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

September 14, 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: Sunrise Wind Offshore Wind Energy Project, Lease Area OCS-A-0487

Dear Ms. Stromberg:

We have reviewed the final Essential Fish Habitat (EFH) assessments provided on May 30, 2023, and July 6, 2023, for the proposed Sunrise 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 Sunrise Wind Farm (SRWF) within Lease Area OCS-A-0487, located on the outer continental shelf (OCS) 18.9 statute miles south of Martha's Vineyard, Massachusetts, approximately 30.5 miles east of Montauk, New York, and 16.7 miles from Block Island, Rhode Island. The EFH assessment describes a project that includes up to eighty-seven (87) offshore wind turbine generators (WTGs) with a nameplate capacity of 11 megawatts (MW) per turbine, one offshore converter station - direct current (OCS-DC), scour protection for foundations and cables, up to 155 miles of inter-array cables within the lease area, and a temporary pier constructed in Smith Point County Park in Suffolk County, NY. The project also includes the construction and installation of the Sunrise Wind Export Cable (SRWEC), will transmit a high-voltage direct current (HVDC) with an open loop cooling system from the SRWF to the Long Island Power Authority (LIPA) Holbrook Substation in the Town of Brookhaven, New York. The SRWEC consists of one 320-kV DC export cable bundle with export cable segments located in federal waters (SRWEC–OCS) and a segment of export cables located in New York State territorial waters (SRWEC–NYS). The two SRWEC circuits will total 104.6 miles in length (99.4 and 5.2 miles for each SRWEC-OCS and SRWEC-NYS 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) overlaps areas of known cod spawning activity and poses a high risk of population-level impacts to southern New England Atlantic cod, and 2) would result in significant alterations of complex habitats associated with the southern edge 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. Mitigation measures outlined in this letter, particularly time of year restrictions for Atlantic cod spawning as well as avoidance and minimization of development within cod spawning and complex habitat areas are the most effective and critical means to reducing population level risks and permanent alteration of complex habitats.

The EFH assessments provided to us on May 30 and July 6, 2023, were updated to reflect changes to the proposed action resulting from new survey data that found glauconite soils in the lease area, which presented feasibility issues for the proposed action and alternatives described in the draft Environmental Impact Statement (DEIS). As a result, options for minimizing impacts to EFH, including highly complex habitat areas and areas important for Atlantic cod spawning, were substantially reduced; alternatives that considered full relocation and/or removal outside cod spawning and complex habitat areas were replaced with alternatives that consider a small number of turbine removals within portions of the cod spawning area (identified as Priority Area 1). This situation shows why the site assessment surveys need to be completed earlier in the process so that findings can be considered in project design to reduce environmental impacts. Receipt of this information late in the process has limited options that may have been available (e.g. alternative foundation types) at the early planning phase, which may have allowed for further reduction in impacts to NOAA trust resources. Given the more limited options now available to avoid and minimize impacts to sensitive habitats in the lease area, it is even more important that the Bureau of Ocean Energy Management (BOEM), the United States Army Corps of Engineers (USACE), and the Environmental Protection Agency (EPA) incorporate mitigation measures as conditions of project approval that would reduce adverse environmental impacts of the project. As proposed, the project does not provide sufficient mitigation measures to reduce the significant adverse effects to EFH from the project.

Although we deemed the EFH assessment complete for the purposes of initiating consultation due to the need to complete the EFH consultation prior to BOEM's issuance of the FEIS, the provided documents include outdated information and do not fully describe each element of the proposed action or fully evaluate all of the direct, indirect, individual, and synergistic adverse impacts to EFH in the project area that are likely to occur from the construction, operation, maintenance, and decommissioning of the Sunrise Wind project. For example, the EFH assessment does not analyze the cumulative effects of constructing these projects during the Atlantic cod spawning season. While the EFH assessment includes a section that compares the proposed Sunrise Wind construction schedule with adjacent South Fork and Revolution Wind projects, the schedules used in this analysis are inconsistent with information provided to us on these projects. Additionally, the project schedule presented in the Sunrise EFH assessment is inconsistent with the Environmental Impact Statement (EIS) and the Biological Assessment (BA), creating further challenges for our evaluation of impacts of the project on EFH.

In addition, information in the EFH assessment related to acoustic effects from pile driving appears to be inconsistent with the most up to date Underwater Noise and Exposure Modeling report conducted for the project (Kusel et al. 2022). As a result, the EFH assessment underrepresents the anticipated acoustic effects to EFH from pile driving. Further, there is no evaluation or discussion on how multiple adjacent project activities (e.g., seafloor preparation, cable installation, pile driving, etc.) with limited mitigation measures would impact the Cox Ledge ecosystem and associated complex habitats used by federally managed species in the project area. Such an analysis is essential to the evaluation of the adverse effects of the proposed action including synergistic effects. Similarly, for the nearshore portions of the project in the

Long Island Intracoastal Waterway, the EFH assessment did not consider an evaluation or discussion on how the replacement of the Smith Point Bridge in combination with the proposed construction activities for Sunrise Wind would impact benthic resources documented in the project area including submerged aquatic vegetation (SAV).

Currently, the project does not include any mitigation measures to reduce adverse impacts to Atlantic cod EFH, a species of ecological, economic and cultural significance to this region. Rather, the EFH assessment downplays impacts of the project on Atlantic cod due to the limited information on the Southern New England population. A lack of information does not equate to no impact nor does it justify exclusion of mitigation measures that would reduce the risk of population level adverse impacts to Atlantic cod. We are concerned that, absent mitigation measures, impacts from construction and operation of the Sunrise Wind Project and cumulative effects from adjacent development projects will result in population level adverse effects and hinder our efforts to rebuild Atlantic cod stocks in Southern New England. These same concerns have also been raised by our New England Fisheries Management Council (see July 19, 2023 letter to BOEM).

We have also recently learned that some additional WTG locations were deemed infeasible since the receipt of the most updated EFH assessment on July 6, 2023 and that some alternatives considered to reduce impacts to EFH may be modified or no longer feasible. We rely on the information provided to us in the EFH assessment to inform the conservation recommendations (CRs) we provide through the consultation process. This updated information was not communicated to us in the final EFH assessment or provided as an amendment. Therefore, our EFH CRs are focused on the proposed action and information provided to us in the updated EFH assessments dated May 30 and July 6, 2023. The scientific basis for our determination and our EFH and FWCA recommendations is provided in the attached Appendix A. We have additionally provided comments and recommendations on the draft NPDES permit No. MA0004940 in Appendix B.

Consultation Responsibilities

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.

The Bureau of Ocean Energy Management (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 under USACE jurisdiction 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. Additionally, the lessee has applied to the Environmental Protection Agency (EPA) for a National Pollutant Discharge Elimination System (NPDES) permit under the Clean Water Act. The USACE and EPA 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 permits issued by the USACE and EPA for the proposed activity and that it will be USACE’s and EPA’s responsibility to respond to any EFH conservation recommendations issued for actions under their jurisdiction.

The comments and recommendations provided for this project, through our statutory obligations under the MSA and FWCA, will assist the federal action agencies in supporting the Administration's goals to combat the climate crisis in a manner that “conserves our lands, waters, and biodiversity” (E.O. 14008). We expect BOEM, USACE, and EPA to give full consideration of these recommendations so that the project may contribute to the Administration’s efforts to help mitigate climate change in an environmentally responsible manner.

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 Avoid and Minimize Adverse Impacts to Atlantic cod spawning

1. To minimize adverse effects to Atlantic cod spawning aggregations within and adjacent to the project area, and to reduce the risk of population-level effects to this species, no pile driving should occur in the lease area between November 1 and March 31 of each year.

2. In-water bottom disturbing construction activities should not be permitted to occur within Priority Area 1 (inclusive of WTG 123 and 124[1]) between November 1 and March 31 of each year to minimize impacts to Atlantic cod spawning. Bottom disturbing activities should be sequenced so that construction during this time is occurring within the southernmost and easternmost portion of the lease and construction in areas adjacent to Priority Area 1 is minimized to the greatest extent practicable between November 1 and March 31 of each year.

3. To the extent practicable, detonation of unexploded ordinances/munitions of explosive concern (UXO/MEC) should not be conducted in the lease area from November 1 through March 31 of each year.

4. HRG sub-bottom profiling (e.g. sparkers, boomers) survey activities should not be permitted to occur in Priority Area 1, inclusive of WTG 123 and 124, between November 1 through March 31 of each year.

