UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
GREATER ATLANTIC REGIONAL FISHERIES OFFICE
55 Great Republic Drive
Gloucester, MA 01930

February 20, 2025

Betsy Valente
Chief, Freshwater and Marine Regulatory Branch
Office of Wetlands, Oceans, and Watersheds
Office of Water, U.S. Environmental Protection Agency
Washington, DC 20004

Dear Ms. Valente,

We have reviewed the Essential Fish Habitat (EFH) assessment and additional supporting documents provided to us by the U.S. Environmental Protection Agency (EPA) on February 13, 2025, regarding a proposed Marine Protection, Research and Sanctuaries Act (MPRSA) permit for the Woods Hole Oceanographic Institution's Locking Ocean Carbon in the Northeast Shelf and Slope (LOC-NESS) Project. The proposed ocean alkalinity enhancement research project involves the transportation and disposition of 50% sodium hydroxide solution in Wilkinson Basin, offshore of Massachusetts. The research activities for the LOC-NESS project are designed to (1) evaluate the effectiveness of the applicant's approach to monitoring changes in alkalinity and any subsequent carbon dioxide uptake by the ocean resulting from the sodium hydroxide additions and, (2) collect scientific information to better understand any potential adverse impacts to human health, the environment or other uses of the ocean resulting from the alkalinity enhancement activity. The proposed experiment would occur within the Wilkinson Basin, approximately 38 miles from the nearest shoreline in Cape Cod, Massachusetts, over a 7-day period between mid-July and mid-September, 2025.

Consultation Responsibilities
The Magnuson-Stevens Fishery Conservation and Management Act (MSA) and the Fish and Wildlife Coordination Act require federal agencies to consult with one another on projects such as this. Insofar as a project involves EFH, as this project does, this process is guided by the requirements of our EFH regulation at 50 CFR 600.905, which mandates the preparation of EFH assessments and generally outlines each agency's obligations in the relevant consultation procedure. We offer the following comments and recommendations on this project pursuant to the above referenced regulatory process.

Project Description
The proposed project would release up to 16,500 gallons of a 50% sodium hydroxide (NaOH) solution. The solution would be transported by tug-and-barge (transport vessel) from the Port of Quincy, Massachusetts, to the release location in Wilkinson Basin. The NaOH solution would be released at a controlled rate (1-4 liters per second) from the transport vessel into surface ocean waters (via hose/pipe one to two meters below the surface) for 4 to 12 hours to establish a patch of increased alkalinity in the surface waters. During the release, the transport vessel would be traveling at approximately 3 knots in an outward spiral pattern. Rhodamine Water Tracer dye

would be released along with the NaOH solution to allow the applicant and their research team to track the movement and dispersion of the alkalinity patch as it mixes with surrounding ocean waters. A seawater pump has been added to the proposed deployment to pump seawater from the side of the transport vessel into the outflow of sodium hydroxide solution and tracer dye at a rate of approximately 200 L/s to further enhance the mixing and dilution of the alkalinity patch and aid in retaining the sodium hydroxide solution and tracer dye in the surface waters after the release. During the release, the transport vessel would be traveling between 1-5 knots (target 3 knots) in an outward spiral pattern. The proposed release methods would be expected to result in an initial patch size of approximately 800 meters in diameter, which is anticipated to expand to approximately 8,000 meters in diameter during the seven-day monitoring period.

Proposed Monitoring

According to EPA's supporting documents, the monitoring plan for the proposed experiment indicate that the research vessels would be outfitted with pH and fluorescence sensors capable of monitoring seawater chemistry and the tracer dye in real time. The applicant and their research team would continuously monitor the total alkalinity, partial pressure of carbon dioxide, dissolved oxygen, temperature and salinity of seawater using ship- and platform-based sensors. The applicant and their research team would take discrete samples of seawater every 4-6 hours using a Conductivity, Temperature, Depth rosette sampler and Niskin bottles to monitor a suite of other physical-chemical properties and would be combined with other physical measurements such as air temperature, surface water currents and wind speeds. Drifting buoys equipped with GPS trackers and strobes would be released into the alkalinity patch from the research vessel and used for tracking the patch continuously, alongside shipboard sensors on the research vessel. Autonomous underwater gliders, water-column sediment traps, aerial drone imagery and satellite data may also be collected. Monitoring would continue for several days and nights, within and outside of the alkalinity patch until the alkalinity and tracer dye are no longer detectable from baseline concentrations by the research team's instrumentation. Proposed biological monitoring includes phytoplankton and zooplankton community measurements to assess impacts on major microbial groups (e.g., picophytoplankton, coccolithophores, diatoms, heterotrophic bacteria) and other critical organism groups such as zooplankton and copepods. Phytoplankton community composition would be measured using flow cytometry and other imaging tools. Plankton tows would be conducted to sample macroplankton, such as copepods and other zooplankton. Furthermore, the applicant and their research team would conduct ship-board incubations of alkalinity-enhanced seawater to directly assess carbon fixation rates over the course of the release and subsequent dilution of the sodium hydroxide solution.

