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

June 16, 2023

Ms. Jessica Stromberg
Chief, Environmental Branch for Renewable Energy
Bureau of Ocean Energy Management
45600 Woodland Road, VAM-OREP
Sterling, Virginia 20166-4281

Re: Revolution Wind Offshore Wind Energy Project, Lease Area OCS-A-0486, Offshore Rhode Island

Dear Ms. Stromberg:

We have reviewed the final Essential Fish Habitat (EFH) assessment provided on March 23, 2023, for the proposed Revolution Wind, LLC offshore wind energy project. The project includes the construction, operation, maintenance, and decommissioning of a commercial scale offshore wind energy facility, known as the Revolution Wind Farm (RWF) within Lease Area OCS-A-0486, located 15 statute miles southeast of Rhode Island within the Rhode Island/Massachusetts Wind Energy Area on the outer continental shelf (OCS). The EFH assessment describes a project that includes up to seventy-nine (79) offshore wind turbine generators (WTGs) with a nameplate capacity of 8 to 12 MW per turbine, two offshore substations (OSS), scour protection for foundations and cables, and up to 155 miles of inter-array and 9.3 miles of OSS interconnecting submarine cables within the lease area. The project also includes the construction and installation of the Revolution Wind Export Cable (RWEC), which will transmit a high-voltage alternating current (HVAC) from the RWF to the mainland electric grid in North Kingstown, Rhode Island. The RWEC consists of two parallel transmission export cables co-located within a single corridor with export cable segments located in federal waters (RWEC–OCS) and a segment of export cables located in Rhode Island State territorial waters (RWEC–RI). The two RWEC circuits will total 83.3 miles in length (23 and 18.6 miles for each RWEC-OCS and RWEC-RI segment per circuit, respectively).

EFH Determination

Based on the project information presented in the EFH assessment, it is our determination that the proposed project would result in significant adverse impacts to managed species and their designated EFH. Specifically, the proposed project: 1) poses a high risk of population-level impacts to southern New England Atlantic cod, and 2) would result in significant alterations of the Cox Ledge ecosystem that is known for its heterogeneous complex habitats, including vast areas of three-dimensional rocky substrates that support important federally managed species and their prey. Although we deemed the EFH assessment complete for the purposes of initiating consultation, the provided documents do not fully consider or evaluate the direct, indirect, individual, and synergistic adverse effects to EFH or the sensitive and vulnerable resources in the project area that are likely to occur from the proposed project activities and development of Cox Ledge. We have significant concerns with the environmental implications and precedentsetting nature of developing this sensitive ecological area without a full and reasoned evaluation of adverse impacts or measures to avoid and minimize adverse impacts to Cox Ledge and the species that rely on this ecologically important habitat area. The scientific basis for our determination is provided in the attached Appendix.

Consultation Responsibilities
As discussed in our previous letters to BOEM on this project, including our June 1, 2021, scoping comments, in the Magnuson-Stevens Fishery Conservation and Management Act (MSA), Congress recognized that one of the greatest long-term threats to the viability of commercial and recreational fisheries is the continuing loss of marine, estuarine, and other aquatic habitats. Congress also determined that habitat considerations should receive increased attention for the conservation and management of fishery resources of the United States. As a result, one of the purposes of the MSA is to promote the conservation of EFH in the review of projects conducted under federal permits, licenses, or other authorities that affect or have the potential to affect such habitat. The MSA requires federal agencies to consult with the Secretary of Commerce, through NOAA Fisheries, with respect to “any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken, by such agency that may adversely affect any essential fish habitat identified under this Act,” 16 U.S.C. § 1855(b)(2).

The Fish and Wildlife Coordination Act (FWCA) provides authority for our involvement in evaluating impacts to fish and wildlife from proposed federal actions that may affect waters of the United States. The FWCA requires that wildlife conservation be given equal consideration to other features of water resource development programs through planning, development, maintenance and coordination of wildlife conservation and rehabilitation. The FWCA does this by requiring federal action agencies to consult with us "with a view to the conservation of wildlife resources by preventing loss of and damage to such resources as well as providing for the development and improvement thereof in connection with such water-resource development" (16 USC 662). One of the reasons that Congress amended and strengthened the FWCA in 1958 was that it recognized that “[c]ommercial fish are of major importance to our nation[,]” and that federal permitting agencies needed general authority to require “in project construction and operation plans the needed measures for fish and wildlife conservation” S.Rep. 85-1981 (1958). As a result, our FWCA recommendations must be given full consideration by federal action agencies.

BOEM is the lead federal agency for offshore wind development activities and, as such, you are responsible for consulting with us under the MSA, the FWCA, and the Endangered Species Act (ESA). However, we also recognize the U.S. Army Corps of Engineers’ (USACE) jurisdiction and responsibilities under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act. We understand that our comments and recommendations related to activities proposed in nearshore waters (inside 3 miles), will be considered by the USACE as part of their regulatory review, including their obligation to ensure that the proposed actions adhere to the Clean Water Act Section 404 (b)(1) Guidelines. Further, the USACE will use BOEM’s EFH assessment to fulfill their regulatory responsibilities and that any appropriate EFH and FWCA recommendations we make to BOEM as part of the MSA and FWCA consultations will be considered for incorporation as special conditions to any Department of the Army permit issued by the USACE for the proposed activity and that it will be USACE's responsibility to respond to any EFH conservation recommendations issued for actions under their jurisdiction.

EFH Conservation Recommendations
In order to avoid, minimize, and offset significant impacts to EFH and Habitat Areas of Particular Concern (HAPCs) as result of the proposed project, pursuant to Section 305(b)(4)(A) of the MSA, we recommend that you adopt the following EFH conservation recommendations (CRs).

Recommendations to Minimize Adverse Impacts to Atlantic cod spawning

1. To minimize adverse effects to Atlantic cod spawning aggregations in and adjacent to the project area, and to reduce the risk of adverse population level effects to this species:
    a. No pile driving activities in the lease area should occur between November 1 and March 31 of each year.
    b. No seafloor disturbing activities should occur between November 1 and March 31 of each year, within the Revolution Wind lease area and along the export cable route (RWEC-OCS) located from KP 45 to KP 56 (mile 28 to 35) which includes the locations where use of the boulder plow is currently proposed.
    c. No removal or detonation of unexploded ordinances (UXOs) should occur between November 1 and March 31, of each year.
    d. No HRG sub-bottom profiling (e.g. sparkers, boomers) survey activities should occur between November 1 and March 31, of each year, within the Revolution Wind lease area. This recommendation supersedes the October 2017 EFH consultation on the Site Assessment Plan (SAP) due to new information related to cod spawning activity in the project area.

2. To minimize impacts to Atlantic cod sensitive life stages and complex habitats on Cox Ledge:
    a. No more than the minimum number of turbines required to meet the power purchase agreement should be permitted.
    b. The largest size turbines considered in the COP (12MW) should be used to further reduce the number of turbines required for a viable project.
    c. Avoid UXO detonation on and adjacent to Cox Ledge to avoid adverse impacts to complex habitats and other sensitive marine resources.

3. To minimize adverse impacts to Atlantic cod spawning habitats:
    a. Remove the following nine (9) WTGs locations and associated inter array cables to minimize overlap with Atlantic cod spawning habitat: B36, B37, B38, B39, B44, B45, B46, B49, and B50. Turbines are numbered based on WTG labels identified in the Inspire habitat data pop-up viewer.
    b. Re-route the OSS-link cable connecting the two offshore substations (OSSs) to avoid crossing directly through Atlantic cod spawning and complex habitat. Specifically, the OSS-link should be routed north and east around the area of complex habitat and extend north and west outside of the lease area (and north of the spawning location) to connect to the other OSS station at the northern end of the lease.

4. Continue the on-going telemetry and passive acoustic survey within the lease area and expand the existing study beyond the lease area boundaries to identify the full scope of the area affected by project construction and operation and to assess individual, synergistic, and cumulative effects of the project on cod spawning activity pre-, during, and post construction.
    a. Provide continuous monitoring of Atlantic cod spawning aggregations between November 1 and April 30 prior to the construction of the project, during project construction, and post construction.
    b. Place additional receivers in pending turbine locations. Once constructed, additional receivers should be added to the turbines to increase coverage.
    c. Add an additional glider to the ongoing survey to increase the spatial coverage of the Revolution Wind project area. The ongoing survey should focus on increasing survey coverage (i.e. increase the number of glider tracts) within the project area to provide better resolution and detection of cod spawning activity within the project area before, during, and after construction.
    d. Add a third glider to expand the survey coverage outside the lease area to assess synergistic and cumulative effects of the project on the distribution of cod spawning activity.
    e. Data and results from this study should be made available to NMFS Habitat and Ecosystem Services Division (HESD).

Recommendations to Minimize Impacts to Benthic Habitats

5. To minimize adverse impacts in complex habitats on Cox Ledge:
    a. In addition to the nine (9) turbines that overlap with cod spawning habitat, remove the following five (5) WTG and associated inter array cables to minimize impacts to complex habitats: B48, B52, B53, B61, and B62. Turbines are numbered based on WTG labels identified in the Inspire habitat data pop-up viewer.
    b. Removal of additional turbines beyond the 14 identified above should be selected based on the following criteria (1) adjacent to the areas already planned for removal to reduce habitat fragmentation, (2) located within complex habitats and impacts cannot be minimized through micrositing and (3) impacts to complex habitats from inter array cable connecting the turbines would be reduced. The following turbines and associated cables are consistent with these criteria and should be considered for removal: B42, B43, B54, B55, B69, and B70. Turbines are numbered based on WTG labels identified in the Inspire habitat data pop-up viewer.

6. Microsite WTGs, inter array cables and export cables (both RWEC-OCS and RWEC-RI) to avoid complex habitats.
    a. For any WTGs located within complex habitats that are not removed, the WTGs should be microsited outside identified complex habitats, including large boulders/habitat elements (i.e., >/= 0.5 m in diameter) and into low multibeam backscatter return areas.
    b. Inter-array, and export cables should be microsited to minimize impacts to complex areas and/or areas of high habitat heterogeneity (diversity of structural

elements, including bathymetric features) and complexity. Cables should be microsited around all identified complex habitats, including large boulders/habitat elements (i.e., >/= 0.5 m in diameter) and into low multibeam backscatter return areas.

c. Cables should be sited to avoid unexploded ordinances (UXOs) and the relocation or detonation of any UXOs.

d. A WTG, inter-array and export cable (included RWEC-OCS and RWEC-RI) micrositing plan should be developed to demonstrate how long-term to permanent adverse impacts to complex habitats and benthic features will be avoided and minimized within the lease area.

   i. At a minimum, the micrositing plan should include: 1) depictions of the microsited WTGs and cables (i.e., include a figure depicting large boulder locations, multibeam backscatter returns, and the proposed microsited cable); 2) information describing how the microsited locations were selected (i.e., what information other than multibeam backscatter and boulder locations was used to determine the cable path); and 3) for any cables that are identified to be infeasible to be fully microsited around complex habitats and within low multibeam backscatter areas, detailed information supporting the feasibility issues encountered, calculated impact areas of large boulders and/or medium to high multibeam backscatter area, and impact minimization measures to be used should be provided.

   ii. The final micrositing plan should be submitted to NMFS HESD prior to commencement of any in-water work. A copy of a redline-version of the draft plan that addresses any comments or questions submitted by BOEM (or other commenters) should also be provided to NMFS along with the final plan.

7. Re-route the current export cable alignment at the exit of the lease area to avoid impacts to complex habitats. The cable corridor should be rerouted to avoid the area of highly complex habitats where the use of a boulder plow is currently proposed (located between KP 45 to KP 56). The habitat data demonstrates that within this area of the project, complex habitats are patchy and soft bottom habitats are found in adjacent areas. The export cable should exit the lease area (referred to as Zone 4 in the EFH assessment) further north to avoid complex habitats and dense fields of large boulders >0.5 m.

8. To minimize impacts from boulder/cobble removal/relocation activities, relocate boulders and cobbles as close to the impact area as practicable, in areas immediately adjacent to existing similar complex bottom, placed in a manner that does not hinder navigation or impede commercial fishing, and avoids impacts to existing complex habitats. In order to minimize impacts to complex habitats, boulders that will be relocated using boulder "pick" methods should be relocated outside the area necessary to clear and placed along the edge of existing complex habitats such that the placement of the relocated boulders will result in a marginal expansion of complex habitats into soft-bottom habitats (i.e., boulders should be placed outside the relocation area and in an area of low multibeam backscatter return immediately adjacent to medium or high return areas) and reduce risk to navigation and fishing operations in the area.

a. A boulder relocation plan should be developed that identifies where boulders will be removed from and where they will be placed. Resource agencies and the fishing industry should be consulted in preparation of the boulder relocation plan. The plan should identify all areas where a boulder plow will be used during site-preparation. At a minimum, the plan should include: 1) a clear depiction (i.e., figures) of the location of boulder relocation activities specified by activity type (e.g., pick or plow, removal or placement) and overlaid on multibeam acoustic backscatter data; 2) a detailed methodology for each type of boulder relocation activity and technical feasibility constraints; 3) any proposed measures to minimize impacts to attached epifaunal assemblages on boulder surfaces; 4) measures taken to avoid further adverse impacts to complex habitat and fishing operations; and 5) a summary of any consultation with resources agencies and the fishing industry in development of the plan.
b. The final, BOEM approved pre-construction boulder relocation plan should be submitted to NMFS HESD prior to commencement of any in-water work. A copy of a redline-version of the draft plan that addresses any comments or questions submitted by BOEM (or other commenters) should also be provided to NMFS HESD along with the final plan.
c. In all offshore/nearshore areas where seafloor preparation activities include the use of boulder plows, boulder picks, jets, grapnel runs or similar methods used, post-construction acoustic surveys (e.g. multibeam backscatter and side scan sonar) capable of detecting bathymetry changes of 0.5 feet (ft.) or less, should be completed to demonstrate how the benthos were modified by seabed preparation activities and project construction.
    i. In areas where boulder plows are used and the berm height exceeds three ft. above the existing grade, the created berm should be restored to match that of the existing grade/pre-construction conditions.
d. Data should be provided to NMFS HESD in an online viewer with pre-construction and post-construction survey data. As-built post-construction information should also be provided, including information on how, if at all, the final boulder placement differs from the boulder relocation plan and why such changes were necessary.

9. Avoid anchoring in complex habitats and areas of high habitat heterogeneity and complexity during all phases of the project including any area where large boulders (>/= 0.5 m in diameter) or medium to high multibeam backscatter returns occur.
    a. If anchoring is necessary in complex habitats and areas of high habitat heterogeneity, extend the anchor lines to the extent practicable to minimize the number of times the anchors must be raised and lowered to reduce the amount of habitat disturbance.
    b. Jack-up barge locations should avoid complex habitats for WTG construction and maintenance. Where full avoidance is not feasible, the proposed locations for the jack-up barge should be selected to avoid, and in order of priority:
        i. Complex habitats with high density large boulders;
        ii. Complex habitats with medium density large boulders;
        iii. Complex habitats with low density large boulders;

iv. Complex habitats with scattered large boulders;
v. Complex habitats with no large boulders.

c. For any area where large boulders or medium to high multibeam backscatter returns occur and vessels must remain stationary, dynamic positioning systems (DPS) or mid-line buoys on anchor chains should be required.
d. An anchoring plan should be developed to demonstrate how anchoring will be avoided and minimized in these habitats during all phases of the project and in both state and federal waters. At a minimum, the anchoring plan to be developed should include: 1) depictions of the lease and export cable areas that clearly identify areas, using GPS location coordinates, where large boulders and/or medium to high backscatter returns occur, and either: a) DPS, or b) mid-lines buoys are required for anchoring; 2) information describing the operations and number of vessels that will be necessary to maintain vessel position using DPS or mid-line buoys within complex areas (i.e., large boulder and medium to high multibeam backscatter areas); and 3) for any complex habitat area that is identified for it to be infeasible to be fully avoid anchoring within or using mid-line buoys, detailed information supporting the feasibility issues encountered, calculated impact areas of large boulders and/or medium to high multibeam backscatter area, and impact minimization measures to be used should be provided.
    i. A copy of the anchoring plan, with complex habitat coordinates, should be provided to all vessel operators.
    ii. The final anchoring plan should be submitted to NMFS HESD prior to commencement of any in-water work. A copy of a redline-version of the draft plan that addresses any comments or questions submitted by BOEM (or other commenters) should also be provided to NMFS along with the final plan.
    iii. Data should be provided to NMFS in an online viewer with pre-construction and post-construction survey data. As-built post-construction information should also be provided, including information on how, if at all, the final anchoring differed from the anchoring plan and why such changes were necessary.

10. To minimize permanent adverse impacts to existing habitats from scour protection:
    a. Avoid and minimize the use of scour protection by micrositing cables (inter-array cables, RWEC-OCS and RWEC-RI) to allow for full penetration/burial, regardless of habitat type (this can be done by siting cables in appropriate substrates)
        i. Additional bottom surveys (e.g. sub-bottom cores) should be conducted, as necessary, to inform the micrositing of the cable and reduce the extent of soft bottom habitat conversion via placement of scour protection.
        ii. Should scour protection be necessary, the minimum amount of scour protection should be used to accomplish the purpose/intent of the scour protection.
    b. Use natural, rounded stone of consistent grain size in the entirety of any areas with complex habitat to match existing conditions.

c. Avoid the use/placement of engineered stone (e.g., riprap; cut, crushed, or graded stone; etc.) or concrete mattresses within complex habitats (i.e., areas with boulders >/= 0.5m, and/or medium to high multibeam backscatter returns).
    i. As determined through the technical feasibility analysis, if the use of engineered stone or concrete mattresses cannot be avoided in these areas, the impact should be mitigated through the addition of a natural, rounded stone veneer. At a minimum, any exposed surface layer should be designed and selected to provide three-dimensional structural complexity that creates a diversity of crevice sizes (e.g., mixed stone sizes, natural rounded stone veneer) and rounded edges (e.g., tumbled stone, or natural round stone veneer), and be sloped such that outer edges match the natural grade of the seafloor.

d. Avoid the use of plastics/recycled polyesters/net material (i.e. rock-filled mesh bags, fronded mattresses)

e. Develop a scour and cable protection plan for all habitat areas. At a minimum, the plan should include: 1) a clear depiction of the location and extent of proposed scour or cable protection within complex habitat (i.e., figures displaying existing areas with large boulders and/or medium to high multibeam backscatter returns and the extent of scour or cable protection proposed within each area); 2) all available habitat information for each identified area (e.g., plan view imagery, video transects); and 3) detailed information on the proposed scour or cable protection materials for each area and habitat type;

f. The final scour and cable protection plan should be submitted to NMDS HESD prior commencement of any in-water work. A copy of a redline-version of the draft plan that addresses any comments or questions submitted by BOEM (or other commenters) should also be provided to NMFS HESD along with the final plan.

