SEPA ENVIRONMENTAL CHECKLIST

Purpose of checklist:

Governmental agencies use this checklist to help determine whether the environmental impacts of your proposal are significant. This information is also helpful to determine if available avoidance, minimization or compensatory mitigation measures will address the probable significant impacts or if an environmental impact statement will be prepared to further analyze the proposal.

***Instructions for applicants*:**

This environmental checklist asks you to describe some basic information about your proposal. Please answer each question accurately and carefully, to the best of your knowledge. You may need to consult with an agency specialist or private consultant for some questions. You may use "not applicable" or "does not apply" only when you can explain why it does not apply and not when the answer is unknown. You may also attach or incorporate by reference additional studies reports. Complete and accurate answers to these questions often avoid delays with the SEPA process as well as later in the decision-making process.

The checklist questions apply to all parts of your proposal, even if you plan to do them over a period of time or on different parcels of land. Attach any additional information that will help describe your proposal or its environmental effects. The agency to which you submit this checklist may ask you to explain your answers or provide additional information reasonably related to determining if there may be significant adverse impact.

Instructions for Lead Agencies:

Please adjust the format of this template as needed. Additional information may be necessary to evaluate the existing environment, all interrelated aspects of the proposal and an analysis of adverse impacts. The checklist is considered the first but not necessarily the only source of information needed to make an adequate threshold determination. Once a threshold determination is made, the lead agency is responsible for the completeness and accuracy of the checklist and other supporting documents.

Use of checklist for nonproject proposals: [help]

For nonproject proposals (such as ordinances, regulations, plans and programs), complete the applicable parts of sections A and B plus the SUPPLEMENTAL SHEET FOR NONPROJECT ACTIONS (part D). Please completely answer all questions that apply and note that the words "project," "applicant," and "property or site" should be read as "proposal," "proponent," and "affected geographic area," respectively. The lead agency may exclude (for non-projects) questions in Part B - Environmental Elements –that do not contribute meaningfully to the analysis of the proposal.

A. Background [help]

1. Name of proposed project, if applicable: [help]

Ecology Aqueous Film Forming Foam (AFFF) Collection Program

2. Name of applicant: [help]

Washington Department of Ecology

3. Address and phone number of applicant and contact person: [help]

Sean Smith
Product Replacement Coordinator
sean.smith@ecy.wa.gov
425-649-4495
3190 160th Ave. SE
Bellevue WA 98008

4. Date checklist prepared: [help]

September 1, 2020

5. Agency requesting checklist: [help]

Washington Department of Ecology

6. Proposed timing or schedule (including phasing, if applicable): [help]

Project is authorized under the 2019/2021 Ecology Legislative Decision package. Ecology must receive all invoices for this program prior to the end of fiscal year 2021.

7. Do you have any plans for future additions, expansion, or further activity related to or connected with this proposal? If yes, explain. [help]

The Legislature and the public have shown great interest in removing per- and polyfluoroalkyl substances (PFAS) from use and reducing its potential to contaminate state ground and drinking water. For example, as of July 2020, Washington state law prohibits the sale and manufacture of PFAS-containing firefighting foam. State law also prohibits its use for training. Meanwhile, the Washington State legislature provides funding for the department to conduct an aqueous film-forming foam (AFFF) collection program. To date, this PFAS foam program is limited to the state's municipal fire departments and the Washington Department of Transportation. (Please see Appendix 1 for a list of participating fire departments. If your fire department is not on the list and interested in participating in this program, please contact Sean Smith at 425-649-4495 or sean.smith@ecy.wa.gov) Ecology has also heard from businesses, airports, and manufacturing facilities that have thousands of gallons of firefighting foam they would like to dispose of, but do not qualify for the current program. Future funding could be used to collect and dispose of this additional foam.

This SEPA checklist considers the environmental impacts of the collection of PFAS-containing firefighting foam, its transport, and disposal through incineration. Ecology's chosen disposal method is to incinerate the foam at a Resource Conservation and Recovery Act (RCRA)-permitted commercial hazardous waste incinerator capable of exposing the PFAS foam to temperatures in excess of 1300°C (2372°F), with hold times greater than two seconds. These conditions maximize PFAS destruction.