During early coordination, we expressed concerns regarding uncertainties of the effects to planktonic life stages of federally-managed species, primarily eggs and larvae, from the proposed enhanced alkalinity experiment. Although the mobility of adult and juvenile stages may have the capacity to minimize time spent exposed to elevated pH waters, the effects of short-term increases of pH above 9.0 on marine animals, particularly for egg and larval life stages in the upper water column, is not well understood. In response to our preliminary comments, you noted that the applicant and their research team plan to characterize planktonic species abundances and composition, including ichthyoplankton and any other fish life stages present in collected samples using bongo net tows following standardized protocols by the Ecosystem Monitoring (EcoMon) and the Long-Term Ecological Research Network (LTER) within and outside the

alkalinity patch. However, as noted in the supporting documents, these methods would not distinguish between dead and injured, and alive specimens, and would only allow for an analysis of the presence or absence of any fish species or their life stages within and immediately outside the alkalinity patch. Based on these concerns, we initially recommended that in-situ and/or onboard monitoring to evaluate the potential effects of the proposed experiment on planktonic egg and larval life stages should be implemented as part of the LOC-NESS project. Subsequently, fish larvae abundance in the Wilkinson Basin was provided as < 1 fish larva per 100 m^3 across the shelf and changes have been made to the proposed NaOH application which further dilute the NaOH in surface waters. We appreciate the inclusion of additional methods to dilute NaOH; such as adding pumped water into ship wake to increase dilution, releasing material at slower rate, and increased vessel speed to reduce the time that pH will remain above 9.0 from 2 minutes to 12 seconds (according to modelled results). Given these findings on the abundance of larvae and modelled timing of elevated pH, we are unaware of a viable method for shipboard analysis or in-situ investigation of the effect on larval species. However, because this is a small scale test of a potentially larger scale application of ocean alkalinity enhancement, we recommend researchers investigate the effect of short term exposure to elevated alkalinity pH, on select larval species in a controlled setting, such as a laboratory or mesocosm investigation.

While the proposed experiment may be spatially and temporally restricted, the expectations are that these experiments may be scaled up to commercial-scale carbon dioxide removal applications. Therefore, we believe these data gaps should be addressed now rather than later when the spatial and temporal scales of future experiments and commercial-scale ocean alkalinity enhancement operations could have more substantial negative effects. Laboratory or mesocosm studies should focus on biologically and commercially important early life stage fish and invertebrates.

Project Affects to EFH and Federally-managed Species

According to the EFH assessment, EPA has determined that the proposed activities for the LOC-NESS project would not adversely affect the quantity of EFH, but may cause short-term impacts to the quality of some EFH via temporary changes in water quality within surface waters in a portion of the project areas. Specifically, based on the applicant's calculations, the seawater pH would return to near baseline values within 24 hours and would not be detectable after 48 to 72 hours after the release in both phases. Furthermore, due to the proposed release method and the rapid dilution of NaOH, the highest pH values (above 9.0) are modelled to be present for no more than 12 seconds near the immediate discharge point.

The supporting documents provided by EPA as part of the EFH consultation included some discussions about the effects of high alkalinity water on aquatic organisms. For example, the supporting documents state "sustained seawater with pH above 9.0 can be stressful to fish and prolonged exposure to pH above 9.5 can be life-threatening". In addition, the "EPA is not aware of any publication regarding the impacts of short-term increases of pH or alkalinity (less than 1 hour), as is proposed in this research study, on marine animals at any life stage". Furthermore, the supporting documents state "while fish gills are a potential exposure route for impacts from elevated seawater pH, it is expected that the mobility of the adult and juvenile stages of these organisms would minimize time spent interacting with the elevated pH waters". In our view, although adult and juvenile life stages of fish may have the capacity to swim out of the high

alkaline plume during the experiment, based on the information provided in the EFH assessment, there is no empirical evidence supporting this. Furthermore, planktonic life stages of fish (i.e., eggs and larvae) are not capable of mobility that would allow minimizing time spent in the high alkaline plume. In order to assess these impacts researchers "propose to investigate the effect of high-pH, short-term exposure on marine organisms, specifically the copepod *Calanus finnmarchius*, and potentially on larval species as well", and the EFH consultation indicates that "monitoring activities during both phases would include measurements of water quality (including real-time pH) and biological endpoints (phytoplankton, zooplankton, and ichthyoplankton)". Based on the EcoMon Data for strata 37, the most common fish species encountered in Wilkinson Basin from mid-July to mid-September are Sebastes, Red Hake, Silver Hake, Cunner, and Fourbeard Rockling.