Recommendations to minimize acoustic impacts from pile driving

11. Require the use of noise mitigating measures during pile driving construction, including the use of soft start procedures and the deployment of noise dampening equipment such as bubble curtains.
    a. A plan outlining the noise mitigation procedures for both offshore and inshore activities should be filed with BOEM and the USACE for approval before construction commences. BOEM should provide NMFS HESD with a copy of the final plan before in-water work begins. A copy of a redline-version of the draft plan that addresses any comments or questions submitted by BOEM (or other commenters) should also be provided to NMFS HESD along with the final plan.
    b. The noise mitigation plan should include a process for notifying NMFS HESD within 24 hours if any evidence of a fish kill during construction activity is observed, and contingency plans to resolve issues.
    c. The noise mitigation plan should include passive acoustic sound verification monitoring during pile driving activities. Additional noise dampening technology should be applied should real-time monitoring indicate noise levels exceed the modeled 10 decibel attenuation levels.

   d. Acoustic monitoring reports that include any/all noise-related monitoring should be provided to NMFS HESD.

Recommendations to minimize impacts to Narragansett Bay

12. Use a land based cable corridor for routing the RWEC-RI to shore to avoid impacts to Narragansett Bay.
    a. Should the cable be routed through Narragansett Bay, the cable should be routed along the western side of the proposed cable corridor to minimize impacts to juvenile cod HAPC and complex bottom located along the eastern edge of the proposed cable corridor and consistent with EFH CR #6.
    b. Habitat maps depicting the bottom type, including complex rocky habitats (boulder density), adjacent sandy areas, and SAV should be provided to vessels/captains to ensure HAPCs are avoided. Do not use the delineations of juvenile cod HAPC provided in the EFH assessment, as they are inconsistent with the HAPC definition and do not represent all HAPC in Narragansett Bay.

13. To minimize impacts to SAV in Narragansett Bay the following should be required:
    a. Avoid cable installation, dredging, or other construction activities in SAV.
    b. Barges should not be moored in SAV or SAV habitat.
    c. Avoid unconfined dredging and maintain a minimum 100 ft. buffer between the edge of any SAV beds and any equipment staging or anchoring activities.
    d. Maps derived from updated surveys should be provided to us as well as vessels/captains to ensure SAV is avoided.
    e. Pre- and post-construction monitoring of the SAV bed in the project area should be conducted. Updated pre-construction surveys should be conducted to ensure the SAV bed is accurately delineated prior to construction. Post construction surveys should be conducted to determine if any unanticipated impacts occurred as the result of project construction.
    f. Should the project unintentionally impact SAV through frac-out, mooring in the SAV bed, or other direct or indirect effects from construction of the project, compensatory mitigation should be provided for all areas of SAV impacted by construction activities including cable installation and dredging at a minimum ratio of 3:1.
        i. A compensatory mitigation plan that satisfies each element of a complete compensatory mitigation plan as identified in the published regulations 33 CFR Parts 325 and 332 "Compensatory Mitigation for Losses of Aquatic Resources," (Mitigation Rule) and NOAA's Mitigation Policy for Trust Resources should be required for any impacts to SAV. This plan should be included as a special condition of the permit.

14. Avoid in-water work including cable installation, seabed preparation, pile driving, HDD pit excavation, or other extractive or turbidity/sediment-generating activities from February 1 to June 30 of any given year in the nearshore waters to depths of 5 meters (m) to avoid impacts to winter flounder early life stages (eggs, larvae).

15. To minimize impacts to estuarine habitats associated with excavation of the HDD exit pits for the sea-to-shore transition, the following should be required:
    a. Unconfined dredging should not be permitted
    b. Dredged materials from HDD exit pits should be stored on a barge and used to backfill the excavated areas once construction and installation is complete.
    c. Detailed frac-out plans should be developed for all areas where HDD is proposed to be used. A copy of the final plan should be provided to NMFS HESD prior to construction.

16. To minimize impacts from vessel operation in Narragansett Bay:
    a. All vessels should float at all stages of the tide.
    b. All vessels should be required to follow EFH CR 9 and CR 13 to avoid anchoring in rocky and vegetated habitats.

17. To minimize impacts to shellfish from construction activities in Narragansett Bay:
    a. Avoid seafloor disturbance activities including cable installation, dredging, or other construction activities from May 1 to October 14 of any given year.
    b. A shellfish survey should be conducted prior to the commencement of dredging at the HDD exit pits to identify high densities of shellfish.
        i. Shellfish beds that are identified should be relocated in coordination with RI DEM prior to commencement of in-water work.
    c. The cable should be microsited around areas of high density shellfish beds.

18. Avoid in-water work from February 15 to June 30 of any given year to avoid impacts to anadromous fish during the upstream in-migration to their spawning grounds.

Recommendations to address uncertainties and minimize impacts from project operation

19. Revise the Benthic Habitat Monitoring Plan to address agency concerns related to the adequacy of the proposed methods to detect changes in the existing benthic community structure of Cox Ledge, the offshore, and inshore project areas. The plan should be required to address potential changes to macrobenthic communities across and within each habitat type in the project area, including the artificial substrates to be constructed.
    a. The plan should include pre-construction/baseline monitoring data, which should be collected for a minimum of three years for each survey conducted.
    b. The plan should include post-construction monitoring of the existing, natural soft and hard bottom benthic community structure within the lease area and export cable corridor, post-construction benthic community development, and invasive species (e.g., *Didemnum vexillum*) growth on: 1) constructed habitats, 2) natural habitats within the expected area of project impacts, and 3) within adjacent areas outside the area of impact.
    c. Post-construction multibeam backscatter and side scan survey results should be conducted and included as a component of the benthic monitoring plan.
    d. The monitoring plan should also include measures to evaluate: 1) physical changes to the benthic habitat from construction and boulder relocation, including changes in depth, rugosity, and slope through the collection of acoustic data (multibeam bathymetry and backscatter and side scan sonar), 2) biological

changes to benthic community structure with distance from the area of impact, including areas impacted by boulder removal, cables, scour protection, and WTGs and 3) invasive species distribution and abundance with associated plans for removing/managing invasives.

    i. The applicant should consult with the resource agencies in the revision and refinement of this plan and give the resource agencies a minimum of 90 days to review and comment on the plan. The applicant should submit a final plan to BOEM that addresses, and includes, all resource agency comments, as well as the applicant's response to those comments. A copy of the final monitoring plan should be provided to NMFS HESD prior commencement of any in-water work.

e. All data and metadata should be made available to NMFS HESD.

20. Require the development of an *in situ* project specific monitoring program to address uncertainties related to impacts of the operation of the Revolution Wind project on EFH and federally managed species. This monitoring recommendation is consistent with principles outlined in NOAA's Mitigation Policy for Trust Resources which highlights the use of the best available scientific information, such as results of surveys and other data collection efforts when existing information is not sufficient for the evaluation of proposed actions and mitigation, or when additional information would facilitate more effective or efficient mitigation recommendations. The project specific monitoring program should measure *in situ* the stressors created by project operation on the ecosystem from operational noise, electromagnetic fields (EMF), wind wake effects, and the presence of structures. Studies should also evaluate the biological effects of those stressors on commercially important species in the project area such as Atlantic cod, monkfish and ocean quahog. Monitoring plans should include the collection of baseline data and be provided to NMFS GARFO and NEFSC for review and comment within 90 days of ROD issuance. A response to NMFS comments should be provided. These monitoring studies should be developed in partnership with NMFS and other scientific institutions to aid in addressing the following questions:
    a. How far do effects on sound pressure, particle motion, and substrate vibration extend from the individual WTGs and the Revolution Wind Farm collectively?
        i. What effect do these operational noise effects have on the distribution of larvae for species with designated EFH in the project area and prey for these species (i.e. sand lance)?
    b. What is the spatial distribution of the EMF emissions around inter-array, OSS-link and export cables (RWEC-OCS and RWEC-RI)?
        i. What is the behavioral response to the altered EMF of fisheries resource species/life stages with known EMF-sensitivity?
    c. How far does the marine and atmospheric wind wake extend from the Revolution Wind Farm during operation?
        i. What are the effects on physical water column properties, primary and secondary production, and larval dispersal for species with designated EFH in the project area?
    d. What is the distribution, abundance, survival, growth rate, and recruitment rate of cod larvae along a distance gradient from offshore wind structures?

21. Require the implementation of preventive measures to reduce the risk of contaminant emissions or accidental release of chemicals. Such measures may include backup systems, secondary containments, closed loop systems, and/or recovery tanks.
    a. To reduce the contaminants in the water column Al anodes should be used for the turbine rather than Zn anodes.

Project Decommissioning

22. The EFH consultation should be reinitiated prior to decommissioning turbines to ensure that the impact to EFH as a result of the decommissioning activities have been fully evaluated and minimized to the extent practicable. Pre-consultation coordination related to decommissioning should occur at least five years prior to proposed decommissioning.

We note that EFH CRs 6, 8-19, 20b, and 22 overlap with USACE jurisdiction, and therefore are also likely relevant to their process. In order to provide clarity and improve coordination and efficiency for the EFH process, we request that BOEM and USACE coordinate on the CRs for this project and respond to NMFS with a joint letter indicating how each CR will be treated by each respective agency. Where a CR has been accepted, please indicate which permit it will be incorporated into, and specifically where within that permit the requirement can be found. This process will help to ensure all accepted CRs are made enforceable conditions of their respective actions. This process is consistent with Section 305(b)(4)(B) of the MSA, which requires federal action agencies to provide us with a detailed written response to these EFH conservation recommendations, including a description of measures that the agencies 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 federal agencies (i.e. BOEM and USACE) must explain their 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.

Fish and Wildlife Coordination Act Recommendations

The Fish and Wildlife Coordination Act (FWCA) provides authority for our involvement in evaluating impacts to fish and wildlife from proposed federal actions that may affect waters of the United States. The FWCA requires that wildlife conservation be given equal consideration to other features of water resource development programs through planning, development, maintenance and coordination of wildlife conservation and rehabilitation. Our FWCA recommendations must be given full consideration and are as follows:

1. No in-water work should occur between April 1 to June 30 of any calendar year to avoid and minimize potential impacts to horseshoe crabs spawning along the beaches of the Western Passage of Narragansett Bay.

2. To minimize impacts to American lobster and Jonah crab populations, the number of turbine locations and associated inter array cables should be reduced to the greatest extent possible, consistent with EFH CRs 2-3 and 5. Data and survey results from the proposed ventless trap surveys should be provided to NMFS HESD.

3. The project should be required to mitigate the major impacts to NOAA Fisheries scientific surveys consistent with NMFS-BOEM Federal Survey Mitigation Strategy - Northeast U.S. Region. Revolution Wind's plans to mitigate these impacts at the project and regional levels should be provided to NMFS for review and approval prior to BOEM's decision on its acceptance. Mitigation is necessary to ensure that NOAA Fisheries can continue to accurately, precisely, and timely execute our responsibilities to monitor the status and health of trust resources.

4. Locations of relocated boulders, created berms, and scour protection, including cable protection measures (i.e., concrete mattresses) should be provided to NMFS and the public as soon as possible to help inform marine users, including, but not limited to the fishing industry and entities conducting scientific surveys of potential gear obstructions.

Conclusion
We appreciate the opportunity to coordinate with BOEM on the Revolution Wind offshore wind development project. The conservation recommendations we provide in this letter are based on the information provided and will ensure that the adverse effects to EFH and managed species from this project are adequately minimized and compensated. As additional information about the means, methods, and timing of the proposed construction activities is developed by Revolution Wind, including those proposed within Narragansett Bay, we are available to work with BOEM and USACE to refine our conservation recommendations, as appropriate. Should you have any questions regarding these comments or the EFH consultation process, please contact Sue Tuxbury at (978) 281-9176 or susan.tuxbury@noaa.gov. The ESA consultation is ongoing and is expected to be complete by July 21, 2023. Should you have questions related to the ESA Section 7 consultation, please contact Julie Crocker at (978) 281-9480 or julie.crocker@noaa.gov.

Sincerely,

For Louis A. Chiarella
Assistant Regional Administrator
For Habitat and Ecosystem Services

Attachment: Conservation Recommendation Supporting Information

cc: Katherine Segarra, BOEM
Jessica Stromberg, BOEM
Trevis Olivier, BOEM
Brian Hooker, BOEM
Laura Lee Wolfson, BOEM
Whitney Hauer, BOEM
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Jeffrey Willis, RICRMC
Terry Gray, RIDEM
Thomas Nies, NEFMC
Christopher Moore, MAFMC
Robert Beal, ASMFC

Appendix
Revolution Wind Offshore Wind Energy Project
NOAA Fisheries Essential Fish Habitat
Conservation Recommendation Supporting Information

EFH Consultation History

A draft EFH assessment was provided to us on April 25, 2022. This assessment did not include all of the mandatory requirements for a complete EFH assessment pursuant to 50 CFR 600.920(e) and was deemed incomplete. In letters dated June 24, 2022 and September 22, 2022, we outlined the deficiencies in the draft assessment and identified information that needed to be included in a revised assessment to allow the consultation to be initiated. In response, a revised EFH assessment was provided on February 3, 2023 and included new information provided by the developer regarding the technical feasibility of installing wind turbines at selected locations within the lease area. Subsequently, an addendum to the February document was provided on March 23, 2023, including clarifying information related to the proposed action. In sum, the following information was considered in our consultation: the EFH addendum provided on March 23, 2023, the EFH assessment provided on February 3, 2023, the July 30, 2021 Inspire Environmental Benthic Habitat Mapping Report, and the updated Inspire pop-up viewer.

General Comments

The Revolution Wind project is proposed on Cox Ledge, an ecologically sensitive area that provides valuable habitat for a number of federally managed fish species, their prey, and other marine resources. This area provides habitat for feeding, spawning, and development of federally managed species, and supports commercial and recreational fisheries and associated communities. We have outlined the ecological importance of this area in our letters to BOEM dated October 3, 2011, August 2, 2012, and June 1, 2021. Because of its importance as fisheries habitat, we previously recommended Cox Ledge and associated complex habitats be removed from consideration for leasing in our 2011 and 2012 letters. Within Rhode Island State territorial waters, the RWEC corridor traverses through Narragansett Bay which hosts numerous sensitive habitats that provide important ecological functions and supports countless estuarine-dependent species in the region; it is also one the 28 EPA designated estuaries of national importance.

As stated in our letter, the construction, operation, and maintenance of the Revolution Wind Project will result in significant adverse impacts to managed species designated EFH and we have identified a number of EFH conservation recommendations (CRs) to avoid, minimize, or otherwise offset these effects. However, as discussed in our June 24, 2022, letter on the draft EFH assessment for this project, our evaluation of the effects was hampered by the quality of the EFH assessment and your use of the Project Design Envelope (PDE) in which you analyze the maximum impacts that would occur from the range of design parameters. As we have stated previously, this approach is not appropriate for the EFH consultation and is inconsistent with the EFH regulations because it does not allow for a clear description of the proposed action and its site-specific effects on EFH. The description of the proposed action should essentially deconstruct the project into all of its individual components and fully describe what will be constructed or installed, as well as where and by what means, including both temporary and permanent elements. This is inclusive of both potential alternative layouts and various design parameters associated with project activities (e.g., scour protection). For example, if the developer is considering several methods of constructing the entrance pits for the horizontal directionally drilling (HDD) of the RWEC-RI from nearshore area to the uplands landing location in RI, the EFH assessment should have fully evaluated the direct, indirect, individual, and synergistic effects of each potential construction method. Further, the lack of a full and complete description of all of the components of the proposed action, such as the installation of additional meteorological buoys discussed in the COP or plans for dredge material placement has hindered our ability to fully evaluate the effects of the proposed action on NOAA trust resources including federally managed species and their EFH, and to provide more specific EFH conservation recommendations.

In addition, you maintain that the alternative with the greatest area of benthic impact is also the one with the greatest adverse effect to EFH. To clarify, the EFH regulations define the term "adverse effect" and how adverse effects are evaluated in the EFH assessment. In accordance with 50 CFR 600.910(a),

> "Adverse effect" means any impact that reduces quality and/or quantity of EFH. Adverse effects 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. Adverse effects to EFH may result from actions occurring within EFH or outside of EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions."

EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. For the purpose of interpreting the definition of EFH, 50 CFR 600.10 states that "Waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle. As a result, impacts to benthic habitats or the areal extent of the impacts to benthic habitats are only one of the many considerations that are part of an EFH assessment. The assessment should also consider the impacts that each component, including the potential means and methods of the construction of each component, may have on all of the ecosystem components of EFH as described above for each species and lifestage.

Furthermore, the intent of the EFH consultation is to evaluate the direct, indirect, individual and cumulative effects of a particular federal action on EFH and to identify options to avoid, minimize or offset the adverse effects of that action. It is not appropriate to conclude that an impact is minimal just because the area affected is a small percentage of the total project area or a small component of a species' EFH. Despite this, your EFH determination and conclusions suggests that they are minimal because "impacts represent a small percentage of the habitat available within the Lease Area", which appears to be based solely on direct impacts in the benthic footprint of the project, disregarding the other components of impacts to EFH (e.g. oceanographic effects and associated changes in larval distribution). This is of particular concern as the project area includes a variety of habitats, some of which have been designated as HAPCs or contain complex, difficult to replace, and ecologically important habitats where a relatively smaller impact can have a disproportionately large ecological effect. For example, removal of turbines in the northern portion of the lease area will not have the same ecological effect as removing them from areas of complex habitat and cod spawning.