8. List any environmental information you know about that has been prepared, or will be prepared, directly related to this proposal. [help]

Ecology conducted a literature review of relevant studies, reports, guidance, and documents related to PFAS-containing firefighting foam disposal and its impact upon the environment. A list of relevant materials reviewed and/or developed for this analysis includes:

- RCRA permit for the Aragonite Facility.
- Clean Harbors compliance history for the Aragonite Facility.
- Scientific studies on the efficiency and effectiveness of disposal technologies, including direct landfill disposal and incineration.
- Consultation with Ecology's Product Replacement, Pollution Prevention, Toxic Reduction, and Reducing Toxic Threats Teams, as well as the Air Quality Program, the Tribal Liaison office, and Attorneys General Office.
- Technical memo on PFAS Firefighting Foam Disposal Methods, dated June 30, 2020.
- Firefighting Foam Collection Special Conditions letter, dated July 15, 2020.

In addition, Ecology reached out to state agencies, universities, and the Environmental Protection Agency about regulatory standards for the incineration and disposal of PFAS foam and other wastes, factors to consider when disposing of PFAS foam, PFAS foam destruction options and research opportunities, PFAS destruction technologies, PFAS fate and transport, and PFAS fingerprinting.

9. Do you know whether applications are pending for governmental approvals of other proposals directly affecting the property covered by your proposal? If yes, explain. [help]

This SEPA analysis reviews the impacts from the collection, transport, and disposal of PFAS containing firefighting foam. It does not include government approval of other proposals affecting a specific property.

10. List any government approvals or permits that will be needed for your proposal, if known. [help]

None

11. Give brief, complete description of your proposal, including the proposed uses and the size of the project and site. There are several questions later in this checklist that ask you to describe certain aspects of your proposal. You do not need to repeat those answers on this page. (Lead agencies may modify this form to include additional specific information on project description.) [help]

The Washington state legislature authorized the Washington Department of Ecology to spend state funds on the administration of a program to collect, transport, and dispose of PFAS-containing firefighting foam currently owned by municipal fire departments and select state agencies. A hazardous waste contractor will be hired to conduct the actual collection, transport, and disposal of the foam.

12. Location of the proposal. Give sufficient information for a person to understand the precise location of your proposed project, including a street address, if any, and section, township, and range, if known. If a proposal would occur over a range of area, provide the range or boundaries of the site(s). Provide a legal description, site plan, vicinity map, and topographic map, if reasonably available. While you should submit any plans required by the agency, you are not required to duplicate maps or detailed plans submitted with any permit applications related to this checklist. [help]

This SEPA analysis reviews the potential impacts from the collection, transport, and disposal of PFAS-containing firefighting foam. Any Washington state municipal fire department with qualifying foam may participate, however the program is not specific to a particular site or location. A list of agencies participating in the collection program is included in Appendix1.

Clean Harbors is Ecology's hazardous waste state contractor. They operate permitted hazardous waste incinerators across the United States. These facilities incinerate, among other waste, PFAS-containing foams and other PFAS waste. Clean Harbors operates three facilities that could process the collected foam. These include the El Dorado Facility in El Dorado, Arkansas, the Deer Park Facility in La Porte, Texas, and the Aragonite Facility in Aragonite, Utah.

Ecology has chosen to send the collected foam to Clean Harbors' Aragonite Facility.

According to the Utah Department of Environmental Quality, Aragonite is a commercial waste incineration, transfer, and storage facility located in a remote area of Tooele County, Utah.

The wastes that are handled at the facility include hazardous wastes, PCBs, industrial wastes, and other non-hazardous wastes, including PFAS. The facility is designed to handle high and low BTU liquid wastes, sludges, bulk solids, compressed gas cylinders, and containerized wastes.

The current permitted capacity of the incinerator is approximately 13 tons per hour. It typically processes about 50,000 tons per year. Operations occur 24 hours a day.

The RCRA Permit was reissued by the director of the Division of Waste Management and Radiation Control on September 28, 2012.

The facility is remote and located 2.5 miles south of Interstate 80 at the Aragonite exit (Exit #56). The nearest residential area is Grantsville, about 34 miles from Aragonite. The nearest single dwelling is at Delle, approximately 16 miles to the east of Aragonite. The site is arid to semi-arid with an annual precipitation of 6 to 12 inches (see image 1).