5. To minimize adverse impacts to Atlantic cod spawning habitats, the maximum number of turbines feasible should be removed or relocated outside of Priority Area 1 (inclusive of WTG 123 and 124) to avoid areas of cod spawning and complex habitats. Specifically, at a minimum the following seven (7) WTGs locations and associated inter array cables should be removed in the following order of priority to minimize overlap with Atlantic cod spawning habitat: 92, 93, 94, 91, 95, 122 and 123. Turbine locations that have the highest overlap with and closest proximity to Atlantic cod detections and complex habitats should be prioritized for removal or relocation. Turbines are numbered based on WTG labels identified in the EFH assessment.

6. Support planned and on-going passive acoustic and telemetry surveys within the lease area and expand the existing study to cover the full area of project effects, including areas of hydrodynamic and acoustic effects that are expected to extend beyond the boundaries of the lease area. This should be conducted pre-, during, and post construction 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. Specifically, a) Provide continuous monitoring of Atlantic cod spawning aggregations within and immediately adjacent to the lease area between November 1 and March 31 prior to the construction of the project, during project construction, and post construction b) Place additional passive acoustic receivers within the lease area to increase coverage. c) Add an additional glider to the ongoing survey to increase the spatial coverage of the Sunrise Wind project area and adjacent areas. 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) The survey coverage should extend outside the lease area within areas where project effects occur (i.e. wind wake effects) to assess individual, synergistic and cumulative effects of the project on the distribution of cod

[1] We recommend WTG 123 and 124 be included in Priority Area 1 due to updated data demonstrating overlap with cod telemetry detections and spawning condition cod.

spawning activity e) Data and results from this study should be made available to NMFS Habitat and Ecosystem Services Division (HESD) at NMFS.GAR.HESDoffshorewind@noaa.gov.

Recommendations to Minimize Impacts from Operation of the Offshore Converter Station

7. To minimize entertainment of eggs and larvae from the cooling water intake system (CWIS), relocate the OCS-DC outside of Priority Area 1 to a position further south and east in the lease area. The OCS-DC should be sited as far from documented Atlantic cod spawning activity as feasible and outside sensitive benthic habitat[2] associated with Cox Ledge.

8. The OCS-DC CWIS should be retrofitted with a closed-cycle cooling system when the technology is made commercially viable. The feasibility of upgrading the proposed CWIS with a closed-cycle cooling system and/or incorporating best available technologies should be evaluated every five years upon re-application of the National Pollutant Discharge Elimination System (NPDES) permit for operation of the OCS-DC. This should be included as a condition of COP approval and the NPDES permit.

9. Ichthyoplankton monitoring at the OCS-DC CWIS should be required for the life of the project. The ichthyoplankton monitoring should incorporate comments provided in Appendix B into the final NPDES permit. All data and results from the ichthyoplankton and thermal monitoring should be made available to NMFS HESD at NMFS.GAR.HESDoffshorewind@noaa.gov.

10. To assess impacts to Atlantic cod eggs and larvae, ichthyoplankton monitoring frequency should be increased from quarterly sampling to weekly sampling during peak cod egg and larval presence from December through April of each year.

Recommendations to Minimize Impacts to Benthic Habitats

11. No more than the minimum number of wind turbine generators (WTGs) required to meet the power purchase agreement (PPA) of 880 megawatts (MW) should be permitted with a focus of full removal of WTGs from areas of cod spawning and complex habitats.

12. WTGs, the offshore converter station - direct current (OCS-DC) and cables (inter-array and export) should be micrositedsited to avoid sensitive benthic habitats and UXOs/MECs. Soft bottom areas (identified by low multibeam backscatter returns) absent benthic features should be targeted for micrositing.

13. Develop and implement a WTG, OCS-DC and cable micrositing plan to facilitate the avoidance and minimization of impacts to sensitive benthic habitats. The plan should

[2] the term "**sensitive benthic habitats**" will be used to encompass: complex habitats and benthic features (defined as coarse unconsolidated mineral substrates [i.e. substrates containing 5% or greater gravels], rock substrates [e.g. bedrock], and shell substrates [e.g. mussel reef] consistent with CMECS definitions as well as vegetated habitats [e.g. SAV] and as defined described in our 2021 Recommendations for Mapping Fish Habitat), bathymetric features (such as lumps, banks, and scarps) and other areas of high habitat heterogeneity (diversity of structural elements including bathymetric features) and complexity.

primarily use multibeam backscatter data, bathymetry and boulder data layers to inform micrositing. For areas where sensitive benthic habitats cannot be fully avoided through micrositing, the micrositing plan should avoid and minimize areas in the following order of preference: (i) complex habitats (i.e. areas of medium to high backscatter) with high density large boulders; (ii) complex habitats (i.e. areas of medium to high backscatter) with medium density large boulders; (iii) complex habitats (i.e. areas of medium to high backscatter) with low density large boulders; (iv) complex habitats (i.e. areas of medium to high backscatter) with scattered large boulders; and (v) complex habitats (i.e. areas of medium to high backscatter) with no large boulders. A copy of the final plan should be provided to NMFS HESD at NMFS.GAR.HESDoffshorewind@noaa.gov prior to construction.

14. To the extent practicable, if cables must cross complex habitat or benthic features (i.e. sand waves), they should be located at the narrowest points to cross perpendicularly to reduce the extent of sand wave leveling/dredging required; dredged material should not be disposed of within sensitive benthic habitats.

15. To minimize impacts to sensitive benthic habitats from boulder/cobble removal/relocation activities, boulders and cobbles should be: (i) relocated as close to the impact area as practicable, in areas immediately adjacent to existing similar complex bottom; (ii) placed in a manner that does not hinder navigation or impede commercial fishing; (iii) and avoids impacts to existing complex habitats.

16. In order to minimize impacts to sensitive benthic habitats from boulder/cobble removal/relocation activities, 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.

17. Develop and implement a boulder relocation plan to facilitate the avoidance and minimization of impacts to sensitive benthic habitats. We recommend the plan use multibeam backscatter data and boulder layers (data) to inform micrositing. A copy of the final plan should be provided to NMFS HESD at NMFS.GAR.HESDoffshorewind@noaa.gov prior to construction.

18. To minimize impacts of benthic habitat modification, in all project areas where seafloor preparation activities include the use of plows, jets, grapnel runs or similar methods, post-construction acoustic surveys (e.g. multibeam backscatter and side scan sonar) capable of detecting bathymetry changes of 0.5 meters (m) or less, should be completed to demonstrate how the bottom was modified by preparation and construction activities. Post-construction acoustic survey data should be provided to NMFS HESD in a viewable format at NMFS.GAR.HESDoffshorewind@noaa.gov.

19. In areas where plows, jets, or other similar methods are used and the created berm height exceeds three feet above the existing grade, the created berm should be restored to match that of the existing grade/pre-construction conditions.

20. Avoid anchoring or placing jack-up barge spud cans or footings on/in sensitive benthic habitats including any area where large boulders (>/= 0.5 m in diameter) or medium to high multibeam backscatter returns occur.

21. If anchoring is necessary in sensitive benthic habitats, anchor lines should be extended to the extent practicable to minimize the number of times the anchors must be raised and lowered to reduce the amount of habitat disturbance.

22. If anchoring must occur in any sensitive benthic habitats and vessels must remain stationary, dynamic positioning systems (DPS) or mid-line buoys on anchor chains should be required to minimize impacts to those habitats.

23. If placement of jack-up barge spud cans is necessary in sensitive benthic habitats, we recommend proposed locations for the spud cans be selected to avoid areas in the following order of preference: (i) complex habitats (i.e. areas of medium to high backscatter) with high density large boulders; (ii) complex habitats (i.e. areas of medium to high backscatter) with medium density large boulders; (iii) complex habitats (i.e. areas of medium to high backscatter) with low density large boulders; (iv) complex habitats (i.e. areas of medium to high backscatter) with scattered large boulders; (v) complex habitats (i.e. areas of medium to high backscatter) with no large boulders.

24. Develop and implement an anchoring and jack-up barge plan to facilitate the avoidance and minimization of impacts to sensitive benthic habitats. We recommend the plan use multibeam backscatter data, bathymetry and boulder layers (data) to inform micrositing. A copy of the final plan should be provided to NMFS HESD at NMFS.GAR.HESDoffshorewind@noaa.gov prior to construction.