Lastly, because little information is available on the activities associated with the decommissioning of the Revolution Wind Farm and the effects these actions may have on EFH, this consultation does not cover those activities.

EFH Designations in the Project Area

The proposed Revolution Wind Farm project is located on Cox Ledge in the Atlantic Ocean with project elements extending through Rhode Island Sound and into the Narragansett Bay estuary. These areas provide habitat for feeding, spawning, and development of federally managed species, and supports commercial and recreational fisheries and associated communities. The project area is designated as Essential Fish Habitat (EFH) by the New England Fishery Management Council (NEFMC), the Mid-Atlantic Fishery Management Council (MAFMC) and NOAA Fisheries, for multiple federally managed species. These species include Atlantic cod (*Gadus morhua*), summer flounder (*Paralichthys dentatus*), winter flounder (*Pseudopleuronectes americanus*), inshore longfin squid (*Doryteuthis pealeii*), yellowtail flounder (*Limanda ferruginea*), windowpane flounder (*Scophthalmus aquosus*), ocean pout (*Zoarces americanus*), red hake (*Urophycis chuss*), monkfish *(Lophius americanus*), black sea bass (*Centropristis striata*), little skate (*Leucoraja erinacea*), winter skate (*Leucoraja ocellata),* witch flounder (*Glyptocephalus cynoglossus*), Atlantic sea scallop (*Placopecten magellanicus*), Atlantic mackerel (*Scomber scombrus*), Atlantic surfclams (*Spisula solidissima*), albacore (*Thunnus alalunga*), bluefin tuna (*Thunnus thynnus*), skipjack tuna (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacares*). In addition, the coastal tiger shark species (*Galeocerdo cuvier*) and sandbar shark (*Carcharhinus plumbeus*) have EFH designated in within the export cable route and the lease area, as do five pelagic shark species (dusky shark (*Carcharhinus obscurus*), blue shark (*Prionace glauca*), porbeagle (*Lamna nasus*), shortfin mako (*Isurus oxyrinchus*), and common thresher shark (*Alopias vulpinus*).

Some species and life stages may be more vulnerable to effects of the project. In particular, species with benthic life stages as designated EFH may be more vulnerable, particularly those such as Atlantic cod, Atlantic sea scallop, Atlantic surfclam, little skate, longfin inshore squid, ocean quahog, scup (*Stenotomus chrysops*), white hake (*Urophycis tenuis*), red hake, and winter skate. Species that are habitat limited, aggregate to spawn, or have benthic eggs and larvae may be more vulnerable to the effects from the project. Project effects are of particular concern for Atlantic cod, as recent information demonstrates the project area is supporting spawning activity (Van Hoeck et al. 2023) and cod is a species with early life history stages dependent upon complex structured habitats that are vulnerable to project related impacts. The complex habitats used by Atlantic cod and other species, found on Cox Ledge throughout the lease area, are vulnerable to long-term and permanent disturbances or alterations that can impact the physical (e.g., three-dimensional structure, crevices) and biological (e.g. epifauna) components of these habitats that provide complexity. Atlantic sea scallop, Atlantic surfclam, and ocean quahog are also particularly vulnerable due to their benthic existence and limited mobility. Winter flounder, ocean pout, Atlantic wolffish and longfin squid are benthic spawners with demersal eggs, making reproduction for these species particularly vulnerable. Atlantic cod and longfin squid aggregate to spawn and may be more vulnerable to longer term impacts if spawning behavior is disrupted.

Habitat Areas of Particular Concern
The project area overlaps with two designated and one proposed Habitat Areas of Particular Concern (HAPC). HAPCs are a subset of EFH that are especially important ecologically, particularly susceptible to human-induced degradation, vulnerable to developmental stressors, and/or rare. Currently, both summer flounder and juvenile Atlantic cod HAPCs have been designated in the project area. The juvenile Atlantic cod HAPC includes rocky habitats, SAV, and adjacent sand habitats from mean high water to 20 m in depth. The summer flounder HAPC includes all native species of macroalgae, SAV, and freshwater and tidal macrophytes in any size bed, as well as loose aggregations, within adult and juvenile summer flounder EFH. Both of these HAPCs occur within the project area in inshore waters and may be directly or indirectly impacted by construction of the export cable.

On June 30, 2022, the New England Fishery Management Council also approved a new HAPC for cod spawning and complex habitats that overlaps with the Revolution Wind project and includes the entirety of the RI/MA and MA Wind Energy Areas (WEAs), and extends 10 km beyond the WEAs. The HAPC is focused on known and potential cod spawning areas, and complex habitats (as defined in our Fish Habitat Mapping Recommendations). This action was approved based on new and emerging information demonstrating the importance of this area as cod spawning habitat, and to highlight the importance and vulnerability of complex habitat in this area to offshore wind development[1]. Cod spawning activity has been identified within and adjacent to the project area and complex habitats are found throughout the lease area and portions of the export cable corridor.

Rationale for EFH Conservation Recommendations (CRs)

EFH CRs 1- 4: Recommendations to Minimize Adverse Impacts to Atlantic cod spawning
As stated in our EFH determination, the Revolution Wind project poses a high risk of adverse population-level impacts to southern New England Atlantic cod. Large-scale offshore wind development on and adjacent to areas of cod spawning activity and sensitive habitats remains a significant concern for NMFS. Atlantic cod are a species of extraordinary ecological, economic and cultural significance to this region. Populations are in decline and significantly below target levels and the complex habitats used by this and other species are more vulnerable to long-term and permanent impacts from development. Atlantic cod are divided into two stocks for assessment and management purposes, a Georges Bank (GB) and a Gulf of Maine (GOM) stock. The Atlantic cod stock most affected by the project area is the Georges Bank stock, which includes cod found in southern New England waters and those around Cox Ledge. According to a 2021 management track assessment, the Georges Bank cod stock is below the record low biomass observed in 2014 and experiencing an ongoing declining trend. Despite recent emergency management actions and severe reductions in fishery resource allocations, the latest

[1] https://www.nefmc.org/library/southern-new-england-habitat-area-of-particular-concern-hapc-framework

stock assessment for the GOM Atlantic cod stock estimates biomass at five percent of the target for maximum sustainable yield (Northeast Fisheries Science Center. 2022. Management Track Assessments Fall 2021).

Although the cod in southern New England has traditionally been assessed as part of the Georges Bank stock, new information on the stock structure of Atlantic cod in U.S. waters of the northwest Atlantic has identified five separate, but interrelated, spawning sub-populations in the region (Zemeckis et al. 2014a, 2017, McBride and Smedbol 2022). The southernmost sub-population is in southern New England, overlapping with Cox Ledge and the project area. These sub-populations have not yet been designated as separate stocks for management purposes, so there are no population size assessments available for them. There is, however, information indicating that, unlike other spawning components, cod in southern New England have increased in abundance during the last 20 years (Langan et al. 2020). McBride and Smedbol 2022 discuss the importance of genetic diversity in providing resilience of populations to changing environmental conditions. The increase in this sub-population demonstrates southern New England cod may provide an important genetic component for Atlantic cod resilience to climate change. Given the critically depressed state of Atlantic cod stocks and the social, cultural, and economic significance of the species in the region, it is essential to minimize adverse impacts to habitats that can support and increase survivorship of critical life stages for cod in southern New England.

Spawning behaviors necessary for reproductive success make Atlantic cod vulnerable to impacts from offshore wind development. Atlantic cod spawning involves a complex sequence of competition and courtship behaviors that extend over long periods of time, with individual residence time within aggregations spanning several weeks to months (Rowe and Hutchings 2003; Windle and Rose 2007; Zemeckis et al. 2014b). Atlantic cod form discrete aggregations (known as leks) and use acoustic communication during their spawning season with males producing sounds or grunts to attract a mate (Brawn 1961; Finstad and Nordeide 2004; Rowe and Hutchings 2006). Atlantic cod also exhibit high site-fidelity to spawning areas with cod returning to the same general location each year (Robichaud and Rose 2001; Zemeckis et al. 2014b, Dean et al. 2014). Cod spawning behaviors, including their reliance on acoustic communication and high site-fidelity leave them vulnerable to anthropogenic impacts.

Historical information provided in multiple sources has documented Cox Ledge as an important spawning ground for cod (Deese 2005, Zemeckis 2014c, McBride and Smedbol 2022). Results of a recent study demonstrate that Atlantic cod are actively using portions of the project area for spawning. Spawning on Cox Ledge occurs between November and April (McBride and Smedbol 2022; Van Hoeck et al. 2023). Cod in the project area begin spawning in November, with peak grunt and telemetry detections occurring during the daytime from November through January (Van Hoeck et al. 2023). Review of ichthyoplankton data indicates spawning success occurs later in the spawning season, with peak success occurring between January and March (McBride and Smedbol 2022). Such a pattern is consistent with the complex spawning behaviors previously observed with Atlantic cod (Rowe and Hutchings 2003; Zemeckis et al. 2014c; Windle and Rose 2007; Windle 2006). Adult cod that spawn in southern New England are primarily residential, with high rates of site fidelity (Zemeckis 2014b & c, McBride and Smedbol 2022), and are genetically distinct from other spawning groups (Clucas et al. 2019; McBride and Smedbol

2022). These factors increase the vulnerability of this population to impacts resulting from reduced spawning success.

EFH CR 1: Temporal measures to minimize impacts to cod spawning activity

The EFH assessment suggests in-water work including seabed preparations and cable installation may occur in Quarter 1 (Q1) and Q4, and pile driving activity would occur between May and December. Seabed preparation and cable installation require large equipment to clear the seafloor including boulder plows, boulder skids, boulder picks, and multiple grapnel runs throughout the lease area. Pile driving activities are anticipated to require approximately 10,740 pile strikes over approximately 220 minutes per foundation. OSS installation is anticipated to require approximately 11,563 pile strikes over approximately 380 minutes per foundation. BOEM anticipates a maximum installation rate of up to three WTG monopiles or two OSS monopiles per day. Based on modeling results presented in the EFH assessment, the noise generated from this activity would result in impacts to managed species that extends a distance of approximately 4.4-10.7 km from the WTG location. These activities overlap with the timing and occurrence of cod spawning activity in the project area.

Cod spawning aggregations are easily disrupted and disturbances may result in the long term to permanent dispersion of spawning aggregations (Dean et al, 2012). Physical habitat disturbance occurring during spawning may interfere with mating behavior and egg production (Dean et al 2014, Siceloff and Howell 2013). The same is true for acoustic effects, where peer-reviewed science has documented that elevated noise may cause cod to flee, change swim speed and direction, freeze, or seek shelter; and that this behavioral impact can persist well beyond the cessation of the generated noise (Mueller-Blenkle et al. 2010; Engas et al. 1996; Andersson et al. 2017; Stanley et al. 2017; Van der Knapp et al. 2022). Noise-induced stress has been shown to affect reproductive success, particularly for species such as cod, which are bound to specific spawning grounds and have restricted spawning seasons (de Jong et al. 2020). Irregular continuous sounds such as heavy vessel traffic may have the most pronounced effect on stress, masking, and hearing-loss; affecting reproductive success for Atlantic cod that rely on acoustic communication for reproduction (Stanley et al. 2017; de Jong et al. 2020). The best available science indicates that direct, physical disturbances of active cod spawning aggregations, or indirect disturbances (e.g. noise) are likely to hinder reproductive success and result in the dispersion of the aggregation or abandonment of the spawning site entirely.

Based on our review of the EFH assessment, it is unclear when other noise producing activities such as UXO remediation or HRG surveys are expected to occur. The EFH assessment acknowledges that UXO detonation may result in “direct mortality, disturbance of spawning cod aggregations, and damage to complex habitats (including attached fauna and epifauna present that support adult cod)...”; however, there are no mitigation measures proposed to reduce these adverse impacts. The EFH assessment dismisses any impacts from HRG surveys without providing scientific justification despite acknowledging that the “alteration of the ambient noise environment could interfere with communication and alter behavior in ways that could disrupt localized cod spawning aggregations (Dean et al. 2012; Rowe and Hutchings 2006).” While knowledge of impacts to fisheries based resources from HRG surveys conducted for offshore wind activities are limited (Mooney et al. 2020), these surveys include sub-bottom profiling survey activities that use sparkers and boomers that produce lower frequencies (less than 2 kHz) within the hearing range of fish. Further, fishes with hearing specializations such as cod, can hear above 2 kHz. These surveys also require increased vessel traffic and the operation of equipment towed from the vessel. Should these activities occur during the spawning season, spawning activity may be disrupted by increased stress, masking of communication and/or, physical disruption of aggregations that may affect reproductive success (de Jong et al. 2020; Stanley et al. 2017).

The implementation of temporal restrictions on disruptive activities during vulnerable life stages are among the most successful measures for mitigating disturbance to and facilitating recovery of aggregation-spawning fishes during vulnerable periods (Hammer et al. 2014; Erisman et al. 2017; Chollett et al. 2020; Mooney et al. 2020). European studies on offshore wind farm construction have determined that these activities are likely to have "substantial negative impacts" on cod aggregations and result in the dispersal of such aggregations (Rossington et al. 2013; Hammar et al. 2014). Hammer et al. (2014) evaluated the potential effects of wind farm construction on a genetically and ecologically distinct cod population, similar to the southern New England cod population that relies on Cox Ledge for spawning. Both pile driving and cable laying activities were identified as the most impactful project activities, with pile driving identified as the most detrimental for population level effects. The incorporation of time of year restrictions to avoid such effects during spawning seasons was identified as a mitigation measure that would significantly reduce risks to vulnerable cod stocks from high to low (Hammer et al. 2014). Despite this, BOEM is only considering restrictions on pile driving activities from January to April with contingencies for December, which are aimed to protect the North Atlantic right whale. Reliance on the time of year restriction for North Atlantic right whale leaves cod vulnerable, as November and December are important periods for courtship behaviors necessary for reproductive success (Van Hoeck et al. 2023).

The need for a time of year restriction for cod spawning cannot be understated and we are concerned that BOEM has not considered such a restriction as a measure to minimize impacts in the EFH assessment or the EIS. The best available science and consensus of subject matter experts do not support the analysis in the EFH assessment, which suggests construction impacts would be short-term, and that effects of project construction would be a brief disturbance for spawning cod. The EFH assessment cites Morgan et al. (1997) and McQueen et al. (2022) to support this conclusion. Neither study evaluated activities or conditions analogous to those proposed for the Revolution Wind project. Morgan et al. (1997), a Canadian trawl study, looked at the effects of a single otter trawl pass within a large, robust Atlantic cod spawning aggregation (5 km x 25 km in area) and McQueen et al. (2022) evaluated distributional effects (not spawning behavioral effects) resulting from brief seismic air gun exposures periods (intermittent shooting over a period of one week) at distances from cod spawning aggregations ranging from approximately 5 to >40 kilometers (km). The activities proposed for the Revolution Wind project directly overlap with a population that is highly perturbed and sparse in their distribution (Van Hoeck et al. 2023). More importantly, the proposed duration of construction activities that will occur within and adjacent to documented cod spawning activity cannot be classified as brief. Noise from pile driving activities are expected to affect an area over a 10 km radius and occur on a daily basis over a period critical for reproductive success. Additionally, WTG and cable installation requires multiple, consecutive seafloor disturbances with large equipment in overlapping areas. In addition to the installation equipment itself, multiple pre-installation and post-lay operations are required, including seafloor preparation, installation trials, and the installation of scour protection around WTGs and cables where burial target depth is not achievable. Seafloor preparation requires multiple steps, including a pre-lay grapnel run and boulder relocation that may require multiple passes and/or deployment of specialized tools to the seafloor. Further, geophysical surveys would occur throughout the installation, potentially including multibeam echosounder (MBES), side scan sonar, sub-bottom profiler or imager, cable tracking equipment, and/or visual surveys. According to the EFH assessment and the COP, there could be approximately 60 vessels operating in the project area at one time. All of these activities directly overlap with cod spawning activity in portions of the lease area. The suggestion that these activities are analogous to a single trawl pass, or a week-long intermittent seismic air gun survey occurring, at a minimum of, 5 km away from spawning aggregations is unfounded.

BOEM has also questioned the conservation benefit of a time of year restriction to protect Atlantic cod because fishing activity is permitted in this area. This is a concerning argument as the activities proposed for construction and operation of the Revolution Wind project are not analogous to the fishing effort that occurs in this region. Furthermore, there is an established Fisheries Management Council (FMC) process to address fishing effects on fish stocks and habitat. Management decisions made through the FMC process do not negate BOEM’s responsibilities to avoid, minimize and mitigate the adverse effects to EFH resulting from their federal action.

Due to the vulnerability of spawning aggregations to physical disturbance during spawning and their high-site fidelity for spawning sites, we strongly recommend temporal restrictions on benthic and demersal construction activities, including pile driving, bottom disturbing activities, and other noise generating activities during the spawning season to avoid and minimize impacts to this vulnerable population from project construction. Given the current stock status for the species in the region and the extent and duration of activities proposed, there is high risk for significant and unacceptable adverse effects for the population. Reduced recruitment, even during a single year, could have a substantial impact on this population. Recolonization of an extirpated spawning aggregation is unlikely for Atlantic Cod in the region (Van Hoeck et al. 2023, Ames 2004). Thus, we consider it critical that temporal restrictions on construction activities during the peak spawning period (November 1-March 31) be implemented for this project.