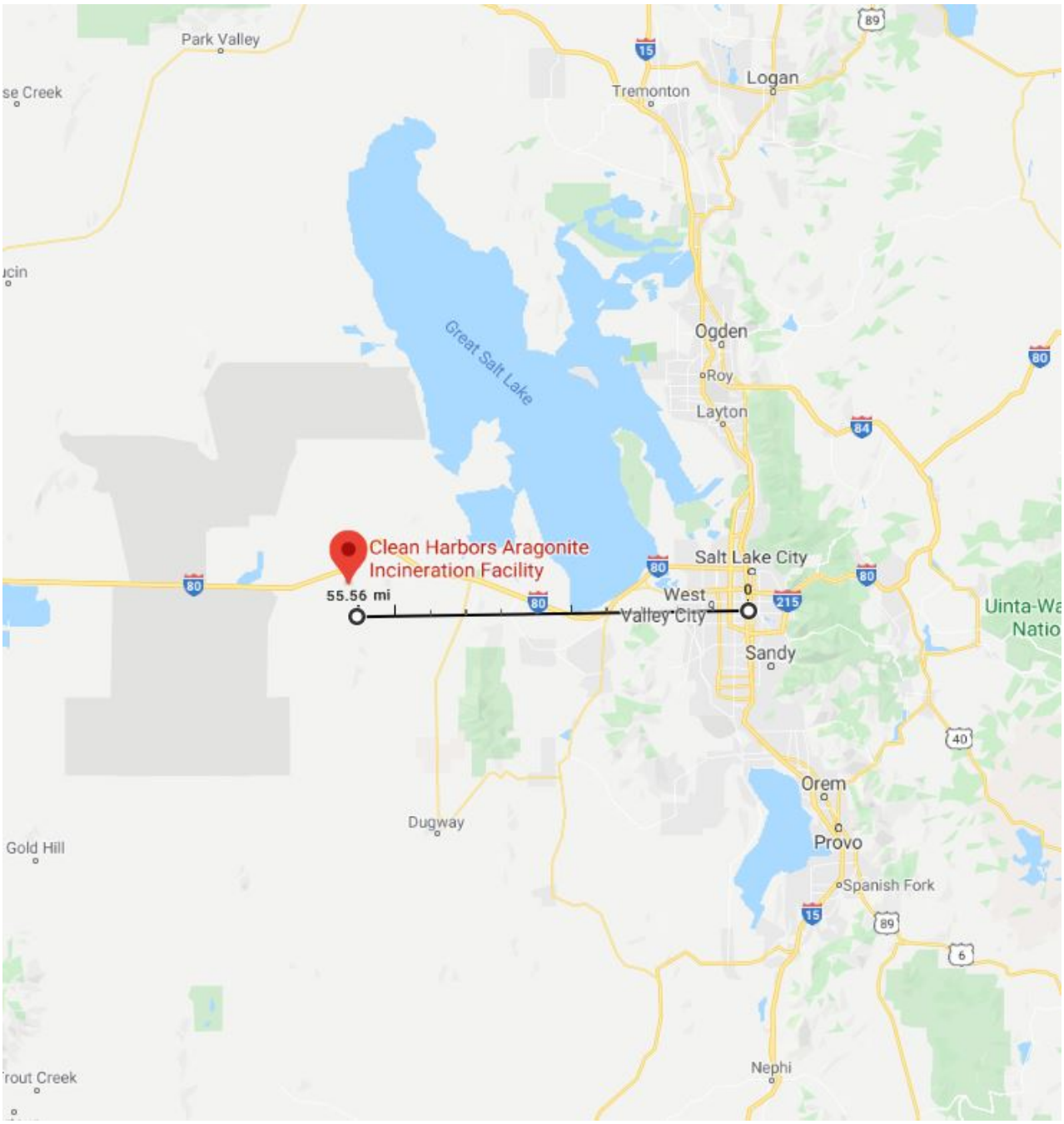

Image 1. Location of the Aragonite Incinerator

B. ENVIRONMENTAL ELEMENTS [help]

As specified in WAC 197-11-315(1)(e), Ecology has determined that the questions in Part B do not aid in the review of this nonproject proposal.

C. Signature [help]

The above answers are true and complete to the best of my knowledge. I understand that the lead agency is relying on them to make its decision.

Signature: 

Name of signee: Raman Iyer

Position and Agency/Organization Northwest Section Manager/Department of Ecology

Date Submitted: September 1, 2020

D. supplemental sheet for nonproject actions [help]

(**IT IS NOT NECESSARY** to use this sheet for project actions)

Because these questions are very general, it may be helpful to read them in conjunction with the list of the elements of the environment.