25. To minimize permanent adverse impacts to existing benthic habitats from the placement of scour protection, all cables should be microsited to allow for full penetration/burial, regardless of habitat type (by siting cables in appropriate substrates). Additional bottom surveys should be conducted, as necessary, to inform the micrositing of the cables.

26. To minimize the impacts of habitat conversion from scour protection, natural or engineered rounded stone of consistent grain size that mimics natural seafloor substrates should be used. 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) and rounded edges (e.g., tumbled stone), and be sloped such that outer edges match the natural grade of the seafloor. Should the use of concrete mattresses be necessary, bioactive concrete (i.e., with bio-enhancing admixtures) should be used as the primary scour protection (e.g., concrete mattresses) or veneer to support biotic growth.

27. Develop and implement a scour protection plan to facilitate the avoidance and minimization of impacts to sensitive benthic habitats. We recommend the plan use multibeam backscatter data, bathymetry and boulder layers (data) to inform this plan. A

copy of the final plan should be provided to NMFS HESD at NMFS.GAR.HESDoffshorewind@noaa.gov prior to construction.

Recommendations to Minimize Acoustic Impacts

28. The use of noise mitigating measures should be required during pile driving construction in the nearshore and offshore project areas, including the use of soft start procedures and the deployment of noise dampening equipment such as bubble curtains or double-bubble curtains.

29. A plan outlining the noise mitigation procedures for offshore 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 at NMFS.GAR.HESDoffshorewind@noaa.gov before in-water work begins. The noise mitigation plan should include (i) 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; (ii) 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; and (iii) acoustic monitoring reports that include any/all noise-related monitoring should be provided to NMFS HESD at NMFS.GAR.HESDoffshorewind@noaa.gov.

30. Vibratory pile driving should be used to the maximum extent practicable for both installation and removal of the temporary pier.

Recommendations to Avoid and Minimize Impacts to Estuarine/Nearshore Habitats

31. Avoid in-water work within Narrow Bay/Long Island Intracoastal Waterway including installation and removal of the temporary pier, or other extractive or turbidity/sediment-generating activities from January 15 to May 31 of each year in estuarine/nearshore waters of 6 meters (m) in depth or less to avoid impacts to winter flounder early life stages (eggs, larvae).

32. In all inshore/estuarine habitats where seafloor preparation and cable installation activities will occur, impacts to sensitive benthic habitats should be avoided and minimized through the use of horizontal directional drilling (HDD), micrositing, and re-rerouting. All disturbed areas should be restored to pre-construction conditions, inclusive of bathymetry, contours, and sediment types. Pre-construction surveys to determine conditions and post-construction surveys should be conducted to verify restoration has occurred. Survey results should be provided to NMFS HESD at NMFS.GAR.HESDoffshorewind@noaa.gov.

33. To minimize impacts from vessel operation in estuarine/nearshore habitats, all vessels should float at all stages of the tide (i.e., avoid vessel grounding); all vessels should be required to follow other EFH CRs associated with anchoring/avoidance.

34. Avoid trenching in open nearshore/estuarine waters. If open trenching is used, excavated materials should not be sidecast or placed in the aquatic environment.

35. To minimize impacts to estuarine/nearshore habitats associated with excavation of the HDD exit pits for any water-to-shore transitions, unconfined dredging should not be permitted.

36. All materials excavated should be stored on uplands or barges and placed back to restore the excavated areas, or removed to a suitable upland disposal site if the material contains elevated levels of contaminants. Dredged materials from HDD exit pits should be stored on a barge or on uplands and used to backfill the excavated areas or removed to a suitable upland disposal site if the material contains elevated levels of contaminants. HDD exit pits should be restored to pre-construction conditions with native and/or clean, compatible material once construction and installation is complete.

37. Frac-out plans should be developed for all areas where HDD is proposed to be used. We recommend these plans be developed with particular attention to protecting SAV that has been documented within the Long Island Intracoastal Waterway. A copy of the final plan should be provided to NMFS HESD at NMFS.GAR.HESDoffshorewind@noaa.gov prior to construction.

38. Avoid seabed disturbing activities in SAV, particularly during installation of the temporary pier. At a minimum a) barges should not be moored in SAV or SAV habitat, b) Maintain a minimum 100 ft. buffer between the edge of any SAV beds and any equipment staging or anchoring activities c) Maps derived from SAV surveys should be provided to vessels/captains to ensure SAV is avoided.

39. 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. 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.

Recommendations to Address Uncertainties and Minimize Impacts from Project Operation

40. We recommend the Benthic Habitat Monitoring Plan dated April 8, 2022, be updated to include the following:
    a. Incorporation of comments provided by NOAA Fisheries on September 24, 2021, related to temporal scale of sampling, statistical design, survey technique strategies, sampling strata selection, and others, which have not been incorporated in the April 2022 version. This should include increasing the extent of sampling in existing habitats in the project area.
    b. Pre-construction/baseline monitoring for a minimum of three years prior to any construction activities and continue annually for a minimum of five years post construction.

c. An expansion of hard bottom habitat monitoring to include natural hard bottom habitats from both disturbed (relocated boulders) and undisturbed habitats. The inclusion of natural hard bottom habitats in the monitoring plan should allow for direct comparison of species assemblage composition and successional stage of natural vs introduced hard bottom habitat.
d. Invasive species (e.g., *Didemnum vexillum*) monitoring as a discrete component within both the natural and introduced hard bottom monitoring to track the fragmentation and spread of invasive species across the lease as a result of construction activities.
e. The inclusion of undisturbed soft bottom habitats in the soft bottom habitat monitoring plan to investigate impacts of cumulative lease development on soft sediment community composition and function.
f. Lease-wide collection of acoustic data (multibeam bathymetry and backscatter and side scan sonar) post-construction to measure the total area subject to physical change as a result of lease development. Post-construction acoustic surveys should be able to answer 1.) How much soft-bottom habitat across the lease has been converted to hard bottom; 2.) How much hard-bottom habitat across the lease has been converted to soft-bottom; 3.) How much natural hard-bottom habitat across the lease has been converted into man-made hard-bottom; 4.) How much total man-made hard bottom has been introduced into the lease; 5.) How much hard bottom habitats have been impacted (i.e., relocated, fragmented, reduced in complexity, etc.) by the project compared with pre-construction surveys; 6.) Have sand wave habitats dredged and leveled during cable installation been restored?

41. Develop an in situ project specific monitoring program to address impacts of the operation of the Sunrise 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. Incorporation of this monitoring recommendation would further align the monitoring efforts at Sunrise Wind with the NOAA Fisheries and BOEM Federal Survey Mitigation Strategy, which has evaluation and integration of wind energy monitoring studies with NOAA Fisheries surveys as a primary goal. 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 American lobster, Atlantic cod, Atlantic sea scallops, black sea bass, Jonah crab, monkfish, ocean quahog, silver hake, scup, skates, and summer flounder. Monitoring plans should include the collection of a minimum of three years of baseline data, during construction, and a minimum of five years of post-construction data collection. Plans should be incorporated into a comprehensive monitoring strategy and be provided to NOAA Fisheries GARFO and NEFSC for review and comment within 90 days of ROD issuance. A response to

NOAA Fisheries comments should be provided. These monitoring studies should be developed in partnership with NOAA Fisheries 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 Sunrise 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 and export cables? The proposed EMF study for the export cables should be expanded to measures EMF emissions from the inter-array cables and the export cables and address the following:
    i. What is the behavioral response to the altered EMF of fisheries resource species/life stages with known EMF-sensitivity?
    ii. Is there a difference in behavioral responses from the HVAC cables associated with the inter-array cables compared with the HVDC cables along the export cable route?
c. How far does the marine and atmospheric wind wake extend from the Sunrise 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 (OCS-DC and turbine foundations)? This question could be addressed by extending the ichthyoplankton study to areas in the lease beyond the OCS-DC. This should include the effect of entrainment, increased water temperature, and modified flow patterns at the OCS-DC; the effects of altered local hydrodynamic patterns around turbine foundations; the broad scale effects of wind wakes on hydrodynamic patterns and larvae that extend beyond the footprint of the project; and the effects of operational noise on larvae.

Recommendations to minimize impacts from contaminants

42. 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.

43. Any anti-corrosion protection methods or systems proposed should be identified. If sacrificial anodes are used, Al anodes should be selected over Zn anodes. Any application of anti-corrosion coatings should be allowed to cure fully on land, and BMPs for reducing spills should be implemented if reapplied offshore.

