluoroethane), and fluoroalkenes (1,1-difluoroethene and 1,2-difluoroethene).

Yamada (2005) heated PTFE (a polytetrafluoroethylene polymer) to a maximum of 1000C with a 2 second residency time, and detected one- and two- carbon fluorochemicals (fluoroform ion and fluoropropene ion). Concentrations of these breakdown products were estimated to be less than or equal to 1000 parts per million or 0.1%.

In addition to the industry studies, another by Garcia (2007) detected one-, two- and three-chain fluorochemical formation from the thermal degradation of PTFE at temperatures between 750 to 1050C.

The global warming potential of fluorine-containing byproducts is thousands of times more potent than carbon dioxide, which has a Global Warming Potential of 1 on this unitless scale (GGP 2016).

Chemical	**Global Warming Potential over 100 year time horizon***
Carbon tetrafluoride (CF4)	6,630
Fluoroform (CHF3)	12,400
Hexafluoroethane (C2F6)	11,100
Perfluoropropane (C3F8)	8,900

* the Global Warming Potential of carbon dioxide is 1.

Fluorinated acetic acids - mono-, di-, and tri-fluoroacetic acids are common thermal breakdown products of PTFE, particularly at lower heats (Ellis 2001). They are toxic to aquatic ecosystems and widely detected in the atmosphere and in precipitation. Some scientists suggest they may be partially responsible for pulmonary edema seen in workers at PTFE plants (Garcia 2007).

Dioxins and furans - Dioxins and furans can be formed in municipal solid waste incinerators when PFAS are incinerated alongside other wastes. (Merino 2016, citing Tupperainen 1998 and McKay 2002). Methodological constraints hinder monitoring for dioxins and furans in other PFAS incineration studies (Aleksandrov 2019).

Un- or partially-reacted PFAS - EPA lists "shorter chain PFAS, partially fluorinated PFAS, and defunctionalized perfluorinated carbon chains" as other potential thermal by-products (USEPA 2020a). Short-chain polyfluorinated alkyl acids require higher temperatures to achieve thermal destruction than long-chain acids (Watanabe 2016). Wang tested for PFAS in air at two municipal solid waste incinerator facilities in China. They reporting higher concentrations of PFOA in air at the incinerator sites compared to an upwind site, while fluorotelomer concentrations were comparable across all samples (Wang 2020).

Hydrogen fluoride - The complete liberation of fluorine from carbon sources in the incinerator would produce hydrogen fluoride, an acutely toxic and corrosive gas. Hydrogen fluoride has to be managed to ensure it doesn't impact machinery of the incinerator itself (USEPA 2020b). As the ITRC reports in its PFAS destruction guidance related to incineration, "there have not been sufficient pilot studies to determine the validity of this concern. This could pose serious health and safety issues and could compromise equipment components." (ITRC 2020)

EPA developing untargeted analytical method, which will help map the full extent of PFAS breakdown products (USEPA 2020a). This is not expected until 2021 at the earliest.

How many breakdown products are present in stack gases or waste ash?

The third major aspect of uncertainty is the ability of incinerator emission controls to capture and contain any harmful byproducts. This is obviously impossible to gauge without full knowledge of the products and their physical and chemical characteristics.

EPA and scientists are optimizing methods that quantify the total organic fluorine in air or other environmental media. These methods are also expected to take at least another year to validate.

They will provide important verification about whether PFAS breakdown happens in the idealized setting of an experimental laboratory, not to mention real world operating conditions of a functional incinerator.

Studies note increased risk of emissions and discharges of products of incomplete combustion during non-normal operating conditions (upset conditions) including start up, shut down, malfunction or during equipment failure (NRC 2000). One study reviewed facility-specific data

on pollutants emitted during startup and shutdown conditions. There was wide variability but 88% of facilities studied had vastly increased emissions of dioxins and furans, dioxin/furan precursors, and carbon monoxide during start up or shut down monitoring compared to normal operating conditions, likely due to incomplete combustion (Obaid 2017).

The portion of incineration byproducts stripped by emission control systems will end up in incineration ash requiring perpetual storage in a hazardous waste landfill or other site. Several studies find incineration reduces but does not eliminate the PFAS in ash residues, and the chemicals are found in leachate from landfills accepting incinerator ash (Solo-Gabriele 2020). Therefore, incineration does not terminate the management responsibilities for entities disposing of PFAS wastes.

REFERENCES

Aleksandrov et al. 2019. Waste incineration of Polytetrafluoroethylene (PTFE) to evaluate potential formation of per- and Poly-Fluorinated Alkyl Substances (PFAS) in flue gas. Chemosphere. 226. 898-906.