Rather than restricting the time of year on project activities, BOEM is suggesting that Revolution Wind would be required to develop an adaptive acoustic monitoring plan for spawning Atlantic cod, including restrictions on project activities if Atlantic cod aggregations indicative of spawning are detected. We consider monitoring important for better understanding project effects; however, we do not consider this proposed approach to be a protective measure for avoiding or minimizing impacts to spawning cod from project construction. First, it is our understanding that this monitoring is proposed for two weeks in October, ahead of the start of the spawning period. It is not realistic to believe that real-time monitoring conducted for two weeks ahead of the spawning season would be capable of detecting any spawning activity that would otherwise occur within the active spawning season. The proposed methodology also relies on the assumption that cod will aggregate and initiate detectable spawning behaviors (e.g.

grunts) while construction is ongoing. Such an assumption is not supported by any available literature; rather the available information on direct disturbances of actively spawning cod is that cod cease spawning and disperse when disturbed (Dean et al. 2012, Morgan et al. 1997). Further, as noted in the results of the recently published acoustic telemetry study conducted in the project area, the lack of detections is not necessarily indicative of a true absence of spawning cod (Van Hoeck et al. 2023). It is unlikely that the proposed monitoring will be capable of successfully detecting cod spawning activity to fully avoid adverse effects and therefore this monitoring should not be conducted in lieu of temporal restrictions during the spawning season.

EFH CRs 2-3: Spatial measures to minimize impacts to Atlantic cod spawning
Atlantic cod have been documented to use multiple habitat types throughout the spawning season, including the use of featureless, soft bottom habitats and adjacent complex, rocky habitats (Ames 1997; Dean et al. 2014; Siceloff and Howell 2013). Similarly, the area of greatest overlap with cod spawning activity in the project area includes a mix of highly complex rocky habitats, gravels and soft bottom. Based on acoustic detections collected on Cox Ledge, the central portion of the lease area covered by WTGs numbers B36, B37, B38, B39, B44, B45, B46, B49, B50 have the greatest overlap with spawning activity. This activity was detected from fixed receivers in 2013 and 2014 as well as fixed receivers and glider surveys between 2019 and 2022. While areas of spawning likely extend beyond these turbines, this area located in the center of the lease has been demonstrated to be an important area for cod spawning (Van Hoeck et al. 2023). Although most of these areas include complex habitats, there is also overlap with softer sediments, which is consistent with what we know about habitat use during spawning activity (Ames 1997; Dean et al. 2014). Our recommendations for WTG and cable removal from this location is based upon both the bounds of the lease area and the limitations of the available data, and considers the positive PAM glider detections within the surveyed areas in addition to the known spawning dynamics and habitat requirements for cod spawning aggregations.

While the strong site fidelity of cod with discrete spawning aggregation locations is well document, there is uncertainty on the mechanisms Atlantic cod use to return to the same spawning site year after year or what habitat features, including the potential for micro-habitat features, are critical to the continued use of a spawning location (Robichaud and Rose 2004, Windle and Rose 2005, Windle 2006, Skjæraasen et al. 2011, Grabowski et al. 2012, Siceloff and Howell 2013). It is unclear how spawning activity will be affected by the permanent alteration of these habitats. Given the current status of the species, we cannot risk losing this important spawning area, as cod may fail to relocate to undisturbed areas (Ames 2004; de Jong et al. 2020; Van Hoeck et al. 2023). Since the purpose of the project can still be met without developing this portion of the lease area, we recommend the overlapping turbines, inter array cable and OSS-link cable be removed and relocated to avoid significant alteration of documented cod spawning areas.

The proposed project would result in long-term to permanent impacts to habitats used for cod spawning. The project as proposed would result in signficant alteration of the substrate, including the estimated relocation of over 6,000 boulders and seabed preparation activities that will result in leveling of the existing substrate, shifting boulders and the creations of berms in addition to the permanent impacts from the presence of WTGs and scour protection. Much of this area includes hard bottom complex habitats that are highly vulnerable to long-term to permanent impacts (Auster and Langton 1999; Bradshaw et al. 2000, Collie et al. 2005; NRC 2002; Tamsett et al. 2010). In addition to the overlap with WTGs and inter array cables, the project proposes to run a high voltage cable connecting the two offshore substations directly through the center of documented spawning activity. Given that much of this area is highly complex, we expect much of this cable will not meet the necessary burial depth and additional scour protection will be required. In addition to permanent impacts to complex habitats, the placement of scour protection in the adjacent softer sediments will result in permanent habitat alteration of soft sediments used for spawning. Operational effects from elevated electromagnetic fields (EMF) and operational noise from development in an area of active cod spawning is also a concern (See sections below for further discussion of EMF and operational noise impacts). We anticipate significant adverse impacts from the construction and operation of the project in this important spawning area on Cox Ledge.

EFH CR 4: Monitoring Project Impacts on cod spawning
The recent, ongoing study on the distribution and use of the Cox Ledge area as an Atlantic cod spawning ground clearly documents spawning activity within the Revolution Wind lease area. However, the spatial and temporal limitations of the survey do not allow for a complete understanding of the full extent and distribution of spawning activity throughout the lease area. The survey was only recently (2019) initiated with a limited number of pre-selected bottom-mounted acoustic receiver locations and along passive acoustic glider paths that overlap with a portion of the project area. While the survey area was extended, inclusive of a larger portion of the Revolution Wind lease area in the 2021/2022 survey season, there is only a single year of data available for review. Atlantic cod grunts and telemetry tags have detection limitations of 10 m and up to 1 km (in ideal conditions), respectively. The autonomous glider is set to a distance of 5 km between paths, allowing for detection of telemetry tags encountered along the glider's path but providing minimal detection capability of cod grunts.

It is important to note that it takes four weeks for the glider to complete a single pass of the surveyed area. This results in temporal disparity in the collection of the glider data across the full survey area. The temporal duration and spatial detection limitations of the glider effectively limit the survey's capability of assessing the full extent of cod spawning activity within the survey area. Despite these limitations, the importance of the central region of this lease area for cod spawning is evident from the multiple telemetry and grunt detections over the course of the survey, and a re-evaluation of previously collected data in the area. However, the current survey is not capable of fully informing the distribution and occurrence of cod spawning activity within the lease area, as well as within the adjacent areas affected by the construction and operation of the project at a resolution sufficient to allow for detecting shifts in spawning activity that may occur as a result of project development and operation. Additional survey effort (i.e., an additional glider, additional bottom-mounted acoustic receivers, telemetry tags and receivers etc.) should be incorporated into the ongoing survey to allow for better spatial and temporal coverage of the entire affected arena including both the lease area and the adjacent areas to document the current extent of cod spawning activity and monitor for changes in spawning activity during and post-construction.

It is necessary to determine the full extent and distribution of cod spawning activity in order to understand how the construction and operation of Revolution Wind affects cod spawning and the southern New England cod distinct population. Detections indicative of cod spawning activity are centralized within the Revolution Wind lease area, but also occurred in other portions of the survey area outside of the Revolution Wind lease. Further study is needed to assess the relative importance of the spawning activity within the lease area for the larger southern New England cod spawning population. It will be important to continue the ongoing study to evaluate a larger area within the lease and extend the study beyond the lease boundary within Southern New England to understand the cumulative and synergistic effects to spawning habitat as a result of construction and operation of the project. Additional survey effort should be incorporated into the ongoing survey to assess the full extent of cod spawning activity throughout the RI/MA WEA and to allow for an evaluation of shifts and changes to spawning activity throughout the WEA (e.g., shifts into adjacent areas) that may result from the construction and operation of Revolution Wind.

EFH CRs 2, 5-10, 12: Recommendations to Minimize Impacts to Complex Habitats

The project area is located on Cox Ledge and overlaps with structurally complex habitats, including natural rocky habitats that have been identified throughout most of the project area, and particularly the central and southern portions of the lease area. Cox Ledge is an area with particularly complex and unique habitat conditions that support a wide range of marine resources. The majority of the lease area comprises rocky complex habitats ranging from gravel and cobbles to large boulder fields comprising boulders greater than 5 m in diameter. Rocky complex habitats are also located along the export cable route. These rocky habitats provide three-dimensional structure that plays an important ecological role for fish as shelter and refuge from predators (Auster 1998; Auster and Langton 1999; NRC 2002; Stevenson et al. 2004). The relationship between benthic habitat complexity and demersal fish community diversity has also been positively correlated (Malek et al. 2010). Rocky habitats are inherently complex, where their physical complexity provides crevices for species to seek shelter from predation and flow; these habitats also provide a substrate for macroalgal and epibenthic growth that can increase the functional value of these habitats as refuge for juvenile fish. Multiple managed fish species have life history stages that are dependent on, or mediated by, rocky habitats and their associated attributes (Gotceitas et al. 1995, Lindholm et al. 1999, Auster 2001, Auster 2005, Methratta and Link 2006). The complexity of rocky habitats with, and without, macroalgal and epifaunal cover have been well demonstrated as important habitats for juvenile and adult life history stages of Atlantic cod, Atlantic pollock (*Pollachius virens*), red hake, American lobster, cunner, and tautog. These rocky habitats are particularly sensitive to disturbances that reduce their fundamental complexity, with impacts ranging from long-term to permanent where extended recovery times of biological components are on the order of years to decades (Auster and Langton 1999; Bradshaw et al. 2000, Collie et al. 2005; NRC 2002; Tamsett et al. 2010).

The structurally complex habitats on Cox Ledge and along the cable corridor are particularly important for the survival of newly settled juvenile cod. Multiple studies have demonstrated that while juvenile cod may initially settle to the substrate indiscriminately, age-0+ juveniles are more abundant in complex habitats (e.g., rocky or vegetated habitats) (Cote et al. 2004; Fraser et al. 1996; Gotceitas et al. 1997; Gotceitas and Brown 1993; Grant and Brown 1998; Keats et al. 1987; Lazzari and Stone 2006; Lindholm et al. 2001; Lough et al. 1989). Post settlement survival and densities have been found to be higher in more structurally complex habitats, with cod survival highest on rocky reefs and cobble bottoms (Tupper and Boutilier 1995) with juveniles maintaining a level of residency within that habitat (Grant and Brown 1998). Rocky habitats provide a substrate for epibenthic growth that provides additional complexity and serves as refuge for juvenile fish that has been shown to significantly increase survivorship of juvenile cod (Lindholm et al. 1999 and 2001). As such, these habitats have been designated as a HAPC for juvenile cod. Due to their important role for multiple marine organisms and vulnerability to disturbances, impacts to rocky habitats should be avoided wherever feasible.

EFH CR 2 and 5: WTG removal to reduce impacts to complex habitats in the lease area

The EFH assessment does not fully consider the long-term to permanent impacts of the project and appears to downplay the scale of permanent impacts to Cox Ledge. The effects determination in the EFH assessment does not consider indirect effects from project operation or habitat fragmentation on Cox Ledge, but rather minimizes the ecosystem effects by suggesting only a small percentage of the lease area will be developed. The project developer is proposing full build out of the lease area outside 21 positions that they deemed infeasible for construction due to geotechnical reasons. Even with the removal of those 21 turbines, our review of the data indicates approximately 60% of the remaining turbine locations are located within complex or heterogeneous complex habitats. Permanent impacts of the project to complex habitats on Cox Ledge will largely result from the seabed preparation activities, including boulder clearing and relocation, as well as cable installation and anchoring within complex habitats, and the addition of artificial hard substrate from WTGs and foundation and cable scour protection. This will result in permanent impacts and fragmentation of the sensitive, vulnerable complex habitats on Cox Ledge.

It is possible to reduce development within complex habitats and thus minimize the extent of permanent impacts to Cox Ledge while still meeting the project purpose. The EFH assessment discusses alternatives to the proposed project. Specifically, there are alternatives considered in the EIS to reduce impacts to habitat including a Habitat Impact Minimization Alternative (Alternative C) that focuses on reducing impacts to cod spawning and complex habitats and an Alternative G3, which considers reducing the total number of turbines to 65 WTGs, but is more limited than Alternative C in removal of turbines that overlap with Cox Ledge, instead removing additional turbines in soft bottom areas. Due to the new information that 21 turbine locations are now infeasible due to geotechnical reasons (taking the number from 100 to 79 WTGs), BOEM is suggesting the Habitat Impact Minimization Alternative (Alternative C) is no longer feasible. We disagree that this alternative cannot be considered or implemented despite these issues. The WTGs we recommend for removal to reduce impacts to Atlantic cod spawning and complex habitats would meet the 65 WTGs already contemplated in Alternative G3, but would focus on removing the most critical areas to reduce impacts to the Cox Ledge ecosystem, consistent with the intent of Alternative C. Given the ecological and economic importance of Cox Ledge, we recommend the Habitat Impact Minimization Alternative (Alternative C) be implemented, consistent with our EFH CRs 2-3 and 5.

The habitat data, which was collected after this area was already leased, demonstrates the full extent of sensitive resources in a vital area of southern New England. Should BOEM choose to move forward with COP approval for this project, we recommend limiting any development on Cox Ledge to the maximum extent possible. This should include further reducing the number of WTGs necessary by using larger WTGs, including the 12 MW considered in the design envelope for the project. We consider it critical to take all feasible measures to reduce the size of this project and permanent impacts to this ecologically sensitive area.

EFH CR 6: Micrositing to minimize impacts to complex habitats

In addition to removal of WTG locations and associated cables, further minimization of impacts to high value complex habitats and HAPCs can be achieved by micrositing the turbine positions and cables to outside of the hard bottom complex areas (i.e. outside areas of large boulders and medium to high multibeam backscatter returns). Detailed plans should be developed and provided to NMFS HESD, as outlined in our CRs that demonstrate how WTGs and cables will ultimately be sited to avoid and minimize impacts to complex habitats. These plans should include not just the WTG foundations, but also a plan for siting around complex habitats for the inter-array cable, the OSS-link cable and the export cables from the lease area to the landing site in Narragansett Bay, as complex habitats extend throughout the project area. Micrositing around the identified unexploded ordinances (UXOs) to avoid the need for detonation is also a critical component of this plan for protecting adjacent complex habitats and HAPCs. Based on our review of the habitat data, it is possible to reduce impact by careful siting and that should be required as a stipulation of the BOEM and USACE permits.

EFH CRs 7 and 8: Export cable Re-routing and boulder relocation

Adverse effects to sensitive habitats can also be minimized by re-routing the export cable where it extends through highly complex habitats as it exits the lease area, specifically between KP 45 to KP 56 (mile 28 to 35). The extent of complex habitats in the northern portion of the lease is quite patchy, with areas of concentrated boulders surrounded by extensive areas of soft substrates. It is unclear why this export cable route was selected, as based on the surrounding habitats, it is likely that impacts to complex habitats could be avoided or significantly reduced by moving the export cable slightly north.

A boulder plow is proposed to be used for two 10 km RWEC segments in this area of complex habitat as it exits the lease area. The boulder plow requires a high-bollard pull vessel with a towed plow generally forming an extended V-shaped configuration that displaces any boulders to the extremities of the plow, establishing a cleared corridor. A tracked plow with a front blade similar to a bulldozer may also be used to push boulders away from the corridor, and multiple passes may be required. It is also our understanding that the plow is able to move boulders up to 2 m in size, and surface boulders may be moved ~8-10 m from their original locations. The boulder plow will clear an area in the seabed between 16-20 m wide, with an approximate 1.5 – 2 m deep trench in the middle (for the cable to eventually lay in) and will create two berms on either side. The two outer berms will consist of items from the surface depending on the seabed profile (generally a mix of rocks and sediment), and the two inner berms will consist of spoils from the trench. The inner berm will be used for backfill over the cable after installation by running a backfill pass with the plow; however, the outer berm would remain in place. Based on information provided in the EFH assessment the boulder plow is expected to be the only equipment anticipated to create large berms.

This equipment and associated activity will result in significant permanent impacts to the biological and physical components of complex habitats and may create safety hazards for fishing operations that could otherwise be avoided. While the use of the boulder plow should require restoration of the existing habitat to minimize permanent physical modifications of the seafloor, it is more important to first avoid any areas where such equipment would be necessary. Permanent impacts to EFH along this portion of the cable route could be avoided altogether by routing the export cable outside this area. Based on our review of the EFH assessment, it is clear that all feasible measures to reduce impacts to complex habitats from the export cables have not been considered in the process. We recommend the cable route from the lease area be re-routed north to eliminate the need to use boulder plow equipment and avoid permanent impacts to complex habitats and navigation and safety hazards for fishing operations.

Based on information provided in the EFH assessment, it is our understanding that Revolution Wind anticipates relocation of approximately 6,160 boulders in the project area, with almost 5,000 boulders in the lease area alone. Revolution Wind estimates 80 percent of the IAC, 60 percent of the OSS-link, and 40 percent of the RWEC-OCS and 70 percent of the RWEC-RI routes may require boulder relocation. A boulder grab would be used for relocating boulders as part of seabed preparation in the RWEC, IAC, and OSS-link corridors and around WTG and OSS foundations, relocating boulders approximately 8 to 15 m off the centerline of the route or from the area to be cleared. A WROV boulder skid would be used in conjunction with the boulder grab as a secondary boulder relocation tool and includes a small skid plate approximately 1.5 m wide capable of rolling small (less than 0.7m in diameter) unburied boulders over short distances to the edges of planned working areas (approximately 10-15m on a cable route, or within 10 m of the edge a 100 m radius around foundation work areas). We anticipate the relocation of boulders at this scale will result in a major adverse effect to EFH. These adverse effects could be substantially reduced by following our EFH CRs to avoid development in complex habitat areas; however, we still anticipate boulder relocation will be necessary given the extensive coverage of sensitive complex habitats in the lease area. Placement of boulders into existing complex habitats would further exacerbate the adverse impacts to complex habitats that may have otherwise been avoided by micrositing the project footprint. Additionally, moving large boulders into other habitat types such as soft bottom habitat could result in unnecessary habitat conversion that could render this area unusable for some federally managed species and early life stages, while also creating navigation and safety hazards for the fishing industry. To reduce the effects on complex habitats, we recommend boulders be relocated as close to the impact area as practicable and immediately adjacent to existing boulders, in areas of soft bottom habitats (i.e. into low multibeam backscatter return areas immediately adjacent to medium and high return areas) to minimize further impacts to complex habitats.