When answering these questions, be aware of the extent the proposal, or the types of activities likely to result from the proposal, would affect the item at a greater intensity or at a faster rate than if the proposal were not implemented. Respond briefly and in general terms.

PFAS is an acronym for "per- and polyfluoroalkyl substances," a group of over 4,700 synthetic organic chemicals. PFAS are used in many consumer products and in some types of firefighting foams. Some forms of PFAS have been linked to health problems in people and are toxic in animals.

PFAS are water soluble and highly mobile, meaning they can easily contaminate groundwater and can be hard to filter out. There are no natural processes that can break these substances down. Exposures could continue for hundreds or thousands of years.

Long chain perfluorinated compounds were added to firefighting foam up until 2002 because of its heat resistance, water and oil repelling attributes, and diffusion and persistence characteristics. It also helps aid in the quick dispersal of the foam. Shorter chain perfluorinated compounds have been used in firefighting foam since 2002.

Perfluorinated firefighting foam, also known as aqueous film-forming foam or AFFF, is a firefighting agent used commercially and by firefighting services to combat flammable liquids and petroleum fires. AFFF contains perfluorinated compounds that persist in the environment and are not known to degrade by any natural process. The military, commercial airports, oil refineries, train yards, and other industrial facilities use these foams because of their effectiveness in combating fires.

PFAS-containing firefighting foam is responsible for contaminating drinking water across the state. Contaminated drinking water has been found around military bases such as Fairchild Air Force Base, Whidbey Island Naval Air Station, Joint Base Lewis McChord, and at Issaquah, WA. PFAS, even in very small doses, can negatively impact human health. In 2019, the Washington State Legislature authorized the Department of Ecology to collect, transport, and dispose of PFAS-containing firefighting foam from municipal fire stations.

1. How would the proposal be likely to increase discharge to water; emissions to air; production, storage, or release of toxic or hazardous substances; or production of noise?

The collection, transport, and final disposal of AFFF has the potential to discharge emissions to the air and water and release hazardous substances to the environment. The actual transport of the collected foam may result in air emissions from the processing and packaging of foam for transport, as well as the actual transport to the final disposal site. In addition, PFAS foams contain chemicals that, if handled improperly, spilled, or used to suppress fires can contaminate the air, ground and drinking water. There is also the potential for PFAS to volatize and degrade air quality.

As for disposal, Ecology examined several options for disposing of firefighting foam stockpiles in Washington. The first is to incinerate the foam. This requires industrial facilities designed to burn dangerous waste at high temperatures to destroy compounds into smaller compounds or their base elemental constituents. The second option is land disposal, which requires indefinite containment and monitoring of buried firefighting foam. The third option is to collect the foam and hold stockpiles indefinitely until there is more research and consensus on how to best dispose of PFAS waste streams.

Ecology has chosen to incinerate the foam. Below is a discussion of the disposal methods, their potential for release, and our reasoning for the preferred method.

Preferred Disposal Method – Incineration and Land Disposal of Ash

Research indicates that incineration at high enough temperatures for a long enough hold times is capable of breaking the PFAS molecules. This is the only large-scale disposal mechanism believed to destroy the molecule, therefore reducing the amount of PFAS that must be managed in a Subtitle C landfill. This is important because PFAS is considered a "forever chemical," meaning it will outlast the life of hazardous waste landfills and pose a long term risk of soil and groundwater impacts.

Studies point to incineration's ability to destroy the PFAS molecule. Studies in 2005 and 2014 showed that perflourooctanic acid (PFOA) was not measured at detectable levels after a 2 second residence time at 1000°C. According to an Environmental Protection Agency (EPA) technical briefing, temperatures above 1000°C (1832°F) with a residence time greater than 1 second may be needed for 99.99% complete unimolecular destruction of all fluorinated organic compounds.

The EPA technical briefing also indicated that temperature requirements and residence times are not well studied, and it is possible some products of incomplete combustion (PIC) such as carbontetraflouride (CF4), Flouroform (CHF3), 1,2-diflouroehylene (C2H2F2), and Hexaflouroethane (C2F6) remain after incineration activities. According to the EPA, CF4, the most difficult fluorinated organic compound to break via incineration, requires temperatures over 1400°C (2552°F). Ultimately, these PICs which are not as well studied as the larger PFAS molecules, may settle out in residue ash, be captured in secondary pollution control devices, or escape as emissions. Ash and particulates captured by the secondary pollution control devices are collected and disposed of at the Grassy Mountain Subtitle C landfill located adjacent to the Aragonite facility.