We have determined that the proposed action would adversely affect EFH (i.e., the top 10 meters of the ocean water column), and could adversely affect federally-managed species and other NOAA trust resources that may occur in the action area during the LOC-NESS experiment. This adverse effect would likely be limited, spatially and temporally, to the discharge plume within 24 hours after discharge. The most acute affects would likely be limited to an area near the discharge point for 12-75 seconds. Although the spatial and temporal scale is relatively small, the proposed experiment has the potential to injure or kill all life stages of federally-managed species (especially planktonic egg and larval stages) that may occur in the action area during the NaOH deployment. Furthermore, the EFH regulations define an adverse effect as any impact that reduces quality and/or quantity of EFH, and may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality and/or quantity of EFH (Part 600, Subpart J, §600.810). As such, any loss or injury to prey species and their habitats for federally-managed species could be considered an adverse effect to EFH.

EFH Conservation Recommendations

In order to avoid, minimize, and offset substantial impacts to EFH resulting from the proposed project, pursuant to Section 305(b)(4)(A) of the MSA, we recommend that you adopt the following EFH conservation recommendations (CRs):

1. In addition to planned laboratory tests on *Calanus finnmarchius*, we recommend that controlled laboratory and/or mesocosm studies should be developed and implemented to evaluate the potential effects of high alkalinity deployments on sensitive planktonic egg and larval life stages. This recommendation need not be performed in advance of the proposed in-situ deployment planned for mid-July to mid-September of 2025. However, these laboratory or mesocosm analyses should be implemented prior to the commercial-scale application of NaOH for ocean alkalinity enhancement.
    a. Laboratory or mesocosm studies should investigate representative egg and larval samples from the following families of fish:
        i. Sebastinae (Ex. Sebastes)
        ii. Gadidae (Ex. Cod, Pollock, Haddock, Fourbeard Rockling, White, Silver or Red Hake)
        iii. Clupeidae (Ex. Herring)

iv. Pleuronectidae (Winter flounder, Plaice, Yellowtail flounder)

b. Depending on the spatial geography targeted for mCDR applications, additional analyses of the following taxa representative of the species that are most commonly found throughout the Gulf of Maine may be warranted. These taxa serve important ecological functions and support economically and culturally significant fisheries:
   i. Pectinidae (Ex. Sea scallop)
   ii. Homaridae (Ex. Lobster)

2. Should laboratory or mesocosm monitoring for effects to biological communities identify any indications of adverse effects to EFH or federally-managed species, an assessment of methods and protocols should be reevaluated to determine if additional measures to avoid and minimize adverse effects can be implemented for further carbon dioxide removal tests and potential commercial scale applications.

Please note that Section 305(b)(4)(B) of the MSA requires you to provide us with a detailed written response to these EFH CRs, including a description of measures you have adopted that avoid, mitigate, or offset the impact of the project on EFH. In the case of a response that is inconsistent with our recommendations, Section 305(b)(4)(B) of the MSA also indicates that you must explain your reasons for not following the recommendations. Included in such reasoning would be the scientific justification for any disagreements with us over the anticipated effects of the proposed action and the measures needed to avoid, minimize, mitigate, or offset such effects pursuant to 50 CFR 600.920(k). Please also note that a distinct and further EFH consultation must be reinitiated pursuant to 50 CFR 600.920(1) if new information becomes available or the project is revised in such a manner that affects the basis for the above EFH conservation recommendations.

Conclusion

We appreciate the opportunity to provide these EFH conservation recommendations. The conservation recommendations we provide in this letter are based on the information provided in the EFH assessment and supporting documents, and will ensure that the adverse effects to EFH, federally-managed species, and other NOAA trust resources from this project, and commercial scaled-up applications of ocean alkalinity enhancement, are minimized. If you have any questions regarding our conservation recommendations or information in this letter, please contact Kaitlyn Shaw at 978-282-8457 or kaitlyn.shaw@noaa.gov.

Sincerely,

Louis A Chiarella
Assistant Regional Administrator
for Habitat and Ecosystem Services

cc:
GARFO (Pentony)
PRD (Koch, Anderson)
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