According to the EFH assessment, BOEM has committed to requiring a boulder relocation plan. We recommend this plan be developed in consultation with NMFS and the fishing industry to understand and consider risks associated with these actions. We understand additional, unforeseen issues may occur during construction that may affect how boulders are relocated or how the boulder relocation plan is ultimately followed. As such, BOEM should require the collection of post-construction information so the agencies and the public understand how the benthos were modified by the boulder plow, boulder grab and boulder skid equipment, as well as the placement of all relocated boulders. Fine-scale (resolution of 5-10 cm) post-construction multibeam backscatter and side scan sonar surveys should be conducted throughout the lease area and the cable route. That information should be provided to NMFS in an online GIS viewer, with the pre-construction data so we can review before and after changes to the lease area and cable route. The as-built post-construction surveys are necessary for us to understand how construction and operation of the project have modified the benthic environment.

EFH CR 9: Anchoring in complex habitats

Given the long recovery times for complex habitats and associated biological components, measures should be taken to avoid anchoring or spudding within complex habitats to reduce impacts to these high value habitats. Measures exist to help reduce the level of impacts from anchor scars including, extending anchoring lines during cable installation to reduce the number of anchoring points, using mid-line buoys, and careful planning to reduce anchoring in sensitive areas. While we understand anchoring may change due to field conditions, a plan should be developed that outlines measures to be taken to reduce impacts to complex habitats. The anchoring plan as well as habitat data, including multibeam backscatter data should be provided to the vessel operators so that avoidance measures can be taken in real time. Furthermore, it is important to note that the EFH assessment did not address the anchoring of measurement buoys (wave buoys and ADCPs) proposed to be installed within the lease area and inshore project area. As stated above, anchoring adversely affects EFH and all anchoring activities should have been fully described and effects analyzed in the EFH assessment.

EFH CR 10: Scour protection in complex habitats

In addition to construction activities, the operation of the project, including the presence of WTGs and scour protection will result in permanent impacts to Cox Ledge and associated complex habitats, as well as habitats along the export cable route, leading to permanent alteration of the seafloor. The addition of artificial hard substrate to protect turbine foundations and cables in structurally complex rocky habitats will result in a loss of both physical and biological structural complexity provided previously by natural rocky habitats. It is also expected to cause shifts in the community composition of fishes, as they often do not mimic natural rocky habitat. The type and attributes of artificial hard substrates will be an important factor in how fish species may use these artificial substrates. As previously discussed, natural rocky habitats are inherently complex and multiple managed fish species have life history stages that are dependent on, or mediated by, rocky habitats and their intrinsic fine-scale attributes (Gotceitas et al. 1995, Lindholm et al. 1999, Methratta and Link 2006). Rocky habitats also provide a substrate for macroalgal and epibenthic growth that can increase the functional value of these habitats as refuge for juvenile fish. It takes years to decades to establish the epifauna and macroalgae that play an important role in mediating the spatial distribution and success of multiple managed fish species, thus the addition of artificial substrates is not expected to replace the functions and values of natural habitats, particularly for juvenile species.

Epibenthic colonization of installed artificial hard substrates may vary widely based on the structure and composition of the installed substrate. For example, benthic monitoring at the Block Island Wind Farm demonstrated that three years post-construction the installed concrete mattress used as cable protection supported no epifaunal growth, indicating that deployment of these devices would have an overall negative effect on organisms that inhabit natural hard bottom substrates (HDR 2019). Artificial substrates provide novel habitats that can act as a platform for the introduction or expansion of invasive invertebrate species. Further, impacts to the benthic communities of adjacent natural rocky habitats during installation of artificial substrates are expected to be long term, with recovery times of the biological components ranging from years to a decade or more (Auster and Langton 1999; Collie et al. 2005; NRC 2002; Tamsett et al. 2010). The success of placed artificial hard substrate in offsetting losses of natural rocky habitats will be highly dependent on the physical attributes and composition of the novel hard substrate and the fine scale features of the natural rocky habitats that will be lost.

CR 2 and CR 10: Recommendations to Minimize Impacts to Soft Bottom Habitats

In addition to complex habitats, soft bottom habitats present in the project area serve important functions for the fish and invertebrate species that rely on them for refuge, feeding, and reproduction. Sand ripples and sand waves are found in both the lease area and along the export cable route. These habitats can provide structural complexity and are specified as components of EFH for multiple managed fish species. Sand waves (ripples and megaripples) found in sandy, high flow environments provide fish with shelter and opportunities for feeding and migration (Gerstner 1998). In addition to providing flow refugia, sand waves may also play an important role in mediating fish-prey interactions and providing shelter from predation (Auster et al. 2003). Additionally sand and mud habitat types support distinct benthic communities that serve as EFH for managed fish species by directly providing prey and foraging habitat, or through emergent fauna providing increased structural complexity and shelter from predation. Habitat attributes within fine-grained substrates also provide important functions for managed fish species including shelter, foraging, and prey. For example, biogenic depressions, shells, moonsnail egg cases, anemone, and polychaete tubes within mud and sand habitats serve as shelter for red hake (Able and Fahay 1998; Wicklund 1966; Ogren et al. 1968; Stanley 1971; Shepard et al. 1986). Disruptions of these features during sensitive life history stages may result in disproportionate impacts to the species that rely upon their mediating effects. While impacts to soft bottom habitats would affect EFH for multiple managed fish species, soft bottom habitats that do not include stable benthic features (i.e. sand ridges/trough complexes) are expected to recover more quickly from temporary construction activities than other more complex habitats.

Permanent impacts to soft bottom habitats are anticipated from operation of the project, including both habitat loss and changes in benthic communities. The presence of structures and scour protection on the seafloor will result in the permanent elimination of habitat for Atlantic surfclam, ocean quahog, Atlantic sea scallop, longfin squid, sand lances and numerous other invertebrates that provide prey for federally managed species. This will also eliminate habitat for various flatfishes and sand lances that use surficial sediments for refuge (burying) habitat. Changes to benthic communities within soft-sediment habitats would also be expected, resulting from not only direct conversion of soft to hard substrate within the footprint, but also indirect effects to adjacent soft-sediment habitats.

Of particular concern are impacts to sand lances from habitat alteration, as sand lance provide prey for federally- and state-managed fishery species in addition to countless other marine organisms (i.e., seabirds, whales) and have been recently shown to prefer habitat within offshore wind energy areas (Friedland et al. 2023; Mazur et al. 2020). There are two phenotypically similar Northwest Atlantic (NWA) species of sand lance: the American sand lance (*Ammodytes americanus*), which primarily occur in shallow nearshore waters, and the Northern sand lance (*A. dubius*) that favors deeper, offshore waters throughout New England the Mid-Atlantic (Auster and Stewart 1986; Nizinski et al. 1990; Nizinski 2002). The occurrence of NWA

Ammodytes appears to be patchy across temporal and spatial scales, in part due to habitat requirements for coarse-grained sandy bottom substrates that allow them to bury and hide from predators (Nizinski 2002). Fertilized eggs of NWA Ammodytes are demersal and adhesive, making them more vulnerable to project impacts, and are thought to develop on sandy substrates over the course of a two-month period (Smigielski et al. 1984). Larvae live in the water column for the first 3–4 months until they settle into demersal habitats, which historically occurred in May along the Northeast USA (Auster and Stewart 1986; Potter and Lough 1987; Scott 1973). Disruptions from construction and loss of habitat for this species is particularly concerning as NWA Ammodytes are known prey for myriad species in the region, however, their relative importance has not been well understood until recently.

A recent literature review and analysis (Staudinger et al. 2020) using various datasets (e.g., NEFSC trawl survey) determined that dozens of species of fishes and squids, nine marine mammals, and sixteen seabirds were well documented to prey on NWA Ammodytes. Despite the importance of this species as a prey source for managed fish species, the EFH assessment does not provide an analysis of impacts to sand lance. While it is difficult to predict the extent of adverse effects from construction and operation of the project over a 30-year period on this critical prey species, this uncertainty does not mean there are not adverse impacts. Given the significance of this prey species, we recommend BOEM invest in further studies (see EFH CR 20a) to better understand cumulative and ecosystem effects of this crucial prey species and require the applicant to take all practicable measures to reduce project level impacts.

EFH CRs 2 and 10: Reduced project scope and Cable burial

Permanent loss of soft bottom habitats for species that rely on them including sand lance, Atlantic surfclam, ocean quahog, Atlantic sea scallop, and longfin squid could be minimized by reducing the size of the project (EFH CR 2) and thus associated inter array cables and by ensuring full burial of all cables so that additional scour protection is not required (CR 10). The export and inter array cables should be carefully routed and microsited within the cable corridor into soft bottom habitats that allow the cable to reach full burial depth. In addition to avoiding and minimizing complex habitats, the micrositing plan should include a component that focuses on measures for achieving full cable burial in soft bottom habitats to reduce the extent of soft bottom habitat conversion from placement of scour protection.

EFH CRs 2-3, 5-7, and 9-10: Recommendations to minimize impacts from Invasive species

The EFH assessment mentions potential for facilitated establishment or range expansion of invasive species due to artificial reefs, but does not fully evaluate this threat. The number of non-native species on new artificial hard substrate can be 2.5 times higher than on nature substrate, which may provide opportunities for the spread of introduced species (Glasby et al. 2007, Taormina et al. 2018). Some post-construction studies have observed invasive species colonizing on turbines and scour protection rocks (Degraer et al. 2012; De Mesel et al. 2015; Guarinello and Carey 2020; HDR 2020; Lindeboom et al. 2011), using the introduced substrate to expand their range in the area (De Mesel et al. 2015). Fouling assemblages often differ between manmade structures and natural hard bottom habitat, and some evidence suggests these structures can potentially influence biota on adjacent natural hard substrate (Wilhelmsson and Malm 2008). There may be a particular concern for the natural rocky hard bottom habitat to be impacted with the lease area on Cox Ledge.

The invasive tunicate *Didemnum vexillum* (*D. vexillum)* has been expanding its presence in New England waters. Benthic monitoring at the Block Island Wind Farm has shown that this species is part of a diverse faunal community on morainal deposits and is an early colonizer along the edges of anchor scars left in mixed sandy gravel with cobbles and boulders (Guarinello and Carey 2020). Four years after construction at the Block Island Wind Farm, *D. vexillum* was common on WTG structures (HDR 2020). *D. vexillum* is not only an opportunistic species on novel and disturbed substrates, but is also allelopathic, inhibiting larval settlement and growth of other epifaunal species. Studies have shown that activities that cause fragmentation of *D. vexillum colonies* can facilitate its distribution (Lengyel et al. 2009; Morris and Carman 2012). It is important to minimize or eliminate activities that return fragmented colonies of *D. vexillum* to the water column, to reduce the spread of this invasive species (Morris and Carman 2012).

The Revolution Wind project poses a high risk of expanding invasive colonization in the project area, particularly given the extent of proposed seafloor disturbance in complex habitats. While this is not addressed in the EFH assessment, we expect the effects of turbine and cable installation where *D. vexillum* is present could fragment the invasive colonies. The EFH assessment only discusses the risk of invasive spread through vessel bilge waters, which is a significant omission given the high risk of *D. vexillum* expansion from fragmentation. Further, the addition of new artificial substrate used for cable and scour protection and the presence of WTG structures may provide habitat for this invasive tunicate in areas where habitat for this species did not previously occur. Given the risks associated with this project, it will be important to substantially reduce the extent of development and associated disturbances within complex habitats to minimize risk of invasive expansion to natural rocky habitats on Cox Ledge. This should include significantly reducing the size of the project and development within complex habitats, including removal of turbine locations and associated inter-array cables, re-routing the OSS-link and portions of the export cable, and micrositing WTGs and cables outside complex habitats to reduce the risk of invasive species expansion (as recommended in EFH CRs 2-3, and 5-7). Additionally, measures to reduce the extent of anchoring in complex habitats (as recommended in CR 9) will help reduce scarring within complex habitats that could lead to invasive colonization (Guarinello and Carey 2020). Ensuring cables can reach full burial depth, regardless of habitat type (CR 10) will minimize the extent of scour protection, thus reducing the extent of artificial substrate for invasive colonization.

EFH CRs 11: Recommendations for minimizing acoustic impacts from construction

The project will also affect EFH through changes in the acoustic environment, which will occur during all phases of the project. Construction-related acoustic impacts are expected to be greatest with respect to magnitude/intensity and extent, while operational-related acoustic impacts will be greatest with respect to frequency/duration (Hoffmann et al. 2000; Tougaard et al. 2020). Although elevated noise levels will occur during construction from increased vessel traffic, seabed preparation and cable installation, noise generated from pile driving during construction of the WTGs is expected to result in the greatest noise levels and affect a more extensive area of EFH (Taormina et al. 2018). For the Revolution Wind project, pile driving is proposed for the WTGs in the lease area and within Narragansett Bay. Monopile foundations will be installed using a 4,000-kJ hammer in the lease area. At the HDD excavation pit, the project proposes to use vibratory pile driving for cofferdams installation and/or an impact hammer for driving casing pipes. While Revolution Wind will attempt to avoid UXOs, they have identified the potential for detonation of up to 13 UXOs in the project area that could occur within the RWEC and/or the lease area.

High-levels of acoustic exposure have been shown to cause physical damage and/or mortality in fishes. Pile driving and explosives are the only anthropogenic sound sources that have been known to cause fish kills. Fish can experience injury from sound exposure both physically, (i.e., tissue damage) as well as physiologically through increased stress levels (Anderson et al. 2011; Banner and Hyatt 1973; Popper and Hawkins 2018; Popper and Hawkins 2019). Sound exposure can also result in temporary threshold shifts (TTS) or a temporary decrease in or loss of sensitivity (Amoser and Ladich 2003).

Effects of acute and chronic sound exposure may also affect necessary life functions for fish and invertebrates, including health and fitness, foraging efficiency, avoidance of predation, swimming energetics, migration, and reproductive behavior (Hawkins and Popper 2017; Popper and Hawkins 2019; Feist 1992; Nedwell et al. 2003; Popper and Hastings 2009; Samson et al. 2014, Slotte et al. 2004). The behavioral responses from acoustic effects in fish is less understood and may vary by species (Popper and Hawkins 2018; Popper and Hawkins 2019). Behavioral impacts to fish and invertebrates remains a concern, as noise generated through pile driving may affect a much larger area than mortality and injury (Popper and Hawkins 2016; 2019). The Revolution Wind project may affect an area of impact up to 10.7 km per pile for behavior. Behavioral impacts can include startle responses or if capable, fish may leave the area of elevated noise levels (Feist 1992; Nedwell et al. 2003; Popper and Hastings 2009; Samson et al. 2014, Slotte et al. 2004), eliminating the ability of fish species to use the habitat for feeding or reproduction. Migratory routes may also be altered when fish are frightened away from areas. Noise from pile driving activity may also impact sensitive life stages and habitats (Hastings and Popper 2005; Popper and Hasting 2009), including disruption of larval settlement (Popper and Hawkins 2019) and larval development (Nedelec 2015).

There is much less known about acoustic impacts on invertebrates, as there is little information available on how invertebrates detect sound (Popper and Hawkins 2018). However, a study looking at scallop larvae demonstrated that noise exposure may result in malformations in early larval stages, suggesting potential reductions in recruitment from noise exposure (de Soto et al. 2013). Sessile species and sensitive life stages, such as demersal eggs, are expected to be vulnerable to noise emitted through project construction, due to their inability to leave the area. The vibrations at the interface between the sediment and water column can extend several km from the source and potentially impact bottom dwelling species in the project area (Thomsen et al. 2015, Hawkins and Popper 2017, Popper and Hawkins 2019).

EFH CR 14: Minimizing acoustic impacts from construction

There are measures that can be taken to minimize the effects of construction noise on EFH. Avoiding pile driving and UXO detonation during times of the year when sensitive life stages are present (as recommended in CRs 1, 14,17-18), remains the most effective way to minimize impacts to sensitive life stages. Additionally, noise dampening measures may reduce the overall extent of EFH affected by pile driving activities. The EFH assessment indicated the project will be required to use noise dampening methods to reduce noise levels by at least 10 dB, though these methods have not yet been defined. Some noise dampening methods, such as bubble curtains, may be effective in reducing sound pressure emitted from pile driving, but may be less effective in reducing impacts of particle motion (Andrew Gill, pers. comm., Oct 25, 2018, Narragansett, RI). In addition, on-site verification is important; a study in Belgium measuring noise levels from pile driving found that a single bubble curtain proved less effective at mitigating noise effects than predicted (Norro 2018). Some additional measures such as soft start, where noise levels are slowly ramped up to allow animals to evacuate the area, may help reduce the extent of mortality. However, this may not be effective for all species, particularly those that cannot easily move out of the area or for species that either do not exhibit flee response, or may have delayed flee responses. To minimize impacts associated with construction we recommend use of all of these methods, including time of year restrictions, use of bubble curtains and soft start procedures. On-site verification should be used to determine if dampening methods are working as intended.

EFH CRs 11-18: Measures to minimize impacts to Narragansett Bay

Revolution Wind plans to construct and install the RWEC-RI through the West Passage of Narragansett Bay to a western shore landfall location at Quonset Point in North Kingstown, Rhode Island. As we have discussed in our previous letters, Narragansett Bay hosts numerous sensitive habitats that provide important ecological functions and support countless estuarine-dependent species in the region. It is one of 28 US EPA designated estuaries of national importance and one of 30 National Estuarine Research Reserves, designated to protect and study estuarine systems. The RWEC-RI is proposed to be installed through the West Passage of Narragansett Bay, and will result in direct and indirect adversely affects to the estuary, including designated HAPCs for summer flounder (areas of macroalgae and submerged aquatic vegetation) and juvenile cod (rocky habitats, SAV, and adjacent sand habitats from mean high water to 20 m in depth) as well as sensitive life stages for federally managed species and their prey (e.g. anadromous fish species and shellfish) in Narragansett Bay.