Recent sampling by the Center for the Advancement of Public at Action at Bennigton College in Vermont found that an incinerator in New York may not be completely destroying the PFAS

molecule. The State of New York however questions these results noting that the Bennington college sampling shows "no pattern of contamination, none of the chemical fingerprints typically found with PFAS related (firefighting foam) contamination, no widespread evidence of contamination, questionable sampling protocols, and trace levels of PFAS typical of urban locations in New York State and beyond." New York has begun comprehensive field testing "to help determine if contaminants are present in the communities surrounding the Norlite facility in the city of Cohoes as a result of Per- and Polyfluoroalkyl Substances (PFAS) incineration and past practices of the facility." New York does not have a firm date on when it expects results.

Incineration is the only technology available now that can under appropriate conditions, process large volumes of AFFF foam, destroy the foam's PFAS molecule, reduce the foam's volume, minimize ground water impacts, minimize waste deposited in landfills, control air emissions, while reducing impacts upon taxpayers. For these reasons, incineration at a RCRA permitted commercial hazardous waste incinerator is the Department of Ecology's preferred disposal method.

The following disposal options were consider but are not preferred when compared to incineration.

Direct Land Disposal

Direct land disposal, unlike incineration, does not involve any thermal treatment. This disposal method allows for the storage of PFAS firefighting foam in a centralized location and within a Subtitle C landfill. One state has chosen to landfill its collected foam and is shipping it to a US Ecology landfill in Idaho. US Ecology evaluated the Idaho landfill because the location experiences limited rainfall, reducing the need for leachate management. Collected leachate from the US Ecology landfill is sent to a local waste water treatment plant if it meets discharge limits. If it does not meet discharge limits, the leachate is to be injected into non-hazardous industrial waste wells in Ohio.

Ultimately, land disposal is not Ecology's preferred method because PFAS chemicals persist indefinitely and are found in landfill leachate which requires indefinite management and monitoring of the disposed foam.

Concentrating large amounts of PFAS-containing AFFF poses a long-term risk of contaminating soil and groundwater. Additionally, landfill operators are not required to monitor for PFAS compounds in landfill leachate. This, and the fact that PFAS molecules are expected to outlast the lifespan of Subtitle C landfills, is of major concern to Ecology.

Hold for New Treatment Technologies

Several emerging technologies show potential for treating groundwater contaminated with PFAS. These include high-frequency ultrasound, electrochemical oxidation, non-thermal plasma, ultraviolet light, and a combination of high pressure and heat. Alkaline hydro-thermal treatment technology shows promise in achieving high levels of PFAS destruction including that in AFFF at reduced energy investments. These emerging technologies have been tested at the field scale, but are not yet feasible at a large scale. Other remediation technologies, such as chemical oxidation, ball milling, and electron beams, have progressed in the laboratory. However, additional research is needed to make them feasible, cost-effective, and applicable in the field.

Currently, these technologies are not ready for full scale implementation and have been primarily designed to treat wastewater, not concentrated AFFF.

Proposed measures to avoid or reduce such increases are:

The collected PFAS-containing foam will be sent to the Aragonite RCRA-permitted commercial waste incinerator, operated by Clean Harbors, in Utah. Minimum conditions on foam processing, including temperature and residence time within the incinerator, will be set to ensure maximum destruction of PFAS molecules. Collection, transport, and processing will comply with all hazardous waste, clean air, and clean water regulations. Final land disposal of any residual ash will comply with local land disposal regulations and be sent to the RCRA Part B Hazardous Waste Grassy Mountain landfill with legally required leachate and emissions controls. Collection, transport, and processing at the landfill will comply with all hazardous waste, clean air, and clean water.

2. How would the proposal be likely to affect plants, animals, fish, or marine life?

PFAS-containing foam, when used to suppress fires, for training or spilled/improperly stored, is known to negatively impact water quality. PFAS foam is suspected to have contaminated drinking water at localities near Joint Base Lewis McChord, Whidbey Island Naval Air Station, Fairchild Air Force Base, and Issaquah, WA. Once released into the environment, PFAS will migrate to both terrestrial and aquatic systems. Uptake into plants can occur within affected areas and may transfer PFAS to wildlife and humans that consume those plants. Some compounds have a propensity to bioaccumulate and then biomagnify up the food chain, with relatively low levels in invertebrates and fish and higher levels observed in animals at the top of the food chain (for example, seals, seabirds, and polar bears). If humans consume these animals, PFAS contamination can be transferred. In some states such as Michigan, "do not eat" advisories have been issued for PFAS-contaminated animals such as deer. The Washington State Department of Health lists the most consistent health impacts of PFAS exposure as increased serum lipids especially cholesterol, reduced birth weights, reduced immune response to vaccines, and increased serum liver enzymes indicative of liver damage. Other health outcomes reported in some exposed populations include thyroid disease and testicular and kidney cancer.