Ellis, et al. 2001. Thermolysis of fluoropolymers as a potential source of halogenated organic acids in the environment. Nature 412 (6844), 321e324. https://doi.org/10.1038/35085548

Ellis, et al. 2003. The use of 19F NMR and mass spectrometry for the elucidation of novel fluorinated acids and atmospheric fluoroacid precursors evolved in the thermolysis of fluoropolymers. Analyst 128 (6), 756e764. https://doi.org/10.1039/B212658C

García, et al. 2007. Products obtained in the fuel-rich combustion of PTFE at high temperature. J. Anal. Appl. Pyrol. 80 (1), 85e91. https://doi.org/10.1016/j.jaap.2007.01.004

Greenhouse Gas Protocol. 2016. Global Warming Potential Values. https://www.ghgprotocol.org/sites/default/files/ghgp/Global-Warming-Potential-Values%20%28Feb%2016%202016%29_1.pdf

Horst, et al. 2020. Understanding and Managing the Potential By-Products of PFAS Destruction. Groundwater Monitoring & Remediation. https://ngwa.onlinelibrary.wiley.com/doi/abs/10.1111/gwmr.12372

ITRC. 2020. PFAS - Per- and Polyfluoroalkyl Substances: Treatment Technologies. Interstate Technology Regulatory Council. https://pfas-1.itrcweb.org/12-treatment-technologies/

McKay. 2002. Dioxin characterisation, formation and minimisation during municipal solid waste (MSW) incineration: Review. Chem. Eng. J. 86, 343.

Merino, et al. 2016. Degradation and removal methods for perfluoroalkyl and polyfluoroalkyl substances in water. Environ. Eng. Sci. 33 (9), 615e649. https://doi.org/10.1089/ees.2016.0233

National Academy of Sciences (NAS). 2000. Waste Incineration and Public Health. National Research Council. http://www.nap.edu/catalog/5803.html

Obaid et al. 2017. Comparing non-steady state emissions under start-up and shut-down operating conditions with steady state emissions for several industrial sectors: A literature review. Energies. 10(2):179. https://www.mdpi.com/1996-1073/10/2/179

Solo-Gabriele, et al. 2020. Waste type, incineration, and aeration are associated with per- and polyfluoroalkyl levels in landfill leachates. Waste Manag. 107, 191e200. https://doi.org/10.1016/j.wasman.2020.03.034

Taylor and Yamada. 2003. Final Report - Laboratory Scale Thermal Degradation of Perfluoro-Octanyl Sulfonate and Related Precursors. University of Dayton Research Institute (UDRI) May 2003.

Taylor, et al. 2014. Investigation of waste incineration of fluorotelomer-based polymers as a potential source of PFOA in the environment. Chemosphere 110, 17e22. https://doi.org/10.1016/j.chemosphere.2014.02.037

Tuppurainen, et al. 1998. Formation of PCDDs and PCDFs in municipal waste incineration and its inhibition mechanisms: A review. Chemosphere 36, 1493.

United States Environmental Protection Agency, 2019. Guidance for Applicants Requesting to Treat/Dispose of PCBs Using Incineration or an Alternative Method. https://www.regulations.gov/docket?D=EPA-HQ-OLEM-2018-0305

United States Environmental Protection Agency, 2020a. Update on PFAS Analytical Methods. Impellitteri, Mills and Gillespie - Environmental Protection Agency. https://cfpub.epa.gov/si/si_public_record_Report.cfm?dirEntryId=349050&Lab=CESER

United States Environmental Protection Agency, 2020b. Thermal Treatment of PFAS in Environmental Media: A review of the state-of-the-science. Mark Mills, Diana Bless Environmental Protection Agency; Kavitha Dasu, Dinsuah Siriwardena, Amy Dindal Battelle Memorial Institute.

https://cfpub.epa.gov/si/si_public_record_Report.cfm?dirEntryId=348571&Lab=CESER

Wang, et al. 2013. Mineralization behavior of fluorine in perfluorooctanesulfonate (PFOS) during thermal treatment of lime-conditioned sludge. Environ. Sci. Technol. 47 (6), 2621e2627. https://doi.org/10.1021/es305352p

Washington Ecology. 2020. Per- and polyfluoroalkyl Substances (PFAS) Disposal Considerations. June 30, 2020.

Watanabe et al. 2016. Residual organic fluorinated compounds from thermal treatment of PFOA, PFHxA and PFOS adsorbed onto granular activated carbon (GAC). Journal of Material Cycles and Waste Management. 18:625-630. https://link.springer.com/article/10.1007/s10163-016-0532-x

Watanabe, et al. 2018. Thermal mineralization behavior of PFOA, PFHxA, and PFOS during reactivation of granular activated carbon (GAC) in nitrogen atmosphere. Environ. Sci. Pollut. Res. Int. 25 (8), 7200e7205. https://doi.org/10.1007/s11356-015-5353-2