Several of the project construction activities will result in the suspension and redeposition of fine-grained sediments, including cable installation, boulder clearing, the placement of scour and cable protection, installation and removal of cofferdams, anchoring, and dredging. Sedimentation impacts vary by habitat type and the depth of deposition, and are more pronounced in estuarine environments. Adverse impacts in soft bottom habitats typically occur as a result of substantial deposition events or burial of demersal eggs. The deposition of fine-grained sediments within rocky habitats may result in adverse impacts ranging from the loss of attached epifauna due to smothering, to inhibiting the settlement of larvae resulting from even small depths of deposition on rock surfaces. Elevated suspended sediments in the water column have been documented to result in adverse impacts to various life stages of fish. High turbidity can impact fish by requiring greater utilization of energy, gill tissue damage and mortality (Newcombe and Jensen 1996; Wilber and Clark 2001). Sedimentation impacts will be most impactful for epibenthic invertebrate species and sensitive life stages of fish, such as demersal eggs (i.e., winter flounder, longfin squid, ocean pout). Demersal eggs are sensitive to sedimentation impacts (Berry et al. 2011; Newcombe and Jensen 1996) and are expected to be impacted by project construction, including cable laying and dredging. Cable installation will also result in 100% mortality of any eggs or larvae (benthic and pelagic) that become entrained in the water intake for the jet plow.

Inshore project construction activities including cable installation, boulder clearing, the placement of scour and cable protection, and anchoring, will also result in permanent habitat elimination or conversion to both structurally complex and soft bottom habitats. According to the EFH addendum, cable protection will be required at seven known locations along the RWEC-RI where the cable crosses buried utilities, as well as at the offshore subsea joints (up to two per cable). Collectively, impacts from RWEC cable protection will directly convert soft-bottom habitat to hard artificial substrate within the footprint of the project and cause habitat loss and changes in benthic communities.

EFH CRs 6, 10 and 12: Cable Routing to Minimize Impacts to Estuarine Environments
Given potential effects from export cable installation and operation, it is important to consider a suitable export cable route that would avoid sensitive estuarine environments, such as Narragansett Bay. Through the NEPA process, we recommended a habitat impact minimization alternative be considered for the export cable route; however, this alternative was not put forward for full evaluation. Similarly, such an alternative route was not evaluated in the EFH assessment. While the COP considers several alternative options through Narragansett Bay, it does not appear a land-based option to avoid the Bay was considered. We continue to recommend Narragansett Bay be avoided through the consideration of a land-based route. The feasibility of such a route should at least be considered to determine if it meets the least environmentally damaging practicable alternative (LEDPA) requirement under the USACE 404(b)(1) guidelines.

Based on that evaluation, should the project continue to move forward as proposed, it will be critical to take all feasible measures to reduce impacts to sensitive and valuable habitats in Narragansett Bay. This includes micrositing the cable to avoid sensitive habitat areas, including HAPCs (as recommended in CRs 6 and 12). Based on the habitat data provided, we expect careful consideration for cable routing will be needed within Rhode Island Sound to minimize impacts on complex habitats and identify a route that can obtain full burial depth through these areas (consistent with EFH CR 6 and 10). Within Narragansett Bay, we recommend the cables be routed along the western edge of the cable route to minimize impacts to HAPC (both rocky habitats within the corridor and SAV beds adjacent to the cable corridor). To do this, it is important to have a clear understanding of the location of the HAPCs that warrant avoidance.

We have concerns about how the juvenile Atlantic cod HAPC was defined and delineated in the EFH assessment. Based on our review of the habitat data, it does not appear that the delineated juvenile inshore cod HAPC in the broader RWEC-RI corridor is consistent with the accurate definition for juvenile cod HAPC. The EFH assessment defined the HAPC as intertidal and benthic structurally complex habitats to a maximum depth of 396 ft. (120 m), including eelgrass, mixed sand and gravel, and rocky habitat. As discussed above, the juvenile Atlantic cod HAPC includes structurally-complex habitats, including SAV, mixed sand and gravel, and rocky habitats (e.g., pebble, cobble, and boulder) with and without attached macroalgae and emergent epifauna from inshore areas between 0 - 20 m (relative to mean high water line). While the habitat data provided in the pop-up viewer and other figures in the EFH assessment identify and delineates structurally complex habitats consistent with the HAPC definitions along the majority of the RWEC-RI, the definition and delineation of the cod HAPC provided in the EFH assessment only incorporate a subset of these delineated areas. Maps depicting habitat types along the RWEC-RI route, including complex and large grain complex habitats and adjacent sands should be provided to vessel operators so that impacts to these important habitats can be minimized.

EFH CR 13: Minimizing impacts to Submerged Aquatic Vegetation (SAV)
SAV habitats are among the most productive ecosystems in the world and perform a number of irreplaceable ecological functions that range from chemical cycling and physical modification of the water column and sediments to providing food and shelter for ecologically and economically important organisms (Kritzer et al. 2016; Lefcheck et al. 2019; Stephan and Bigford 1997). A recent study evaluating over 11,000 comparisons from 160 peer-reviewed studies of structured habitats found that SAV is one of the most productive nearshore-structured nursery habitats; outperforming other structured habitats such as reefs and marshes in fish and invertebrate density and growth (Lefcheck et al. 2019). SAV beds, such as those observed in the project area, can dampen wave energy (Lei and Nepf 2019), reduce current velocities (Fonseca et al. 1982), and facilitate sediment deposition over large spatial scales (Zhang and Nepf 2019). SAV can also improve water quality by assimilating excess dissolved nitrogen and phosphorus and promoting sediment denitrification (McGlathery et al. 2007). In addition to being designated a HAPC for summer flounder and inshore juvenile Atlantic cod, the NEFMC has also highlighted the importance of SAV for winter flounder in the text description of EFH for winter flounder eggs in their Omnibus Habitat Amendment 2 (NEFMC 2016). SAV is also designated as a special aquatic site under Section 404(b)(1) of the federal Clean Water Act because of its important role in the marine ecosystem for nesting, spawning, nursery cover, and forage areas for fish and wildlife.

In many locations along the east coast, eelgrass coverage has declined by fifty percent or more since the 1970's (Thayer et al. 1975, Short et al. 1993, Short and Burdick 1996). Loss of eelgrass is attributed to reduced water quality and clarity resulting from elevated inputs of nutrients or other pollutants such as suspended solids and disturbances such as dredging (Kemp et al. 1983, Short et al. 1993, Short and Burdick 1996, Orth et al. 2006). Eelgrass may also be adversely affected through shading and burial or smothering resulting from turbidity and subsequent sedimentation (Deegan and Buchsbaum 2005, Duarte et al. 2005, Johnson et al. 2008). Given the widespread decline in eelgrass beds along the East Coast, any additional loss to this habitat may significantly affect the resources that depend on these meadows. Successful compensatory mitigation for impacts to SAV can be costly and difficult to implement, making this habitat especially vulnerable to permanent loss.

Inspire Environmental (2021) surveyed benthic habitat conditions within the RWEC-RI to characterize the benthic habitat composition. Along the RWEC-RI, Stations 451 and 453 identified the presence of SAV including benthic macroalgae and filamentous algal beds, respectively. An additional towed video survey was conducted along 52 transect lines near the RWEC-RI landfall and identified eelgrass beds on portions of the nearshore margin of the landfall zone within 820 ft. (250 m) from the nearest HDD exit pit. The Rhode Island Coastal Resources Management Council (RI CRMC) Eelgrass Mapping Task Force 2021 summer field surveys have identified eelgrass beds along the western shores of Conanicut and Dutch Island, and north of Bonnet Point in the West Passage. It is important to note that the EFH assessment failed to acknowledge that portions of the RWEC-RI are in proximity to known SAV beds or analyze potential impacts to these SAV beds. Routing the cable along the western edge of the cable corridor, further from these SAV beds (as recommended in EFH CR 12a), will help minimize the risks of adverse impacts from sedimentation.

The analysis of impacts to eelgrass in the EFH assessment suggests construction impacts would be short-term in duration and unlikely to adversely affect this component of complex habitat. This analysis did not fully consider potential effects from sedimentation or potential for frac out along the HDD route. According to the EFH addendum, uncontained dredging is proposed as a sea-to-shore construction method in which HDD exit pits would be dredged using a backhoe excavator and Venturi eductor device. Sediment modeling evaluated for landfall of the project showed the deposition of sediment exceeding 0.1, 1.0, and 10 mm may extend up to 1,771, 1,377 and 738 ft. from excavation of one exit pit location, respectively. Additionally, TSS plumes exceeding 50 mg/L and 100 mg/L could extend up to 1,460 and 1,312 ft. from the exit pits, which would overlap with the adjacent eelgrass beds. Prohibiting unconfined dredging at the HDD pit location would help minimize the potential risk to the SAV bed.

According to the EFH assessment, it is our understanding that a pre-construction and installation SAV survey will be completed to identify any new or expanded SAV beds and the project design will be refined to avoid impacts to SAV to the greatest extent practicable. Absent an updated SAV survey, we cannot know for certain if impacts can be avoided, therefore both pre- and post-construction monitoring is necessary. Post-construction surveys should be completed to identify any unanticipated impacts to SAV that occurred as a result of project construction. Information from the pre- and post -construction and installation SAV survey should be provided to NMFS HESD in an online GIS viewer so we can review the before and after changes to the sea-to-shore transition and cable route. Should the project unintentionally impact SAV compensatory mitigation should be provided at a minimum ratio of 3:1. We recommend cable installation, dredging, staging equipment, mooring, and other construction activities within and adjacent to SAV beds be avoided and a minimum of, a 100 ft. set-back from the edge of the SAV bed for mooring, anchoring or stage equipment be maintained at all times. Updated habitat maps should also be provided in the form of maps to vessels/captains to ensure SAV is avoided.

EFH CR 14: Minimizing Impacts to Winter Flounder EFH
Winter flounder, a federally managed species with EFH designated in the project area, may be more vulnerable to project impacts, particularly inshore construction associated with dredging, seabed preparation, and cable installation. Winter flounder are known to display high spawning site fidelity (Saila 1961) and typically spawn in the winter and early spring, although the exact timing is temperature dependent and thus varies with latitude (Able and Fahay 1998). Winter flounder have demersal eggs that sink and remain on the bottom until they hatch. After hatching, the larvae are initially planktonic, but following metamorphosis they assume an epibenthic existence. Winter flounder larvae are negatively buoyant (Pereira et al. 1999) and are typically more abundant near the bottom (Able and Fahay 1998). Young-of-the-year flounder tend to burrow in the sand rather than swim away from threats. As a result, both eggs and larvae can be destroyed by dredging and other sediment disturbing activities including cable installation, the placement of scour protection. In addition, laboratory studies examining hatching success found winter flounder eggs are sensitive to sedimentation as delayed hatching occurred when eggs were buried under ≥1 mm of sediment, and few eggs hatched when buried under >3 mm of sediment

(Berry et al. 2011). Increased turbidity and the subsequent deposition of the suspended sediments can smother the winter flounder eggs and adversely affect their EFH.

Winter flounder numbers are at or near historic lows, as stocks have steadily declined since the 1980s. The 2020 Southern New England/Mid-Atlantic management track stock assessment for winter flounder concluded that the stock is overfished and that the spawning stock biomass in 2019 was only 32% of the long-term sustainable biomass target. This stock is not making adequate rebuilding progress due to low productivity. Recruitment (i.e., survival of eggs to the juvenile and adult stages) has been declining despite low fishing mortality rates for the past 10 years. Similar to regional trends, winter flounder was one of the most abundant demersal fish species in Narragansett Bay, however, following the 1980s, the subpopulation has entered a consistent decline to very low levels (Gibson 2013). Therefore, it is important to minimize impacts to spawning success and egg/larval survival to rebuild this stock and achieve a sustainable commercial and recreational fishery for this stock. The area of the proposed project is spawning and nursery habitat for winter flounder. To avoid and minimize impacts to spawning adults, eggs, and larvae of winter flounder, bottom disturbing *and* sedimentation and turbidity-generating activities should be avoided from February 1 to June 30 of any given year in areas that have been designated as EFH for those life stages.

EFH CR 15: Reducing Impacts from HDD Pit Excavation

Construction and installation of the RWEC at the landfall work area would be accomplished with horizontal directional drilling (HDD) via a sea-to-shore transition to bring the two cables that comprise the RWEC onshore. According to the EFH addendum, four sea-to-shore construction methods are proposed with no preferred method identified at this time. The proposed methods include uncontained dredging, a casing pipe installation, and two cofferdam designs (sheet pile or gravity). Our ability to provide specific recommendations on the least impactful method was hindered by the lack of analysis in the EFH assessment. The EFH assessment did not analyze the impacts of these methods, rather focused the analysis on the "maximum impact scenario", for direct benthic impacts only. For example, the EFH assessment identified the gravity based cofferdam as the most impactful due to benthic footprint, and did not consider impacts to other components of EFH. As we have stated in our previous comments, effects to EFH from all parameters and methods considered in the proposed action should be analyzed, consistent with the EFH regulations. BOEM did not adequately evaluate the impacts associated with each method.

According to the EFH addendum, the two HDD exit pits overlap soft bottom habitat composed of mud and sandy mud within nearshore waters. Sedimentation impacts are more pronounced in estuarine environments and impacts will be most impactful for epibenthic invertebrate species and sensitive life stages of fish, such as demersal eggs (i.e., winter flounder, longfin squid) as well as SAV beds found in the project area. Unconfined dredging, identified as one of the four options considered for sea-to-shore transition, is expected to result in the most extensive sedimentation impacts. Should dredging be necessary for excavation of the pits we recommend that unconfined dredging not be permitted within open waters of Narragansett Bay to minimize suspension and redeposition of fine-grained sediment impacts. To further reduce effects from suspension and redeposition of fine-grained sediments we recommend that any excavated materials should not be sidecast or placed in the aquatic environment. Rather all materials should be stored on a barge and subsequently used to backfill the trench to restore the excavated areas. Should HDD methodology further require drilling fluids/contaminants, a detailed frac-out plan should be developed for all areas where HDD is proposed to be used in the event of an inadvertent return event. These plans should be shared with NMFS HESD prior to construction.

EFH CR 16: Minimizing impacts from Vessels

There are measures that can be taken to minimize adverse impacts from vessel activity during construction, installation, operation and maintenance of the inshore project components. Vessel activities can result in direct disturbances to bottom habitats including contact by anchoring or grounding out in sensitive habitats such as SAV beds, shellfish, or complex habitat. During each project phase, we recommend that vessels float at all stages of the tide to avoid and minimize direct and indirect impacts to sensitive habitats in nearshore waters. We further recommend that all vessels avoid anchoring/spudding in rocky and vegetated habitats in the nearshore project area, consistent with EFH CRs for minimizing impacts from anchoring and impacts to SAV.

EFH CR 17: Minimizing impacts to Shellfish

Shellfish such as blue mussel (*Mytilus edulis*), northern quahog (*Mercenaria mercenaria*), soft-shelled clam (*Mya arenaria*), bay scallop (*Argopecten irradians*), and Eastern oyster (*Crassostrea virginica*) provide an important ecological role through water column filtration, sediment stabilization, and supplying habitat for multiple fish species (Zimmerman et al. 1989; Dame and Libes 1993; Coen et al. 1999; Nakamura and Kerciku 2000; Forster and Zettler 2004; Newell 2004; Coen and Grizzle 2007; McDermott et al. 2008). Infaunal species such as shellfish filter significant volumes of water, effectively retaining organic nutrients from the water column (Nakamura and Kerciku 2000; Forster and Zettler 2004). Shellfish are also an important food source for federally managed species such as skates, bluefish (*Pomatomus saltatrix*), summer flounder, windowpane flounder, winter flounder, and scup. Additionally, the siphons of hard clams provide a food source for winter flounder and scup (Steimle et al. 2000).

Shellfish are vulnerable to seafloor disturbances, particularly those that result in elevated levels of suspended sediments, which can interfere with spawning success, feeding, and growth for species such as mussels, clams, and oysters (Wilber and Clarke 2001). Further, sessile species and life history stages are highly vulnerable to smothering and activities that may result in dislodgement of recently settled individuals. Early life stages (eggs and larvae) in the project area are also vulnerable to mortality from entrainment in the water intake used for jet plow cable installation. To avoid and minimize impacts to shellfish, seafloor disturbing activities should be avoided from May 1 through October 14 of any given year. Further minimization of impacts to shellfish can be achieved by micrositing the cable around areas of high density shellfish beds. Prior to the commencement of dredging, we also recommend a shellfish survey be conducted at the HDD exit pits. Shellfish beds identified during the survey and those that cannot be avoided by micrositing should be relocated in coordination with RI DEM prior to the commencement of in-water work.

EFH CR 18: Minimizing Impacts to Anadromous Fish

Nearshore portions of the project area are important habitat for anadromous species such as alewife (*Alosa pseudoharengus*) blueback herring (*Alosa aestivalis*), and American Shad (*Alosa sapidissima*), collectively called “alosines.” These species use estuarine systems, including the

West Passage of Narragansett Bay, to reach freshwater streams and rivers for migrating, spawning, and nursery functions. Alosines have complex lifecycles where individuals spend most of their lives at sea then migrate great distances to return to freshwater rivers to spawn during the late winter and spring. American shad (stocks north of Cape Hatteras, N.C.), alewife, and blueback herring are believed to be repeat spawners, generally returning to their natal rivers to spawn (Collette and Klein-MacPhee 2002; Pess et al. 2014). Anadromous species have been declining in numbers over the last several decades and commercial landings for these species have declined dramatically from historic highs (ASMFC 2018).