Disposal options will have differing impacts upon plants, animals, fish, or marine life. Incineration of PFAS foam produces residual ash, waste products from the treatment train like carbon scrubbers, and air emissions. Incineration of PFAS foam is subject to RCRA, Clean Air, and Clean Water standards. According to Utah DEQ, Clean Harbors is a good faith actor and has shown a willingness to address and make any needed correction. Residual ash and spent cleaning filters are sent to a nearby landfill. Leachate from the landfill is collected and sent for incineration.

Incineration can produce air emissions. The Aragonite facility in Utah is in compliance with EPA's 2008 air quality standards listed in table 1. These are Clean Air Act standards and the incinerator receives regular inspections.

Particulate	**Units**	**Standard 2008**
Dioxins and Furans	Ng of toxic equivalents/m3 dry gas	.40
Carbon Monoxide	ppm dry volume	100
Total Hydrocarbons	ppm dry volume	10
Hydrochloric acid and chlorine	ppm dry volume	32
Cadmium, lead	Ug/m3 dry gas	230

Arsenic, beryllium, chromium	Ug/m3 dry gas	92
Mercury	Ug/m3 dry gas	130
Particulate Matter	Grains/m3 dry gas	.459

Table 1: EPA Air Emissions Standards for the Aragonite Incinerator

Proposed measures to protect or conserve plants, animals, fish, or marine life are:

> Properly collecting, transporting, and disposing of PFAS-containing foam destroys PFAS molecules, thereby reducing the long-term negative environmental effects that impact plants, animals, fish, and marine life. Collected foam will be sent to the Aragonite RCRA-permitted commercial waste incinerator in Utah. Incineration and final land disposal will comply with relevant local, state, and federal regulations and law. In addition, conditions will be set on the hazardous waste contract to ensure the maximum destruction of the PFAS molecule, thereby limiting and minimizing downwind contamination. Residual ash will be sent to Clean Harbors' Grassy Mountain Landfill. Leachate from this landfill is collected and sent to the Aragonite facility for incineration, further limiting impacts upon plants, animals, fish, and marine life.

3. How would the proposal be likely to deplete energy or natural resources?

According to the Utah DEQ, the Aragonite incinerator is a single 140 million BTU slagging rotary kiln with a vertical afterburner chamber. Clean Harbors reports it burns butane and uses roughly 1.7 million kwh of electrcity per month. Aragnoite can process 13 tons of waste per hour. As such, Aragonite uses 181kwh/ton of waste.

This energy use is comparable to Clean Harbors other large industrial incinerators. The Deer Park facitlity in Texas uses 2,500,000 kwh/month and processes10 tons of waste per hour or 347kwh/ton. Meanwhile, El Dorado in Arkansas uses 2,900,000 kwh/month. It processes 18.2 tons of waste per hour or 221 kwh/ton.

Proposed measures to protect or conserve energy and natural resources are:

Clean Harbors' Aragonite incinerator is regulated by both local and state agencies. Impacts associated with its operation at full capacity have been analyzed and permited under Utah and federal law. Aragonite's current operating permit was issued in 2012. The incinerator runs 24 hours a day, processing 13 tons of waster per hour. This continuous operation maximizes the efficiency of energy used versus waste processed.

4. How would the proposal be likely to use or affect environmentally sensitive areas or areas designated (or eligible or under study) for governmental protection; such as parks, wilderness, wild and scenic rivers, threatened or endangered species habitat, historic or cultural sites, wetlands, floodplains, or prime farmlands?

PFAS containing foam, when used to suppress fires, for training or spilled/improperly stored is known to negatively impact water quality. PFAS foam is suspected to have contaminated drinking water at localities near Joint Base Lewis McChord, Whidbey Island Naval Air Station, Fairchild Air Force Base, and Issaquah, WA. PFAS is extremely difficult to remove from soil, surface water, groundwater, or drinking

water once it's released to the environment. Collecting PFAS-containing foam from the state's municipal fire departments will eliminate a highly concentrated source of one of the state's largest pollution threats.