Project Decommissioning

44. 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 the proposed decommissioning.

We note that many of the EFH CRs may overlap with USACE jurisdiction, and therefore are also likely relevant to their process. Additionally, CRs that apply to construction and operation of the OCS-DC CWIS overlap with EPA jurisdiction as part of their issuance of a NPDES permit. In order to provide clarity and improve coordination and efficiency for the EFH process, we request that BOEM, USACE, and EPA coordinate on the CRs for this project and respond to NOAA Fisheries 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, USACE, and EPA) 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 May 15 to July 15 of any calendar year to avoid and minimize potential impacts to horseshoe crabs spawning along the Long Island beaches including the Fire Island National Seashore.

2. The project should be required to mitigate the major impacts to NOAA Fisheries scientific surveys consistent with NOAA Fisheries-BOEM Federal Survey Mitigation Strategy - Northeast U.S. Region. Sunrise Wind's plans to mitigate these impacts at the project and regional levels should be provided to NOAA Fisheries 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.

3. Locations of relocated boulders, created berms, and scour protection, including cable protection measures (i.e., concrete mattresses) should be provided to NOAA Fisheries, all other federal agencies with maritime jurisdiction, and the public as soon as possible to help inform all interested parties of potential gear obstructions.

4. Ichthyoplankton and zooplankton samples collected as part of the Biological Monitoring outlined in the NPDES permit should be provided to NOAA Fisheries NEFSC to cross-verify samples for incorporation into the Ecosystem Monitoring Program plankton dataset.

Conclusion
We appreciate the opportunity to coordinate with BOEM on the Sunrise 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 Sunrise Wind, we are available to work with BOEM, USACE, and EPA to refine our conservation recommendations, as appropriate. Should you have any questions regarding these comments or the EFH consultation process, please contact Gabriella DiPreta at (978) 238-8052 or gabriella.dipreta@noaa.gov. The ESA consultation is ongoing and is expected to be complete by September 29, 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,

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

Attachment: Appendix A: Conservation Recommendation Supporting Information
Appendix B: Additional comments on the draft NPDES permit

cc: Genevieve Brune, BOEM
Brian Hooker, BOEM
Cheri Hunter, BSEE
Timothy Timmermann, EPA
Danielle Gaito, EPA
Mark Austin, EPA
Stephanie Vail-Muse, FWS

David Simmons, FWS
Jon Hare, NOAA
Julie Crocker, NOAA
Naomi Handell, USACE
Stephan Ryba, USACE
Robert Vietri, USACE
Ruthann Brien, USACE
Mary Krueger, NPS
George Detweiler, USCG
Michele Desautels, USCG
Bill Duffy, NOAA
Walter Anoushian, NOAA
Laura McLean, NYDOS
Karen Gaidasz, NYSDEC
Lisa Covert, NYSDEC
Lisa Engler, MACZM
Dan McKiernan, MADMF
Jeffrey Willis, RICRMC
Terry Gray, RIDEM
Cate O'Keefe, NEFMC
Christopher Moore, MAFMC
Robert Beal, ASMFC

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

This attachment provides supporting information for the essential fish habitat (EFH) conservation recommendations (CRs) and the Fish and Wildlife Coordination Act (FWCA) recommendations for the Sunrise Wind Offshore Wind Farm (Sunrise Wind) as described in the attached letter dated September 14, 2023. Here we provide general and specific comments and recommendations on the Sunrise Wind Offshore Wind Energy Project.

EFH Consultation History

A draft EFH assessment was provided to us on August 8, 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 a letter dated October 7, 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 December 16, 2022. However, our evaluation of the revised EFH assessment was hampered, as the information we requested in our previous letter was not included. An additional information request was sent January 10, 2023, relaying the information we need to allow the consultation to be initiated. In early March, we learned that new information was provided by the developer regarding the technical feasibility of installing wind turbines at selected locations within the lease area. In response, BOEM provided us with a revised EFH assessment on May 4, 2023, however the EFH assessment failed to include the new proposed action consistent with the BA. We provided an additional information request along with a list of clarifying questions May 17, 2023, and a request that a revised EFH assessment be provided with the updated proposed action. Subsequently, a revised EFH assessment was provided May 30, 2023, including clarifying information related to the proposed action. While we initiated EFH consultation on June 16, 2023, we also provided BOEM with additional clarifying questions and stated if responses require updates to the analysis, we further request a revised EFH assessment with an updated analysis to help facilitate our review. We received that information through an updated EFH assessment and responses to our clarifying questions on July 6, 2023.

General Comments

The Sunrise Wind project is proposed on the southern edge of Cox Ledge, an ecologically sensitive area[1] that provides valuable habitat for a number of federally managed fish species, their prey, and other marine resources. The complex habitats found in the project area, including

[1] the term "**sensitive benthic habitats**" will be used to encompass: complex habitats and benthic features (defined as coarse unconsolidated mineral substrates [i.e. substrates containing 5% or greater gravels], rock substrates [e.g. bedrock], and shell substrates [e.g. mussel reef] consistent with CMECS definitions as well as vegetated habitats [e.g. SAV] and as defined described in our 2021 Recommendations for Mapping Fish Habitat), bathymetric features (such as lumps, banks, and scarps) and other areas of high habitat heterogeneity (diversity of structural elements including bathymetric features) and complexity.

the extensive rocky habitats at the northern and central portion of the lease are associated with the Cox Ledge ecosystem, inclusive of Priority Areas 1 and 2. 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 on this project dated September 30, 2021, September 6, 2022, October 7, 2022, February 14, 2023, August 31, 2023, and in our October 3, 2011, August 2, 2012, and June 1, 2021, letters for the Revolution Wind project. 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 New York State territorial waters, the Sunrise Wind Export Cable (SRWEC-NYS) corridor traverses in a northwest direction toward Smith Point County Park in the Town of Brookhaven, Suffolk County, NY in the coastal waters off the south shore of Long Island. The onshore export will be installed via horizontal directional drilling (HDD) under the Long Island Intracoastal Waterway (Narrow Bay) from the upland entry point located at Smith Point County Park to the upland punch-out point at Smith Point Marina. Within New York State territorial waters, the SRWEC-NYS will cross the Fire Island National Seashore and areas designated as the South Shore Estuary Reserve (SEER Council 2021) while the temporary pier and onshore transmission cable overlap the Great South Bay-East which is designated as a Significant Coastal Fish and Wildlife Habitat (SCFWH) by the state of New York, and the South Shore Estuary Reserve. Collectively, these estuarine/nearshore waters of the project area host numerous sensitive habitats that provide important ecological functions and support countless estuarine-dependent species in the region.

EFH Designations in the Project Area

The proposed Sunrise Wind Farm project is located on the southern edge of Cox Ledge in the Atlantic Ocean with project elements extending through the South Shore of Long Island and the Long Island Intracoastal waterway (Narrow Bay). 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 project area, as do ten additional shark species (dusky shark (*Carcharhinus obscurus*), blue shark (*Prionace glauca*), porbeagle (*Lamna nasus*), shortfin mako (*Isurus oxyrinchus*), common thresher shark (*Alopias vulpinus*), sand tiger shark (*Carcharias taurus*), basking shark (*Cetorhinus maximus*) spiny dogfish (*Squalus acanthias*), tiger shark (*Galeocerdo cuvier*), smoothhound shark complex Atlantic stock (*Mustelus canis*), and white shark (*Carcharodon carcharias*).

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 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 one designated and one proposed Habitat Areas of Particular Concern (HAPCs). 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, summer flounder HAPC has been designated in the project area and 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. This HAPC occurs within the project area in inshore waters and may be directly or indirectly impacted by construction of the temporary pier.

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 Sunrise 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[2]. Cod spawning activity has been identified within and adjacent to the project area and complex habitats are found throughout the lease area, particularly in the northern and central portions, as well as portions of the export cable corridor.