Alosines are important forage for several species managed by the New England Fishery Management Council and the Mid-Atlantic Fishery Management Council as they provide trophic linkages between freshwater/estuarine and marine food webs. Because they serve as prey for a number of federally-managed species and are therefore considered a component of EFH pursuant to the MSA. Buckel and Conover (1997) in Fahey et al. (1999) report that diet items of juvenile bluefish include *Alosa* species and juvenile *Alosa* have also been identified as prey for windowpane and summer flounder in Steimle et al. (2000). Actions that reduce the availability of prey species, either through direct harm or capture or through adverse impacts to the prey species' habitat are considered adverse effects on EFH. As a result, activities that adversely affect the spawning success and the quality for the nursery habitat of these anadromous fish can adversely affect the EFH for juvenile windowpane and summer flounder by reducing the availability of prey items.

Anthropogenic-induced elevated levels of turbidity and sedimentation, above background (e.g., natural) levels, can lead to various adverse impacts on anadromous fish and their habitats. Increases in turbidity due to the resuspension of sediments into the water column during activities such as dredging, cable installation and other sediment generating construction activities can degrade water quality, lower dissolved oxygen levels, and potentially release chemical contaminants bound to the fine-grained sediments (Johnson et al. 2008). Dredging is also a common stressor to river herring due to the potential impact of sediment-laden water on gill functioning (German et al. 2023). Suspended sediment can also mask pheromones used by migratory fishes such as these to reach their spawning grounds and impede their migration and can smother immobile benthic organisms and demersal newly-settle juvenile fish (Auld and Schubel 1978; Breitburg 1988; Newcombe and MacDonald 1991; Burton 1993; Nelson and Wheeler 1997). Additionally, other effects from suspended sediments may include lethal and non-lethal damage to body tissues, physiological effects including changes in stress hormones or respiration, or changes in behavior (Kjelland et al. 2015).

Noise from other construction activities, such as driving piles, may also result in adverse effects to various fish species. Our concerns about noise effects come from an increased awareness that high-intensity sounds have the potential to adversely impact aquatic vertebrates (Fletcher and Busnel 1978; Kryter 1985; Popper 2003; Popper et al. 2004). Effects may include lethal and non-lethal damage to body tissues, physiological effects including changes in stress hormones, hearing capabilities, or sensing and navigation abilities, or changes in behavior (Popper et al., 2004). In order to minimize the adverse effects of suspended sediment and underwater noise on migrating anadromous fish, we recommend a time-of-year restriction on in-water work from

February 15 to June 30 any given year during the upstream in-migration of these species to their spawning grounds.

EFH CRs 19 - 21: Recommendations for minimizing operational impacts and addressing uncertainties

Given the scale and scope of development and associated impacts (known, predicted and unknown), there is a tremendous amount of uncertainty regarding the effects of this project and others (individually, cumulatively, and synergistically) along the U.S. Atlantic Coast. However, this uncertainty is not appropriately reflected in the EFH assessment or other project documents (e.g., NEPA documents). It is important to note that uncertainty regarding the nature and scale of the impacts is not equal to having no impacts. The Revolution Wind project will cause disturbances on various spatiotemporal scales that interact with one another and other disturbances such as stochastic events (storms), climate change, ocean acidification and others (Fay et al. 2017; Hare et al. 2016; Wiernicki et al. 2020). Multiple overlapping and interacting disturbances have the potential to cause large, nonlinear, or unexpected changes in ecosystem structure and functioning (Buma 2015). For Revolution Wind, the project area (and habitats, species therein) will be subject to decades of operational impacts from [operational] noise, heat, EMF, chemical contaminants, changes to sediment dynamics, hydrodynamics and other oceanographic and atmospheric processes (e.g., Miles et al. 2021; Tougaard et al. 2020), layered atop multiple years of construction-related impacts from pile driving, cable installation, and other actions, all in a climate-change affected ecosystem. This provides additional support for the need for a precautionary approach to development in the highly productive shelf environment in addition to the development of a monitoring program that evaluates a comprehensive suite of physical, chemical, and biological characteristics.

Changes in community structure from offshore wind

A recent study by Kerchof et al. (2019) suggests that earlier reports on offshore wind turbines as biodiversity hotspots should be considered with caution as these reports generally refer to the typical species-rich second stage of succession reached after a few years of colonization, but disappearing later on. Further, their results underline that artificial hard substrata differ greatly from the species-rich natural hard substrata and hence cannot be considered as an alternative for the quantitatively and qualitatively declining natural hard substrata affected by construction and operation of this project. As discussed in this letter, the introduction of artificial material in otherwise natural hard, rocky habitat may result in shifts in the community composition as this man-made material often does not mimic the same complexity of natural rocky habitat, whose crevices provide shelter from predation and flow, as well as substrate for macroalgal and epibenthic growth. Similarly, introduction of artificial hard substrate in otherwise soft or sandy areas may result in presence or aggregations of species not previously located in the area, which may contribute to shifts in community composition and biogeochemistry of the surrounding sediment and/or water column (Lefaible et al. 2023; Reubens et al. 2013). Improved or diminished habitat suitability at these scales will affect individual fitness, which may influence population-level changes if enough individuals are affected (Degraer et al. 2020). This is particularly concerning given the vulnerability of the Atlantic cod population from construction and operation of this project.

In addition to the anticipated permanent impacts to complex and soft bottom habitats, the addition of novel, artificial substrates from foundations and scour protection will result in permanent impacts in the form of habitat conversion and community structure changes often referred to as "reef effects" (Degraer et al. 2020). Provision or alteration of feeding habitats can affect the tight trophic link between the benthos and many fish species (Mavraki et al. 2020), including federally managed species important to commercial and recreational fisheries. Benthic habitat modification associated with offshore wind structures could have a direct effect on an area up to 250 m away from foundations, but these local (near-field) modifications may also affect adjacent (mid- and far-field) environments (Lefaible et al. 2023; 2018). An increase in local colonizing epifouling communities that develop over time generally results in higher organic matter in sediment closer to turbines; however, the effects on macrobenthic communities appear to be site specific and depend on local-scale factors and the foundation type (Lefaible et al. 2018) as well as the age of the turbine (Causon and Gill 2018). Both the attached organisms on artificial WTG structures and the species attracted to them modify the physico-chemical properties of the surrounding sediments through the deposition of organic material in the form of feces, pseudofeces, and shells (Lefaible et al. 2023; Coates et al. 2014). Further, the local depletion in phytoplankton from the concentrations of sessile filter feeders could affect zooplankton and ichthyoplankton distribution and, in turn, the species that feed on them (Daewel et al. 2022; Maar et al. 2009). The resulting changes in macrobenthic assemblage structure may lead to alterations in the function of the local ecosystem (Degraer et al. 2020; 2019). Given the heterogenous and high value habitats found on Cox Ledge it will be critically important for us to understand local ecosystem changes that occur as a result of the construction and operation of the Revolution Wind project.

It is stated in the EFH assessment that the effects of offshore wind farms and WTGs are likely to produce neutral to beneficial effects on EFH. While the EFH assessment does acknowledge some of the potential adverse impacts of reef effects, the assessment still promotes reef effects as overall beneficial or unharmful to EFH, and adverse impacts are not fully discussed and evaluated. While there are findings that confirm both "positive" and "negative" effects of turbine presence on nearby local macrobenthic communities and fish assemblages, it is important to note that long-term impacts of newly introduced artificial reef material associated with offshore wind farms is still not fully understood. As such, the conclusion of neutral to beneficial impacts to EFH is unfounded.

While the EFH assessment describes how turbines have been shown to serve as fish aggregation devices and attract a variety of demersal and semi-pelagic species through a variety of studies (Petersen and Malm 2006; Reubens et al. 2013; Wilhelmsson et al. 2006; Degraer et al. 2020), the assessment fails to discuss the important ongoing "attraction vs production" debate and the potential adverse effects of fish aggregation. This debate questions whether the higher fish biomass documented at man-made structures results from an attraction to the structure from the background area, or whether the man-made structures facilitate the production of new biomass, through food provision, survivorship, or increased reproduction rates (Pickering and Whitmarsh 1997; Osenberg et al. 2002). Increased fish aggregation around turbines does not necessarily imply net or future population growth for the species (Smith et al. 2016). It remains unknown whether offshore wind structures and associated reefs represent an ecological trap (Hale and

Swearer 2016) for the species they attract, i.e. whether they represent areas of lower fitness compared to other habitat options.

Changes in fish distribution and abundance may depend on the characteristics of the region. A meta-analysis examining fish abundance at offshore wind farms in Europe found several factors were associated with higher finfish abundance inside wind farms, including characteristics of the wind farm, sampling methodology used, and location of the farms. Specifically, abundance was higher for soft bottom species and complex bottom species, but no difference was seen with pelagic species (Methratta and Dardick 2019). Turbine foundations at the Block Island Wind Farm attract large numbers of black sea bass, a common resource species that aggregates around structured benthic habitats to feed and reproduce (HDR 2020). This species is expected to benefit from the addition of WTGs and scour protection. However, black sea bass are known to be voracious predators and it is not clear if or how an increase in this species around the WTG would impact sensitive life stages of other fish species including juveniles, eggs, and larvae. Site specific studies are needed to help understand how changes in fish assemblages in the project area are affecting these sensitive life stages.

Oceanographic and Atmospheric Effects from Offshore Wind

The presence of resources within the project area is driven by pelagic habitats as well as the complex benthic features. Water temperatures in this region are warmer at the surface and cooler at the bottom with strong stratified conditions occurring in the spring and summer. Vertical mixing occurs in the fall, maximizing bottom temperatures, followed by a drop in temperatures and nearly isothermal conditions in the winter (Guida et al. 2017). Coast wide distributions of fish and macroinvertebrates have recently been shown to align with distributional trends in lower trophic levels, in addition to more generally known physical factors such as temperature and depth (Friedland et al. 2019). Species distribution models suggest that these primary and secondary production factors are important features of suitable habitat for managed species that are likely to occur in the project area (Friedland et al. 2023; 2021). Specifically, individual taxa are often associated with environmental variables that affect the pelagic habitat including depth, bottom temperature, chlorophyll and thermal fronts, and the presence of several zooplankton species. Large scale changes in hydrodynamics or vertical mixing could potentially affect the habitat suitability for managed species.

A number of model-based and observational studies have been conducted in recent years to help inform the potential effects offshore wind farms may have on the oceanic and atmospheric environment. At various spatiotemporal scales, documented effects include increased turbulence, changes in sedimentation, reduced water flow, and changes in hydrodynamics, wind fields, stratification, water temperature, nutrient upwelling and primary productivity (Dorrell et al. 2022; van Berkel et al. 2020; Floeter et al. 2017). Effects of the Revolution Wind project on oceanographic processes are expected to range from localized structure-induced changes to much farther ranging effects due to atmospheric wind wake effects.

The primary structure-induced hydrodynamic effects of wind turbine foundations are friction and blocking, which increase turbulence, eddies, sediment erosion, and turbidity in the water column (Dorrell et al. 2022). Monopile foundations were found to increase localized vertical mixing due to the turbulence from the wakes generated from monopiles, which in turn may decrease localized seasonal stratification and affect nutrient cycling on a local basis. The introduction of vertical structures in these well-flushed environments changes local hydrodynamics, which largely determines the sediment composition around the turbines (Lefaible et al. 2019). Using both observational and modeling methods to study impacts of turbines on turbulence, Schultze et al. (2020) found through modeling simulations that turbulent effects remained within the first 100 m of the turbine foundation under a range of stratified conditions. Similarly, a laboratory study measured peak turbulence within one monopile diameter distance from the foundation and that downstream effects (greater than 5% of background) persisted for 8–10 monopile diameters distances from the foundation (Miles et al. 2017). As water moves past wind turbine foundations the foundations generate a turbulent wake causing eddies to form that contribute to a mixing of a stratified water column or may disperse or shift aggregations of organisms, including plankton (Chen et al. 2016; Floeter et al. 2017; Nagel et al. 2018) and create localized elevations in turbidity or sediment plumes (Vanhellemont and Ruddick 2014).

Oceanographic changes from atmospheric wind wake effects have the potential to affect areas on a much larger scale than structure-induced hydrodynamic changes. Studies have examined the wind wakes produced by turbines and the subsequent turbulence and reductions in wind speed, both in the atmosphere and at the ocean surface. Alterations to wind fields and the ocean–atmosphere interface have the potential to modify both atmospheric and hydrodynamic patterns, potentially on large spatial scales up to dozens of miles from the offshore wind facility (Christiansen et al. 2022; Daewel et al. 2022; Gill et al. 2020; Cañadillas et al. 2020). The disturbance of wind speed and wind wakes confer a reduction in sea surface wind stress that changes patterns of oceanographic mixing (Dorrell et al. 2022; Floeter et al. 2022). Oceanic response to an altered wind field is predicted to extend several km around offshore wind facilities and to be strong enough to influence the local pelagic ecosystem (Broström 2008; Floeter et al. 2022; Ludewig 2015). Modeling from the North Sea region has also demonstrated localized changes of +/-10% in primary production with follow on effects for secondary production and trophic interactions (Daewel et al. 2022). The regional impact of wind wakes is challenging to quantify due to natural spatiotemporal variability of wind fields, sea levels, and local ocean surface currents in the northeast shelf (Floeter et al. 2022). The implications of these effects on resources in the project area, specifically larval transport and settlement patterns for commercially important species and distribution of important forage species (i.e. sand lance) remains unknown. Site-specific studies are needed to better understand the wind wake effects from the project and to address uncertainties on the biological response to these stressors in the project area.

The EFH assessment includes an analysis of hydrodynamic changes from the project, but only focuses on the local effects associated with the presence of structures and does not consider the broader effects to EFH from wind wake effects. The conclusions related to the significance for EFH is also unsupported. The EFH assessment discusses the potential for adverse impacts to EFH, but does not identify or describe any measures to minimize or mitigate adverse effects to EFH. Simply stating that other suitable habitat for affected species is present in the area does not qualify and a reduction of impacts of wind wake or hydrodynamic changes. While the EFH assessment acknowledges that “altered circulation patterns could transport pelagic eggs and larvae out of suitable habitat, leading to reduced survival”, it later goes on to suggest, without evidence, that hydrodynamic effects for the project are “unlikely to be biologically significant”.

The EFH assessment relies on the Johnson et al. 2021 paper to make this conclusion. As we have stated in our past correspondence related to the Johnson et al. 2021 study, this study does not represent the best available science on this subject. The potential benefits and risks posed by infrastructure mixing of stratified shelf seas, on top of climate change, represents a combined hazard that has not been fully considered. Project specific studies are needed to understand the oceanographic changes from project operation and evaluate the effects of those changes on the Cox Ledge ecosystem and the species that rely on this area.

Effects from Operational Noise
Operation of offshore wind turbines also results in acoustic emissions through the life of the project (35 years). The ability of fish to detect operating wind turbines may depend on conditions at the project site, including the type and number of turbines, water depth, substrate and wind speed (Wahlberg and Westerberg 2005). Existing studies suggest operational noise may be detectable by some fish species, with species such as cod and herring detecting the noise several km away, which may result in masking of communication for some species that use sound; however, behavioral impacts or avoidance is currently expected to be restricted within close range of the turbines (Thomsen et al. 2008; Tougaard et al. 2008; Wahlberg and Westerberg 2005). As discussed in the EFH assessment, some degree of habituation to these operational noise and particle motion effects is anticipated; however, it is unclear how operational noise emitted from the WTGs would affect cod spawning activity in the project area, as cod rely on acoustic communication during spawning and stress or masking may affect reproductive success (Brawn 1961; Finstad and Nordeide 2004; Rowe and Hutchings 2006; de Jong et al. 2020).

Given the importance of the project area for Atlantic cod, effects on this species, including from operational noise emitted from the Revolution Wind project warrants further study. A recent *in situ* study by Cresci et al. (2023) demonstrates that Atlantic cod larvae were attracted to low-frequency continuous sound (100 Hz) consistent with the intensity range of operation noise from WTGs. The orientation of cod larvae toward the sound source (overriding their normal swimming direction) is likely a response to detecting the low-frequency sound pressure and particle motion produced by the sound projector, just as they detect low-frequency acoustic signatures of suitable settlement habitat that are needed for late-stage larvae and juvenile cod to grow. This suggests that drifting cod larvae may be attracted to WTGs, which has implications for the dispersal and spatial distribution of larvae (Cresci et al. 2023). More precise information is needed on turbine noise emissions, including both sound pressure and particle motion, as well as the biological effects from these emissions (Thomsen et al. 2015; Wahlberg and Westerberg 2005; Roberts and Elliot 2017). Such studies should be done at the project level. We recommend Revolution Wind be required to evaluate the noise emissions from project operation and effects on larval and distribution, including for Atlantic cod, at the project area.

Effects of Electromagnetic Fields
EFH will be altered in the benthos in both soft bottom and complex habitats through the emission of EMF during transmission of the electricity produced during project operation, Revolution Wind is proposing to employ HVAC transmission through the construction of 66-kilovolt (kV) transmission cables for the IAC, and a 275-kV cable for the OSS-link. Approximately 88 linear miles (142 km, 76 nm) of 275-kV offshore export cables are proposed. Cables carrying electric

current produce anomalies within the earth's natural fields which could potentially disrupt the migrations of fishes and other marine animals that rely on magnetic cues for navigation and orientation by either causing the magnetic information detected by the animal to be unreliable or misleading, or disrupt the ability for the animal's magnetoreceptors to function (Engels et al. 2014; Putman et al. 2014; Klimley et al. 2021). Many animal groups in the marine environment can sense and respond to EMF, including elasmobranchs, crustacea, teleosts and chondrosteans (Hutchison et al. 2018; Thomsen et al. 2015; Normandeau et al. 2011). Recent studies have demonstrated effects to swimming performance in some fish larvae, including Atlantic haddock larvae, a species with EFH in the project area (Cresci et al. 2022; Durif et al. 2023). These studies were conducted with magnetic fields similar to DC subsea cables; however, it is unclear how EMF emissions from the proposed HVAC cables will affect larval life stages for gadids in the project area.