PFAS foam incineration can produce air emissions. This atmospheric deposition is carried downwind where it is deposited upon the land and surface water. The deposition can then be taken up by biota including humans, potentially negatively impacting their growth and development.

The Aragonite Incinerator is 13 miles to the north of the Cedar Mountain Wilderness Area. The prevailing winds for the surrounding Aragonite vicinity are predominantly from the east and northeast and average 6.8 mph. Wendover is on the Utah/Nevada border 55 miles to the West of the Aragonite incinerator. It is unclear as to whether air emissions from the facility are transported to the community.

Proposed measures to protect such resources or to avoid or reduce impacts are:

Properly collecting, transporting, and disposing of PFAS-containing foam will remove a potentially large source of PFAS pollution thereby preventing its negative impact upon environmentally sensitive areas or areas designated (or eligible or under study) for governmental protection, such as parks, wilderness, wild and scenic rivers, threatened or endangered species habitat, historic or cultural sites, wetlands, floodplains, or prime farmlands.

Collected foam will be sent to a RCRA-permitted incinerator. This disposal mechanism will comply with relevant local, state, and federal regulations and law, including Clean Air restrictions minimizing impacts upon the environmentally sensitive areas.

5. How would the proposal be likely to affect land and shoreline use, including whether it would allow or encourage land or shoreline uses incompatible with existing plans?

This proposal would not likely affect land and shoreline use or encourage incompatible shoreline uses.

Proposed measures to avoid or reduce shoreline and land use impacts are:

This proposal would not likely affect land and shoreline use or encourage incompatible shoreline uses.

6. How would the proposal be likely to increase demands on transportation or public services and utilities?

This proposal is not likely to increase demands on transportation or public services and utilities.

Proposed measures to reduce or respond to such demand(s) are:

This proposal is not likely to increase demands on transportation or public services and utilities.

7. Identify, if possible, whether the proposal may conflict with local, state, or federal laws or requirements for the protection of the environment.

The Washington State AFFF collection program will comply with local, state, and federal laws or requirements for the protection of the environment.

The Department of Ecology communicated and consulted with several entities to determine the compliance of Washington's foam collection program with local, state, and/or federal law, including:

- Washington State Department of Ecology
    - Hazardous Waste and Toxic Reduction
    - Water Quality
    - Air Quality
    - Toxic Clean Up
    - Tribal Liaisons Office
- Washington State Office of the Attorney General
- Washington State Department of Health
- Washington State Department of Transportation
- Washington State Department of Enterprise Services
- Washington State Fire Marshal's Office
- Utah Department of Environmental Quality
- The United States Environmental Protection Agency
- The Federal Aviation Administration