Rationale for EFH Conservation Recommendations (CRs)

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

Recommendations to Minimize Impacts to Atlantic Cod Spawning (EFH CRs 1-6)

As stated in our EFH determination, the Sunrise 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 NOAA Fisheries. 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 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 subpopulation is in southern New England, overlapping 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. The EFH assessment downplays impacts of the project on Atlantic cod due to the limited information on this sub-population; however, a lack of information does not equate to no impact nor does it justify exclusion of mitigation measures that would reduce impacts to EFH for Atlantic cod. We are significantly concerned that, absent mitigation measures, impacts from construction and operation of the Sunrise Wind Project and cumulative effects from adjacent development projects will have adverse population effects and hinder our efforts to rebuild Atlantic cod stocks in Southern New England. 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 establish territories and attract mates (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 and the surrounding areas 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, specifically, cod detections are greatest in areas in the northern portion of the lease, identified as Priority Area 1 (inclusive of WTG 123 and 124) in the EFH assessment. Additional trawl survey data has also identified spawning condition cod (i.e. developing, ripe and running) within this area. 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 20 2022). These factors increase the vulnerability of this population to impacts resulting from reduced spawning success.

Temporal Measures to minimize impacts to cod spawning activity

The EFH assessment suggests in water work would occur during two consecutive spawning seasons, with seabed preparation and cable installation occurring from Q1-Q2 of 2024; Q2-Q4 of 2025 for inter-array cables and from Q1 of 2024 through Q2 of 2025 for offshore export cables. Seabed preparation and cable installation require large equipment to clear the seafloor including boulder grabs, multiple grapnel runs, controlled flow excavation, and trailing suction hopper dredges (TSHD). 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. The EFH assessment further estimates that up to five percent of the total inter-array cable network would require sand wave leveling, however it is unknown where this activity may occur. The EFH assessment estimates that approximately 33 vessels may be operating in the project area at one time, which will result in elevated noise levels in the project area in addition to impacts to the benthos from anchors, anchor chain seep and spuds. All of these activities directly overlap with cod spawning activity in portions of the lease area.

According to the EFH assessment, pile driving activities would occur over approximately 43 days between May 1 and December 31 for installation of the monopile foundations for the wind turbine generators (WTGs) and jacket pile foundations for the offshore converter station - direct current (OCS-DC). Based on the EFH assessment, installation of each monopile is anticipated to require 1 to 4 hours of pile driving, with some installations potentially taking up to 12 hours of pile driving due to more difficult substrate conditions. The installation process for a single monopile is expected to include a one-hour pre-clearance period, four hours of piling at 32 pile strikes per minute, and four hours to move to the next piling location where the process would begin again. The OCS-DC would have a four-legged piled jacket foundation. Installation of a single piled jacket foundation for the OSC-DC is estimated to require approximately 48 hours maximum of pile driving with 32 pile strikes per minute. The EFH assessment identifies multiple construction scenarios that may occur including both consecutive (non-simultaneous) and concurrent (simultaneous) pile installation that may occur between Q1-Q4 of 2024 and Q2-Q3 of 2025, not including January through April.

Our evaluation of impacts of the project on EFH, including Atlantic cod spawning, was complicated by the fact that the EFH assessment does not include the most updated acoustic data. Specifically, the analysis in the EFH assessment underestimates impacts from pile driving as it did not consider the most recent underwater sound and exposure modeling report (Kusel et al. 2022) when discussing the maximum modeled acoustic radial distances (R95% in km) to behavioral thresholds for fish from pile driving activities. Based on modeling results presented in Kusel et al. 2022, the maximum noise generated from impact pile driving for installation of monopiles, assuming 10 dB attenuation, would result in impacts to managed species that extends a distance of approximately 11.77 km from the pile source during the summer and 14.57 km from the pile source during the winter using a 3,200 kJ hammer. Installation of four piles for the jacket foundation piles, assuming 10 dB attenuation, would result in impacts to managed species that extends a distance of approximately 14.85 km from the pile source during the summer, and 19.36 km from the pile source during the winter using a 4,000 kJ hammer. Collectively, these activities overlap with the timing and occurrence of cod spawning activity in the project area.

The EFH assessment considers a maximum impact scenario of pile driving with a 4,000 kJ hammer; however, the 2022 acoustic modeling report analyzes behavioral thresholds based on a range of impact hammer sizes from 1,000 kJ to 4,000 kJ (Kusel et al. 2022). Based on the results of that modeling, we identified a limited number of turbines on the easternmost portion of the lease (WTG 77, WTG 78, WTG 108 WTG 107, WTG 137, WTG 136) that could possibly be driven with a 1,000 kJ hammer while remaining outside the modeled behavioral threshold distances from documented cod spawning activity within the Sunrise Wind lease area and adjacent areas. The use of an impact hammer larger than 1,000 kJ in any other portion of the lease (outside the WTGs identified above) is expected to adversely impact cod spawning activity within and adjacent to the lease area. We recommend a full restriction of pile driving during the spawning season (November 1-March 31), as BOEM is planning to permit the maximum impact scenario for this project, which would include use of up to a 4,000 kJ hammer, and by doing so would be adversely impacting cod spawning activity both within and outside the lease area. The results of the acoustic modeling demonstrate that there are extremely limited options to minimize adverse impacts to Atlantic cod spawning in this region from the proposed pile driving activities.

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 unexploded ordinances/munitions of explosive concern (UXO/MECs) remediation or HRG surveys are expected to occur. However, the EFH assessment indicates that no UXO detonations would occur from December through April to protect North Atlantic right whales. This schedule would leave Atlantic cod vulnerable at the start of the spawning season in November, when they are initiating spawning and forming leks. 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)...” Modeling results provided (with 10 dB mitigation) further indicate that the distance for a UXO detonation to result in potential mortal injury and mortality for all fish hearing groups ranges between 49 m and 290 m (depending on charge weight). In the EFH assessment, it states that BOEM is retaining up to three detonations within the project design envelope (PDE) to account for emergent finds. Currently, only a dual noise mitigation system with a 10 dB attenuation is proposed to be implemented during all detonation events.

The EFH assessment dismisses any impacts from High-Resolution Geophysical (HRG) surveys without providing scientific justification. The EFH assessment does not evaluate how these different types of surveys would affect EFH for federally managed species. 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 within the hearing range of fish. Fishes with hearing specializations such as cod may be more susceptible to behavior impacts from these activities. These surveys also require increased vessel traffic in the project area. 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; Hammer 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 this area for spawning. Both pile driving and in-water bottom disturbing construction 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 that are intended 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 is critical to avoiding population level effects to southern New England Atlantic cod stocks. We are concerned that BOEM has not considered such a restriction as a measure to minimize impacts in the EFH assessment or the Environmental Impact Statement (EIS). The best available science and consensus of subject matter experts do not support the analysis in the EFH assessment. For example, it is stated that preliminary data suggests limited Atlantic cod spawning activity in the area; however, data collected in the project area suggest project overlap with cod spawning activity, particularly in the northern portion of the lease area. The EFH assessment further 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 McQueen et al. (2022) to support this conclusion that "Spawning cod present in the Lease Area would be exposed to elevated acoustic levels which may elicit a short-term behavioral response; however recent studies examining spawning cod behavior in response to seismic airgun sound found that cod did not abandon the spawning site". This study did not evaluate activities or conditions analogous to those proposed for the Sunrise Wind project. 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 Sunrise 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, as they would occur over two consecutive spawning seasons during times of peak activity in the project area (November through March). The suggestion that these activities (e.g. seabed preparation, boulder relocation, sand wave leveling, pile driving) are analogous to a week-long intermittent seismic air gun survey occurring, at a minimum of, 5 km away from spawning aggregations is unfounded.

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 (in-water bottom disturbing activities), including but not limited to seabed preparation, cable installation, and pile driving as well as other noise generating activities including HRG surveys and UXO/MEC detonation during the spawning season to avoid and minimize impacts to this vulnerable population from project construction. In-water bottom disturbing activities such as seabed preparation or cable installation may be sequenced so that construction during the spawning season is occurring within the southernmost and easternmost portion of the lease area and construction in areas adjacent to Priority Area 1 is minimized. This would allow construction to still occur in the lease area during the spawning season while avoiding impacts to documented spawning areas. 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.

Spatial Measures to minimize impacts to cod spawning activity

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; Grabowski et al. 2012; 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 the southern extent of Cox Ledge, within the northern portion of the lease area, identified as Priority Area 1 and inclusive of WTG 123 and 124, 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. Additional trawl survey data has also identified spawning condition cod within this area. While areas of spawning may occur beyond these turbines, this area within the northern portion 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 associated inter-array cable removal from this location is based on the available habitat and cod data, and considers the positive PAM glider detections and trawl survey data within the surveyed areas in addition to the known spawning dynamics and habitat requirements for cod spawning aggregations. It is important to note that cod spawning activity occurs within the lease area beyond the seven WTGs identified in our recommendations. The WTGs identified have the greatest overlap with cod detections and complex habitats in the lease area and were identified based on information in the EFH assessment, which indicated seven turbines would be the maximum number of WTGs feasible for removal.