While the EFH assessment considers the project use of HVAC transmission as a mitigative measure, and states HVAC transmission produces an EMF frequency that is "generally not detectable by electrosensitive organisms", this is not supported by literature. It is important to note that sensory thresholds and tolerance of EMF emissions have only been identified in specific species and cannot be generalized across related taxa. There is also limited data on how species may respond to HVDC versus HVAC transmission. Despite recent studies on this topic, uncertainties still exist around the impacts of EMF emissions on fish and invertebrates, as information on sensitivity thresholds is limited and the biological significance of species detection on a population scale remains unknown (Boehlert and Gill 2010, Taormina et al. 2018).

Burial depth has been suggested to be the most effective means of minimizing magnetic fields (Ohman et al. 2007). A model developed for existing subsea cables found that the strongest EMF is within the first 2 m (7 ft.) of the cable and then decreases to lower levels beyond 10 m (33 ft.) from the cable (SEER, 2022). While deeper burial does not dampen the intensity of EMF, it increases the distance between the cable and seabed or water column, where marine species will detect the EMF emissions. However, even with lower emissions from burial, the EMF emissions are still expected to be within levels detectable by marine species (Hutchinson et al. 2018). Although Revolution Wind will attempt to bury the cable for this project to a target depth of 4 to 6 ft. (1.2 to 1.8 m) where feasible, cable routes are proposed for areas where they cannot be fully buried to the target depth, including areas of complex habitat. We expect EMF emissions to be greater in those areas, lending further support for avoiding development in areas of complex habitats (as recommended in CRs 2-3, 5-7 and 10).

Both the information we do know about EMF and the remaining uncertainties factor into the recommendations we provide for this project. It is unclear how EMF emissions from routing the OSS-link directly through the center of a known cod spawning area will affect spawning activity or behavior, as this OSS-link cable has a voltage approximately four times higher than the inter array cable. Given the status of the species and additional impacts that come from development in this area, including elevated EMF, routing cables through this area should be avoided (as recommended in CR 3). Additionally, further study is needed to address uncertainties on the stressor effects (EMF emissions in areas of burial and non-burial in the project areas) and the biological response on how species of importance to this area respond to elevated EMF in the project area.

EFH CRs 19 and 20: Monitoring Project effects

Revolution Wind is proposing to conduct benthic monitoring in the project area on soft and hard bottom habitat as well as along portions of the RWEC. We reviewed drafts of the monitoring plans submitted to us, and provided comments on these plans (e.g., October 2021 draft and June 24, 2022, letter, respectively). In our comments, we raised significant concerns with some of the studies as proposed that should be addressed prior to their commencement. We received an updated version of the Benthic Monitoring plan, dated October 2022, which appears to address several of our previous comments. We remain concerned with the lack of power analysis and replicate samples. We also remain concerned about 1) the limited duration of pre-construction and post-construction sampling, 2) the lack of soft-bottom benthic community monitoring, 3) the limitation of natural hard-bottom monitoring to boulders rather than the complex suite of hard-bottom habitats that currently exists within the project area and 4) the insufficient sampling necessary to assess changes in the benthic community structure. In addition, we are concerned that the monitoring of multiple habitat types (soft-bottom, complex, and large grained complex habitats) following WTG installation and along the export cable appears to be only focused on fine-grained sediment enrichment with inadequate sampling proposed to assess the benthic community structure of the different habitats.

Given the diversity of habitats on Cox Ledge and throughout the project area and the potential impacts of the project on various life stages of a myriad of species, we consider a robust monitoring program to be an important component of this project that will help elucidate potential impacts of the project on EFH. Currently, we have significant concerns about the ability of the proposed survey designs to detect changes across the lease as a result of construction and operation. While we appreciate that a number of our comments were addressed, we remain concerned with the inadequate sampling and replication to detect meaningful changes (i.e. the statistical power of the study to detect changes). The project area is covered by a diverse range of habitats, including soft bottom to highly complex hard habitats with large boulders, yet the benthic monitoring does not include enough replicates to draw conclusions related to how these different benthic habitats respond to project impacts across the lease area. Specifically, to adequately monitor hard-bottom and mixed substrates using seafloor imagery, a minimum of 15-20 images per station should be collected, and a minimum of three stations per stratum (e.g. depth, distance from turbine, etc.) should be selected.

While the evaluation of the successional stage of soft-bottom habitats may provide useful information, there is no method (i.e. benthic grabs) proposed to assess the community composition of soft-bottom habitats. The monitoring of soft-bottom habitats should include a minimum of three benthic grabs per station, and three stations per stratum, to allow for the assessment of benthic community structure changes post-construction. As noted in the benthic monitoring plan, “the consequences of [the] predicted effects may affect the role of soft and hard bottom habitats in providing food resources, refuge, and spawning habitat…” It is critical to adequately sample and monitor changes in the benthic community structure in order to understand the effects of the proposed project in both soft and hard bottom habitats. Further, the lack of multi-year pre-construction data collection will also place unnecessary constraints on the study's ability to distinguish between naturally occurring annual variability and changes related to the project construction and operation. Adequate baseline data collection is critical for any monitoring study and should include a minimum of three years of pre-construction data collection. This is essential to account for inter-annual variability and allow for the evaluation of changes that result from project impacts rather than natural variability. The Benthic Habitat Monitoring Plan should be revised to address these remaining concerns related to the adequacy of the proposed methods to detect changes in the existing benthic community structure in the offshore and inshore project areas. Additionally, lease-wide post-construction acoustic surveys should be incorporated into the benthic monitoring plan to understand large-scale changes to the substrate.

The revised Benthic Habitat Monitoring Plan should include post-construction monitoring of the existing, natural soft and hard bottom benthic community structure within the lease and export cable corridor, post-construction benthic community development and invasive species (e.g., *Didemnum vexillum*) growth on: 1) constructed habitats, 2) natural habitats within the expected area of project impacts, and 3) within adjacent areas outside the area of impact. The monitoring plan should also include measures to evaluate and quantify lease-wide: 1) physical changes to the benthic habitat including depth, hardness, rugosity, slope, and other morphometrics through post-construction acoustic acoustic surveys (bathymetry, multibeam backscatter and side scan sonar), 2) biological changes to benthic community structure with distance from the area of impact, including impacts from boulder removal and relocation, and 3) invasive species distribution and abundance with associated plans for removing/managing invasives.

We note that the benthic monitoring plan, dated October 2022, proposes to capture the presence, percent cover, and contribution to community composition of invasives in the sampled stations. However, the proposed monitoring surveys are not designed to have the ability to detect the extent of *D. vexillum* fragments and colonizes across the lease area. The proposed surveys could identify the growth of invasives on the subset of novel structures and disturbed areas that are sampled; however, the limited replicates of WTG foundations, the non-probability based sampling design of disturbed and undisturbed boulders, and insufficient collection of baseline data will limit our ability to draw conclusions about lease-wide project effects on invasive species colonizations and fragmentation. There is significant risk of invasive species colonization from this project and the invasive species monitoring component of the benthic monitoring plan should be expanded to understand how the distribution and abundance of invasive species changes due to the construction and operation of the project. The monitoring plan should be revised to increase randomized sampling effort, sample replicates, and baseline data collection to allow for an understanding of how novel and disturbed sites in the project area are colonized by invasive species.

In addition to understanding the impacts to benthic habitats from the project, BOEM should require a monitoring program be developed to address uncertainties related to impacts from the operation of the Revolution Wind project on EFH and federally managed species. This should include the requirements for *in situ* monitoring to measure the stressors created by project operation on the ecosystem from operational noise, EMF, wind wake effects, and the presence of structures. Studies should also evaluate the biological effects of those stressors on commercially important species in the project area such as Atlantic cod, monkfish and ocean quahog. These monitoring studies should be developed in partnership with the NMFS and other scientific institutions to aid in addressing questions related to the spatial extent of these stressors and the biological effects on sensitive life stages, such as cod larvae, primary productivity, and species of commercial importance to the area. This monitoring is consistent with principles outlined in NOAA's Mitigation Policy for Trust Resources which highlights the use of the best available scientific information, such as results of surveys and other data collection efforts when existing information is not sufficient for the evaluation of proposed actions and mitigation, or when additional information would facilitate more effective or efficient mitigation recommendations or enhance the effectiveness of other activities that more directly result in compensation. Monitoring and surveys are particularly important when habitat loss is not the only major threat to NOAA trust resources, when the outcome of monitoring can contribute significantly to our understanding of the species or habitat to inform our recommendations on mitigation measures, or when no other reasonable options for compensatory mitigation are available.

Given the scale of development proposed for Revolution Wind and across the OCS in a relatively short period of time, it will be important that BOEM require a thoughtful and scientifically robust monitoring program at each project to address these data gaps. Methratta et al. (2023) identifies NMFS priority research questions and offers recommended temporal scales, resolution, and available methods and approaches to address questions relevant to understanding impacts of the Revolution Wind project on EFH. A number of important questions need to be addressed to understand the effects of the project on Cox Ledge and across southern New England, particularly related to hydrodynamics effects and atmospheric energy extraction and the consequential effects to primary productivity and larval distribution, a major driver in understanding the presence and seasonality of fish species (Chen et al. 2021; Friedland et al. 2021). Additional studies are also needed related to impacts of operational noise, including particle motion and vibration on the benthos and demersal species as well as effects from EMF emissions and the biological response to those emissions. Specifically, studies are needed to understand how habitat alteration impacts larvae and juvenile fish species in the development areas as the WTGs are expected to attract larger predatory species (e.g., black sea bass) that also have been found to exhibit site fidelity to particular reefs once established. Research on existing wind farms suggests the potential for altered food web structures, which may have important ecosystem implications; however, this has not been well studied (Methratta and Dardick 2019). BOEM and USACE should require the development of a robust monitoring program to address these important questions as a stipulation of COP approval.

EFH CR 21: Minimizing Effects from Contaminants

The EFH assessment did not consider effects to EFH from contaminants. Although available data are scarce making it currently difficult to assess the impact of chemical emissions on the marine environment, environmental contamination from offshore wind farms is an ongoing concern. Potential chemical emissions from the offshore wind industry may originate from the increased traffic and an increased risk of accidental spills from this traffic, the re-mobilization of contaminated sediment due to seabed disturbance by subsea cable and foundation construction, discharges from wastewater treatment plants and cooling water from platforms, artificial scour protection materials, atmospheric emissions from diesel generators, direct chemical emissions, and spills during accidents (e.g. fire on platform and the use of firefighting foams or accidental spills of oil, lubricants or coolants). Drill cuttings piles, produced around the base of wells, are also often contaminated with hydrocarbons and heavy metals (Breuer et al., 2008). Recently, Tornero and Hanke (2016) presented a generic list of potential chemicals released from offshore wind energy facilities, which includes aluminum, copper, zinc, iron, diuran, irgarol, hydrocarbons (BTEX, PAHs), silicon fluids, mineral oils, (bio-) diesel, vegetable oils, synthetic esters, ethylene glycol, propylene glycol, and sulfuric acid. It should be noted that the risk of emissions or accidental release of these chemicals can be substantially reduced by using constructive preventive measures such as backup systems, secondary containments, closed loop systems, and recovery tanks (Kirchegeorg et al. 2018).

In general, chemical emissions from offshore wind farms can be divided into contamination by metals and by organic compounds. Metal emissions may originate from corrosion protection systems such as impressed current cathodic protection systems otherwise known as sacrificial anodes or galvanic anodes, which typically include aluminum (Al), zinc (Zn), and indium (In) (Kirchgeorg et al. 2018; Tornero and Hanke 2016). Galvanic anodes are considered one of the highest related sources of metal emissions into the marine environment (Kirchgeorg et al. 2018). As such, they will likely have a significant local input of metals to the marine environment over the roughly 25-30-year lifetime of the project. The application of Al- and Zn-based galvanic anodes as corrosion protection results in the continuous emission of inorganic matter (e.g. >80 kg Al-anode material per monopile foundation and year) into the marine environment (Reese et al. 2020). A study by Kirchgerog et al. (2018) demonstrated that in the North Sea, the use of Al anodes as opposed to Zn anodes would reduce the total annual emissions for an offshore wind farm with 80 WTG monopile foundations by a factor of around 2.5 (118 tons) due to the higher current capacity. As such, Al-based anodes are recommended to reduce metal contamination, in addition to the lighter weight, reduced costs, and higher current output per anode weight compared to Zn anodes (Bardal 2004).

EFH CR 22: Project Decommissioning

Habitat will also be altered at the decommissioning phase of the project. BOEM requires all equipment to be removed up to 15 ft. (4.6 m) below the mudline. This will again alter habitat by removing the introduced structures that have colonized epibiota during the 30 plus years of operation. The EFH assessment did not fully analyze effects from decommissioning. While details related to decommissioning are limited at this time, we expect habitat to be further altered and disturbed during this process. Given the limited details and lack of analysis on impacts to EFH from decommissioning provided at this time, additional coordination and re-initiation of the EFH consultation will be necessary prior decommissioning of the project. We recommend that coordination begin early, up to five years prior to the proposed decommissioning date.

Rationale for Fish and Wildlife Coordination Act Recommendations

Minimizing Impacts to Horseshoe Crabs

Seafloor disturbances, including trenching, dredging, and sediment placement may result in the loss of horseshoe crabs, their eggs and larvae, and their habitat, resulting in a reduction in prey species for several federally managed species and adverse effect to their EFH. Horseshoe crab eggs and larvae are a food source for a number of other species including striped bass, white perch (*Morone americana*), weakfish (*Cynoscion regalis*), American eel (*Anguilla rostrata*), silver perch (*Bairdiella chrysoura*), summer flounder and winter flounder. Horseshoe crabs are also an important resource for commercial fishermen and the biomedical industry. Avoiding disturbances in Narragansett Bay between April and June will minimize impacts to horseshoe crab spawning.

Minimizing Impacts to American Lobster and Jonah Crab
The Revolution Wind project area is habitat for American lobster (*Homarus americanus*) and Jonah crab (*Cancer borealis*), two species of importance to the commercial and recreational fisheries in the region. Shelter providing habitat has been shown to be a critical requirement for recently settled and early juvenile lobsters (Cowan 1999). Adult lobsters also use cobble-boulder habitat but tend to inhabit a broader range of habitats which may include both protected and exposed locations (Aiken and Waddy 1986; Karnofsky et al. 1989; Mackenzie and Moring 1985). The project area is known to support lobster, and spans an area used for inshore and offshore migrations (Fogarty et al. 1980). Lobster catch in southern New England has declined since the late 1990s, which in part led to the increase in the closely linked Jonah crab fishery (ASMFC 2015). In 2019, (NMFS 2021). Jonah crab are most frequently caught in rocky offshore habitats (ASMFC 2015). Taking steps to minimize project effects to EFH, particularly complex habitats more vulnerable to long-term or permanent impacts, will also be important in reducing project impacts to lobster and Jonah crab in the project area. Incorporation of the EFH CRs outlined above (including EFH CRs 2-3 and 5) as conditions of COP approval will also be beneficial for reducing project impacts to lobster and Jonah crab. We request receipt of data and monitoring reports from the ropeless ventless surveys that are proposed for the project.

Mitigating impacts to NOAA Scientific Surveys
NOAA Fisheries long-term scientific surveys are essential to meet our statutory authorities to sustainably manage our region's fisheries, promote the protection and recovery of marine mammals and endangered and threatened species, and conserving coastal and marine habitats and ecosystems. They also form the basis to understand the impacts of climate change on living marine resources, marine ecosystems, and human communities. NOAA Fisheries scientific surveys collect data used in the assessments for these NOAA trust resources. In the Northeast region, these assessments rely on more than 14 long-term standardized surveys, many of which have been ongoing for more than 30 years. Surveys such as the NOAA Fisheries Ecosystem Monitoring Program and Multi-species Bottom Trawl Survey are critical in quantifying species distribution and abundance as well as defining habitat conditions that form the basis of designating EFH. This project will result in major adverse impacts on NOAA Fisheries scientific surveys. This project in combination with existing and future offshore wind development will also result in major adverse impacts on NOAA Fisheries scientific surveys at the regional level. Additional information on this issue and the need to mitigate these impacts is described in the NMFS-BOEM Federal Survey Mitigation Strategy - Northeast U.S. Region[2].

Survey mitigation should be consistent with the NMFS-BOEM Federal Survey Mitigation Strategy. As per NMFS and BOEM Survey Mitigation strategy actions 1.3.1, 1.3.2, 2.1.1, and 2.1.2, to mitigate the impacts on the eight surveys impacted by the project, the developer will establish a NMFS-approved survey mitigation agreement. The developer will implement this plan in order to provide NMFS with data that are calibrated with and equivalent to the data collected by NMFS for the following impacted surveys:

[2] Available at: https://www.fisheries.noaa.gov/resource/document/federal-survey-mitigation-strategy-northeast-us-region

- Spring and Fall multi-species bottom trawl,
- Ocean quahog & surf clam dredge,
- Atlantic sea scallop,
- North-Atlantic right whale aerial surveys,
- Marine mammal passive acoustics,
- Ecosystem monitoring survey, and
- Aerial-and vessel-based marine mammal and sea turtle surveys.

This project level data will be collected following protocols approved by NMFS and the data will be provided to NMFS for inclusion in a publicly available database. This data will be collected for the duration of the term of the wind energy operations with data collections beginning at a minimum of three years prior to all construction activities. This data will allow NMFS to continue to effectively monitor the status and trends of NOAA trust resources, including resource abundance, distribution, vital rates, and environmental conditions. Such survey mitigation is necessary to ensure that NOAA Fisheries can continue to accurately, precisely, and timely execute our responsibilities to monitor the status and health of trust resources.

Communication of Boulder Relocation and Locations of Other Bottom Structures
As already described in this letter, the project proposes to substantially modify the seafloor through the relocation of over 6,000 boulders and installation of scour protection within the lease area and along the export cable routes. In addition to impacts to EFH, these seafloor impacts pose a safety risk to marine users including the fishing industry and our NOAA scientific survey operations. We request BOEM and USACE require the lessee disseminate information related to locations of relocated boulders, locations of boulder plow use (and associated berms), locations of installed cable armoring and scour protection so that NMFS and the public can be informed as soon as possible and locations can be provided while nautical charts are being updated.

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