References

- Aleksandrov, Krasimir & Gehrmann, Hans-Joachim & Hauser, Manuela & Mätzing, Hartmut & Pigeon, Daniel & Stapf, Dieter & Wexler, Manuela. (2019). Waste incineration of Polytetrafluoroethylene (PTFE) to evaluate potential formation of per- and Poly-Fluorinated Alkyl Substances (PFAS) in flue gas. Chemosphere. 226. 10.1016/j.chemosphere.2019.03.191.
- Application of Non-Thermal Plasma Technology for the Removal of PFAS from Investigation-Derived Wastes, Department of Defense Strategic Environmental Research and Development Program (SERDP). July 2019
- Bennington College, (2020, April 27) *First in the Nation Testing Reveals Toxic Contamination in Soil and Water Near Norlite Incinerator* [Press Release]
- Carignan, Sylvia. Clukey, Keshia, Destroying Forever Chemicals Ignites N.Y. Town's 'Worst Fears, Bloomberg Law, June 25, 2020
- Mahinroosta, Reza, Senevirathna, Lalantha,. 2020. A review of the emerging treatment technologies for PFAS contaminated soils, Journal of Environmental Management, Volume 255.
- Michigan Department of Environment, Great Lakes, and Energy, (2019, September 12) Michigan to protect public from PFAS-containing firefighting foam under $1.4 million collection and disposal program [Press Release]
- Michigan Department of the Environment, Great Lakes, and Energy, Michigan PFAS Action Response Team, (2020) PFAS in Deer
- Per – and Polyfluoroalkyl Substances. Technical /Regulatory Guidance. Interstate Technology Regulatory Council, April 2020
- Rapid Destruction and Defluorination of Perfluorooctanesulfonate by Alkaline Hydrothermal Reaction, Boran Wu, Shilai Hao, Younjeong Choi, Christopher P. Higgins, Rula Deeb, and Timothy J. Strathmann, Environmental Science & Technology Letters 2019 6 (10), 630-636
- Ross I, McDonough J, Miles J, et al. A review of emerging technologies for remediation of PFASs. *Remediation*. 2018;28:101–126.
- Stoiber, Tasha., Evans, Sydney,. Naidenko, Olga, V., 2020 Disposal of products and materials containing per- and polyfluoroalkyl substances (PFAS): A cyclical problem. Chemosphere Volume 260.
- Taylor, Philip H., Yamada, Tak. 2003. Final Report – Laboratory Scale Thermal Degradation of Peffluoro-Octanyl Sulfonate and Related Precursors.
- Taylor, Phillip H, Yamada, Tak. Striebich, R.C., Graham, J.L., Giraud, R.J., 2014 Investigation of waste incineration of fluorotelomer-based polymers as a potential source of PFOA in the environment, Chemosphere Volume 110
- US Environmental Protection Agency, 2020. Per- and Polyfluoroalkyl Substances (PFAS): Incineration to Manage Waste Streams. Technical Brief
- Utah Department of Environmental Quality: RCRA Part B Hazardous Waste Permit: Clean Harbors Grassy Mountain LLC, 2012
- Utah Department of Environmental Quality: Aragonite RCRA Permit,: Clean Harbors, LLC. Utah Department of Environmental Quality, Waste Management and Radiation Control 2012.
- Utah Department of Environmental Quality, Clean Harbors Aragonite, LLC Compliance History, 2020
- Yamada, Tak, Taylor, Philip H., Buck, Robert C., Kaiser, Mary A., Giraud. Robert J. 2005. Thermal degradation of fluorotelomer treated articles and related materials. Chemosphere Volume 61, Issue 7
- Washington State Department of Health, (2020) PFAS, About PFAS

Appendix 1: List of Participating Fire Departments and State Agencies

Adams County Fire District 5	City of Elma	Grandview City
Anacortes Fire Department	City of Port Angeles Fire Department	Grant County Fire District #3
Bald Hills Fire District #17	Clallam 2 Fire-Rescue	Grant County Fire District #5
Bellingham Fire Department	Clallam County Fire District 3	Grays Harbor Fire Dist. #4
Bellingham Fire Department	Cowlitz County Fire District 6	King County Fire District 20
Bothell Fire Department	Cowlitz-Lewis FD #20	Lynden Fire Department
Burlington Fire Dept.	Cowlitz-Skamania Fire District #7	Mason County Fire District #13
Central Pierce Fire & Rescue	Duvall King County Fire Dist 45	Mason County Fire District 11
Central Whidbey Fire & Rescue	East Olympia Fire District #6	Mccleary Fire/GHFD#12
City of Bellevue Fire Department	East Pierce Fire	MCFD 18
City of Buckley Fire Dept	East Pierce Fire and Rescue	Mercer Island Fire Department

Mount Vernon Fire Department	Port Of Moses Lake Fire Department	South Bay Fire Department
Mountain View Fire and Rescue	Port of Seattle Fire Department	South King Fire and Rescue
Nile Cliffdell Fire Department	Richland Fire & Emergency Services	South Kitsap Fire Rescue
NorthMason RFA	Skagit County FD #3	South Snohomish County Fire and Rescue RFA
Oak Harbor Fire Department	Skagit County FD 10	Spokane Co. Fire Dist 4
Paine Field Fire Department	Skagit County Fire District 14	Spokane County Fire District 10
Pasco Fire Department	Skagit County Fire District 19	Spokane County Fire District 11
Pierce County Fire Dist 5	Skagit County Fire District No. 6	Tacoma Fire Department
Pierce County Fire District 16	Snohomish Co. Fire District #4	Thurston County Fire District 9
Pierce County Fire District 26 (Greenwater)	Snohomish County Fire District #15	Thurston County Fire Protection District 13
Port of Bellingham/Bellingham International Airport	Snohomish County Fire District 7	Tumwater Fire Department

Valley Regional Fire Authority	
Valley Regional Fire Authority	
Walla Walla Regional Airport	
West Mason Fire Mason County	
Whatcom County Fire District No. 7	
WSDOT	