While the strong site fidelity of cod with discrete spawning aggregation locations is well documented, 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, the loss of this important spawning area may have long-term population level impacts, 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 the seven WTGs within Priority Area 1, we recommend the overlapping turbines and associated inter-array cables be removed or 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 significant alteration of the substrate, including the extensive boulder relocation 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). Given the risk of significant adverse impacts from the construction and operation of the project within this important cod spawning area, we are recommending development within the identified spawning areas (Priority Area 1, inclusive of 123 and 124) be avoided and minimized to the greatest extent possible.

Monitoring Project Impacts on Cod Spawning
Ongoing studies in the project area including passive acoustic monitoring, acoustic telemetry and trawl surveys have detected tagged and spawning condition cod within and adjacent to the Sunrise Wind area and have documented the Cox Ledge area as an important area for spawning cod. However, there are spatial and temporal limitations of the ongoing surveys that limit our 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 Cox Ledge area in the 2021/2022 survey season, there is only a single year of data available for review and the expanded area does not include all of the Sunrise Wind lease area. Atlantic cod grunts and telemetry tags have detection limitations of 10 m and up to 1 km (in ideal conditions), respectively. The EFH assessment highlights the lack of cod grunts detected in the project area; however, it is also important to recognize that these detection limits make it challenging to detect cod grunts. 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 also 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 northern region of this lease area for cod spawning is evident from the multiple telemetry detections over the course of the survey and the spawning condition cod (i.e. developing, ripe, ripe and running) collected in the areas of cod detections. 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.

It is necessary to determine the full extent and distribution of cod spawning activity in order to understand how the construction and operation of Sunrise Wind affects cod spawning and the southern New England cod distinct population. Pre-, during and post construction monitoring for cod spawning activity is needed to understand the impacts of project construction and operation on the spawning population. It will be important to continue the ongoing study and incorporate additional survey effort through the integration of additional bottom-mounted passive acoustic receivers and gliders to allow for better spatial and temporal coverage to document the current extent of cod spawning activity and monitor for changes in spawning activity during and post-construction. Additionally, the study area should encompass all areas of potential effects from the project, including areas outside the lease that may be affected by construction noise or operational wind wake effects. The May 30, 2023 EFH assessment suggested BOEM was proposing monitoring of cod spawning, but that was removed from the updated July 6, 2023 assessment, so it is unclear if any monitoring is being proposed. We recommend monitoring continue in this area pre-, during and post construction and be expanded to ensure better coverage of the Sunrise lease area and adjacent sites.

While not included in the EFH assessment, we understand BOEM and Sunrise Wind are considering ways to contribute to and expand monitoring in the lease area. We also understand BOEM is considering plans to require additional passive acoustic receivers in the Sunrise Wind project area and adjacent leases, which may include the addition of four to five passive acoustic receivers as part of a program spearheaded by BOEM's Center for Marine Acoustics. We are encouraged by this news, as it will improve coverage in the area to better understand project effects on EFH and Atlantic cod spawning. It will be critical that, in addition to marine mammals, the data collected also evaluate results of Atlantic cod activity as well as other soniferous fish. Given that the ability to collect Atlantic cod grunts is extremely limited (10 m), we also recommend expansion of ongoing glider coverage be included to increase coverage for better understanding Atlantic cod activity and project effects in this area. We also understand that Sunrise Wind will purchase an additional 100 acoustic transmitters that can be used to opportunistically tag Atlantic cod captured during the trawl survey to support the ongoing BOEM-funded Atlantic cod spawning study that is occurring throughout the MA/RI WEA. This should also help expand coverage for this study. This ongoing monitoring is important to help better understand Atlantic cod activity within and around the project area pre-during and post construction; however, 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.

Recommendations to Minimize Impacts from Operation of the Offshore Converter Station (EFH CRs 7-10)

The offshore converter station- direct current (OCS-DC) is proposed to be located within the lease area in Priority Area 1 and will use open-loop cooling during operation. The cooling water intake structure (CWIS) will withdraw raw seawater to dissipate heat produced from AC to DC conversion, followed by the subsequent discharge of the water back into the receiving waters as thermal effluent at a maximum daily effluent temperature up to 90 degrees Fahrenheit. The effluent will additionally contain sodium hypochlorite (i.e., bleach) which is discharged due to the use of an electrochlorinating system to prevent biological growth in the cooling system. Adverse impacts may arise from construction of the OCS-DC in Priority Area 1 during cod spawning and operation of the CWIS that can entrain and impinge aquatic life, specifically eggs and larvae (zooplankton and ichthyoplankton). Impacts may additionally arise due to thermal stress caused by the heated effluent on all life stages and the release of toxic chemicals into the environment.

BOEM's review of HVDC cooling systems concludes that open-loop cooling is currently the only commercially available technology for cooling offshore converter stations from the conversion of AC to DC; however, emerging research is now being conducted to explore closed-loop cooling systems (Middleton and Barnhardt et al. 2022). A study called COOLWIND which began research in 2019 is scheduled to be completed in September 2023, and is developing new closed-loop technology that will not require seawater pumps, filters, heat exchangers, salt water piping, or chlorination of the seawater (European Commission 2023). The goal of this research project is to commercialize the Future Subsea Controllable Cooler (FSCC) subsea cooler developed by Future Technology for use on offshore wind HVDC converter stations. Closed-loop cooling systems or other advances on cooling technology may become commercially available within the coming years (Fisher et al. 2021).

According to the NPDES permit, the OCS-DC proposed for the Sunrise Wind Farm has an operational life span of 25 years, however, the EFH assessment states the operation period may occur up to 35 years. The Clean Water Act (CWA) specifies that the NPDES permit is valid for five years from the date of issuance and that the permit may be reissued upon expiration. Given the extensive life span of the project and the unmitigated effects of the proposed operation, we recommend that the OCS-DC CWIS be retrofitted with a closed-cycle cooling system at the time the technology is made commercially viable. The feasibility of upgrading the proposed CWIS with a closed-cycle cooling system and incorporating best available technologies should be evaluated every five years upon re-application of the NPDES permit for operation of the OCS-DC. We recommend this be included as a condition of COP approval and the NPDES permit.

Since Sunrise Wind proposes to use open-loop cooling for the OCS-DC, we remain concerned about the location of the OCS-DC in Priority Area 1, which is defined by areas of documented cod spawning activity, and the proximity of the CWIS to Cox Ledge. Given the current stock status for Atlantic cod in the region, and documented spawning activity in Priority Area 1, there is a high likelihood for adverse impacts to early life stages from operation of the CWIS due to the entrainment of eggs and larvae. To minimize the risk to early life stages of Atlantic cod, we recommend the OCS-DC be relocated outside of Priority Area 1 to a position further south and east within the lease area and sited as far from documented cod spawning activity as possible and outside of sensitive benthic habitats associated with Cox Ledge. Should BOEM deem relocation of this OCS-DC infeasible, it is particularly important to incorporate additional mitigation and monitoring measures to better understand effects and identify additional measures to reduce impacts.

The EFH assessment refers to an entrainment analysis that was provided in the NPDES permit application to estimate the number of larvae entrained per year based on projected average monthly intake flows of the OCS-DC. However, as stated in the draft NPDES permit, these predictions underestimate the total number of larvae that could be entrained. The analysis provided in the EFH assessment was limited in that only NOAA's Marine Resource Monitoring, Assessment, and Prediction (MARMAP) program and NOAA's Ecosystem Monitoring (EcoMon) program data from a subset of EFH species for which eggs and larvae are present was analyzed. In addition, the analysis was based on a much larger geographic area than the area within the lease area boundary. Further, limiting the analysis to only species with designated EFH ignores impacts to ecologically important forage species such as sand lance (*Ammodytes spp.*) and Atlantic menhaden (*Brevoortia tyrannus*) that provide prey for federally managed species, which are a component of a species' EFH.

EPA re-examined the data for all species and calculated entrainment estimates based on the same MARMAP and EcoMon data, and found that the number of larvae entrained per year based on projected average monthly intake flows nearly doubles from an estimated 2,941,824 larvae in the EFH assessment to 5,632,408 larvae estimated from EPA's analysis. EPA further re-did the analysis trimming the dataset to all species collected within the boundary of the wind farm area and calculated that the estimated number of larvae entrained per year based on projected average monthly intake flows increased from 5,632,408 larvae to 6,345,726 larvae.

It is important to note that this analysis cannot be relied upon to accurately assess the potential population level impacts to Atlantic cod as it relies entirely upon larval data and is based on limited sampling during the spawning season. Because NOAA's National Center for Environmental Information (NCEI) dataset does not identify eggs to species level, the species-specific ichthyoplankton entrainment results in the analyses were based only on larval life stages. While annual entrainment estimated from projected monthly average operation flows was within the range of 5.5 to 6.5 million larvae per year, this value underestimates total entrainment as egg data were not included in these estimates. As stated in the draft NPDES permit, eggs typically occur at higher densities than larvae. Such an approach is particularly problematic for species that spawn in the project area, including Atlantic cod.

Unsupported conclusions appear to be made in the EFH assessment which state that the eggs and larvae of Atlantic cod are not expected to be as susceptible to OCS-DC operation relative to other species, as the analysis estimates that a total of up to 34,239 Atlantic cod eggs and larvae could be entrained on an annual basis. However, this estimate is inaccurate as the entertainment analysis only considered larval life stages and did not include eggs for surveys conducted after 1989. Additionally, we do not have annual juvenile production data for southern New England cod, and cannot conclude that this sub-population, which has potentially high self recruitment (McBride and Smedbol 2022), would not be impacted by the entrainment in the CWIS. An index based estimate of abundance (Richardson et al. 2020, Richardson et al. 2010) of the regional early-life stages (eggs and larvae) cod would provide a better estimate of the population level impacts to the southern New England spawning stock. Additionally, the ability to draw conclusions related to impacts on Atlantic cod is limited by the extent of available sampling data during the spawning season. In order to assess the effects of entrainment and impingement of Atlantic cod eggs and larvae, site-specific data collected consistently throughout the spawning season is necessary.

We recommend the proposed ichthyoplankton study be expanded to include additional sampling to allow for the evaluation of impacts to cod early life stages from the operation of the OCS-DC within an area of cod spawning activity. We consider this monitoring to be critical should relocation of the OCS-DC outside cod spawning areas be deemed infeasible. While the draft NPDES permit includes a requirement for standard impingement/entrainment monitoring requirements for operation of the CWIS, this proposed monitoring is not capable of detecting potential impacts to cod eggs and larvae from operation of the OCS-DC. The frequency and temporal limitations of the sampling, currently proposed as quarterly, is insufficient to evaluate the impacts of OCS-DC operation on early life stages of Atlantic cod. Sampling once a quarter[3]over a 48-hour period would result in only one, or at best two, sampling events during the spawning season (November - April). Cod are broadcast batch spawners where eggs and sperm are released in multiple batches over an extended period that may span 1-2 months (Kjesbu 1989; McBride and Smedbol 2022). For example, a female may spawn over a 50-60 day period and produce between 17-19 egg batches (Kjesbu 1989). Sampling on a quarterly basis would not provide sufficient information to draw conclusions related to entrainment of cod eggs and larvae at the OCS-DC.

Consistent and frequent sampling throughout the spawning season is necessary to provide sufficient data to allow for an evaluation of the effects of the OCS-DC on Atlantic cod spawning. In order to understand impacts of placing the OCS-DC within cod spawning areas (Priority Area 1), the sampling frequency should be increased to weekly during the peak period for eggs and larvae to allow any assessment related impacts of operation on cod early life history stages. Our Northeast Fisheries Science Center (NEFSC) conducted a review of monthly 61-cm bongo data (1977 to 2022) in which larval Atlantic cod concentration (number per 100 m^{-3}) was extracted from Plankton Strata 20 and 24 and North Atlantic Right Whale prey surveys from the southern New England Wind Energy Areas. These results, found that 90% of historical Atlantic cod larval catches were captured between December through April, 96% were captured between December through May, and 99% were captured from November through May. This is consistent with what we know about cod spawning activity in the area, and when we may expect eggs and larvae to be present. Available information shows that leks begin to form in November, with peak grunt detections occurring between November and January and ichthyoplankton data indicates spawning success occurs later in the spawning season, with peak success occurring between January and March (Van Hoeck et al. 2023; McBride and Smedbol 2022). At a minimum, we recommend that ichthyoplankton monitoring frequency be increased from quarterly sampling to weekly sampling during peak egg and larval presence between December through April of each year for five years. This frequency of sampling is particularly important given the proposed location of the OCS-DC within a spawning area and the lack of mitigation measures to reduce impacts of entrainment on early life stages of cod.

We acknowledge that proposed DNA sequencing described in the draft NPDES permit will help with the genetic identification of cod eggs as it is not possible to distinguish between the early-stage eggs of cod, haddock (*Melanogrammus aeglefinus*), and witch flounder (*Glyptocephalus*

[3] Quarters in the draft NPDES permit are defined as Winter (December, January, February), Spring (March, April, May), Summer (June, July, August) and Fall (September, October, November)

cynoglossus) through typical visual examination of physical attributes (Markle and Frost 1985; Lough et al. 1994). DNA sequencing will help ensure reliable identification of cod during the spawning season. While it is important to be able to accurately identify the egg samples, we would note that at a quarterly sampling frequency, as currently proposed, it will not be possible to use this data to understand the effects of the OCS-DC operation on Atlantic cod spawning success in the project area.

The draft NPDES permit currently requires ambient thermal monitoring up to 15 m from the outfall and ichthyoplankton monitoring conducted within the hydraulic zone of influence (HZI) of the CWIS and the full water column (within about 15 ft. of the bottom) on a quarterly basis. We acknowledge that the full water column ichthyoplankton sampling outlined in the permit is consistent with sampling conducted by NOAA's EcoMon program. However, we recommend that the developer coordinate with our NEFSC to ensure the data collected can be incorporated with EcoMon data. We also recommend that the monitoring plan be revised to incorporate comments we provide in Appendix B to help ensure ichthyoplankton surveys are collecting data to allow for a site-specific assessment of the impacts from the OCS-DC operation. The draft NPDES permit further states that ichthyoplankton monitoring frequency may be reduced after four years. Collectively, we recommend that ichthyoplankton monitoring be required for the operational life of the OCS-DC and all data and results be provided to NOAA Fisheries. Results of the monitoring should be considered in the identification of mitigation measures to reduce impacts to EFH. At a minimum, this should be required upon any re-issuance of the NPDES permit.

Recommendations to Minimize Impacts to Benthic Habitats (EFH CRs 11-27)

Rocky Habitats

The project area is located on the southern edge of the Cox Ledge ecosystem and overlaps with structurally complex habitats, including natural rocky habitats that support a wide range of marine resources. Complex habitats have been identified throughout much of the lease area, with particularly dense rocky habitats in the north-west and central portions of the lease area in Priority Areas 1 and 2. Other portions of the lease area include a mix of soft bottom habitats, areas of gravel and cobble with scattered boulders. Rocky complex habitats are also located along portions of the export cable route. 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 et al. 2001, Auster 2005, Methratta and Link 2006). These rocky and shell habitats provide three-dimensional structures that play an important ecological role for fish as shelter and refuge from predators (Auster 1998; Auster and Langton 1999; NRC 2002; Stevenson et al. 2004).

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. Post settlement survival and densities as well as survivorship of juvenile Atlantic cod have been found to be higher in more structurally complex habitats, with cod survival highest on rocky reefs and cobble bottoms (Lindholm et al. 1999 and 2001; Tupper and Boutilier 1995). The relationship between benthic habitat complexity and demersal fish community diversity has also been positively correlated (Malek et al. 2010). 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 various species such as red hake, Atlantic cod 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). Due to their important role for multiple marine organisms and vulnerability to disturbances, impacts to rocky habitats should be avoided wherever feasible.

The project developer is proposing full build out of the lease area outside positions that they deemed infeasible for construction due to the presence of glauconite soils. The location of these glauconite soils are in the south and east portion of the lease which are largely soft bottom habitats with scattered boulders. The newly identified construction feasibility issues have limited the options BOEM is considering to minimize impacts to complex habitats in the project area that may be more vulnerable to permanent impacts. However, it is still possible to reduce development within complex habitats and thus minimize the extent of permanent impacts to the Cox Ledge ecosystem while still meeting the project purpose. The maximum number of turbines possible should be removed from the northern portion of the lease area that overlaps with cod spawning and complex habitats and development within complex habitats associated with Cox Ledge should be minimized to the maximum extent possible.

In addition to removal of WTG locations and associated inter-array cables, further minimization of impacts to high value complex habitats 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 the WTG foundations, as well as the inter-array cable, the OCS-DC, and the export cables. 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. Based on our review of the habitat data, it is possible to reduce impact by careful siting of the WTGs and cables and that it should be required as a stipulation of the BOEM and USACE authorizations.

Based on information provided in the EFH assessment, it is our understanding that Sunrise Wind anticipates relocating boulders in the lease area and along the export cable route. Boulders are scattered throughout the lease area and are particularly dense in areas identified as Priority Areas 1 and 2 (north and central portion of the lease). Using a boulder grab, boulders ranging from 0.5 m to 2.4 m are proposed to be relocated within a 220 m radius center on the foundations and up to 15 m from its original location if the boulder is located on the centerline of the SRWEC or inter-array cable. The EFH assessment estimates that 70 out of 87 potential WTG positions and the OCS-DC may require boulder relocation, and notes that additional boulders may be identified during construction that could also require relocation. The EFH assessment further notes that boulders may be relocated longer distances where technically necessary; however, exact locations where this could be warranted have not yet been identified. There is no further information provided on the anticipated number of boulders expected to be relocated; the assessment does not fully analyze the effects to EFH based on the scale of boulder relocation.

Based on our review of the habitat data, we anticipate removal and relocation of boulders to occur at a substantial scale that will result in significant adverse effects to EFH, particularly in the northern and central portions of the lease area. Removal and relocation of boulders can result in impacts to EFH through habitat conversion, elimination of biota and epifaunal coverage, and reductions in structural refuge for early life stages. 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. This can create hazards for fishing and survey operations in the area and pose a significant safety risk and adverse economic impacts due to gear damage/loss and lost fishing opportunities. These adverse effects could be substantially reduced by following our EFH CRs to minimize 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 and the minimum number of turbines being contemplated for removal. 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 NOAA Fisheries and the fishing industry so that the risks and consequences of the boulder relocation activities can be understood and incorporated into the plan. We recognize that 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 benthic habitat was modified by boulder relocation activities. Fine-scale post-construction multibeam backscatter and side scan sonar surveys should be conducted throughout the lease area and the cable route. The information should be provided to NMFS HESD in a viewable format (e.g. 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 to understand how construction and operation of the project have modified the benthic environment.

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.

In addition to construction activities, the operation of the project, including the presence of

WTGs and scour protection will result in permanent impacts to the Cox Ledge ecosystem 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. Artificial substrates are not expected to replace the functions and values of natural habitats, particularly for juvenile species and may provide novel habitats that can act as a platform for the introduction or expansion of invasive invertebrate species. 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. 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). 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. Careful consideration of scour protection used is important to minimize impacts so that materials used can mimic, as best as possible, the existing conditions in the project area.

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. Reducing the size of the project and ensuring full burial of all cables so that additional scour protection is not required will help reduce permanent impacts to EFH. 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.

Up to 19.8 km of sand wave leveling of habitats is proposed along the export cable route and up to 5 acres within the inter-array cable network via a controlled flow excavator and/or trailing suction hopper dredger. While sand wave habitats may eventually be expected to recover, temporal losses of the functions and values these habitats provide will occur. Additional habitats may be impacted by dredge disposal; ensuring disposal does not occur within sensitive habitats is necessary to minimize effects of these activities on EFH. Given the large extent of area to be impacted, it is unknown how long it will take these habitats to recover. Micrositing the export cable within the corridor in a manner that reduces the extent of sand wave leveling and dredging will help minimize these impacts.

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 as well as impingement and entrainment from operation of the OCS-DC cooling water intake system (CWIS) 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. Given the importance of sand lance on the ecosystem in this region, more studies to better understand the impacts of this project and others on sand lance are warranted.

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 natural 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 within the lease area.

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). 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 and micrositing WTGs and cables outside complex habitats to reduce the risk of invasive species expansion. Additionally, measures to reduce the extent of anchoring in complex habitats 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, will minimize the extent of scour protection required, thus reducing the extent of artificial substrate for invasive colonization.

Recommendations to Minimize Acoustic Impacts from Construction (EFH CRs 28-30)

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 and OCS-DC is expected to result in the greatest noise levels and affect a more extensive area of EFH (Taormina et al. 2018). For the Sunrise Wind project, pile driving is proposed for the WTGs and OCS-DC in the lease area, installation of the casing pipe within the coastal waters off the south shore of Long Island and installation of the temporary pier within the Intracoastal Waterway. Monopile and piled jacket foundations are proposed to be installed using a 4,000-kJ hammer in the lease area. At the HDD excavation pit, the use of an 18-kJ hammer to install the casing pipe is proposed. An impact hammer with a rated energy of approximately 15,000 foot-pounds (ft-lb) (e.g., APE D8-42) will be used for installation of the production piles for the temporary pier. While Sunrise Wind will attempt to avoid UXOs, they are retaining up to three detonations within the COP PDE to account for emergent finds in the project area.

Based on the acoustic modeling report, the maximum noise generated from impact pile driving for installation of monopiles, would result in impacts to EFH for managed species that extends a distance of approximately 11.77 km from the pile source during the summer and 14.57 km from the pile source during the winter using a 3200kJ hammer (Kusel et al. 2022). Installation of four piles for the jacket foundation piles would result in impacts to EFH for managed species that extends a distance of approximately 14.85 km from the pile source during the summer, and 19.36 km from the pile source during the winter using a 4000kJ hammer (Kusel et al. 2022). While the EFH assessment failed to evaluate impacts from casing pipe installation, acoustic modeling results show behavioral effects on fish could occur up to 2.51 km from the source (Kusel et al. 2022). Acoustic impacts from installation and removal of the temporary pier are unclear as the EFH assessment states approximately 24 production piles would be required, however, a revised Temporary Pier Pile Driving assessment was sent to our Office of Protected Resources Division in March 2023, indicating a revised work scope of up to 26 production piles may be required. Based on acoustic modeling for the 24 production piles, behavioral effects on fish could occur up to 891.3 m from the source using an impact hammer with a rated energy of 15,000 ft-lbs (e.g., APE D8-42) (LGL 2022). 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. 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).

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).

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)

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 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 use a double bubble curtain, plus AdBm complete with air flow optimization during monopile foundation installation (the same methodology proposed for South Fork Wind and Revolution Wind), and that Sunrise Wind is committed to achieving ranges associated with 10 dB of noise attenuation. 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). 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 or other noise dampening methods, and soft start procedures. On-site verification should be used to determine if dampening methods are working as intended.

Regarding the nearshore environment, Sunrise Wind has indicated that they do not intend to use sound barriers or other noise mitigation measures at the Smith Point Marina during pile installations, as that work is not expected to exceed applicable noise requirements. However, it should be noted that impacts from pile driving may have differing effects on the shallow water inshore environment than offshore environments. In addition to the obvious factors such as hammer size, hammer impact energy, and pile type and configuration, environmental factors such as water depth, geotechnical conditions, topography, and seabed properties may cause significant variations in sound levels and sound characteristics (such as the direction and strength of the sound wave) (Amaral et al. 2020 ; Rodkin and Pomerenck 2014). Therefore, sound mitigating measures, such as soft start procedures should be incorporated to minimize impacts to EFH during construction of the temporary pier. The impulsive sounds generated by impact pile driving make them potentially more injurious to marine life as compared to the non-impulsive sounds generated during vibratory pile driving (Popper et al. 2014 ; Southall et al. 2019). The intense underwater sound pressure waves directly associated with impact pile driving may adversely affect fish species and their habitats and have been shown to injure and kill fish via injuries such as rupture of the swim bladder and internal hemorrhaging (CalTrans 2001; Longmuir and Lively 2001). We recommend that vibratory pile driving, to the maximum extent practicable, be used for installation and removal of the temporary pier.

Recommendations for Avoiding and Minimizing Impacts to Estuarine/Nearshore Habitats (EFH CRs 31-39)

As the SRWEC-NYS approaches landfall at the south shore, the cable corridor will cross the Fire Island National Seashore and areas designated as the South Shore Estuary Reserve (SEER Council 2021) via horizontal directional drilling (HDD). Once the cable makes landfall, the onshore transmission cable is proposed to be routed via HDD under the Long Island Intracoastal Waterway. Sunrise Wind proposes to construct and decommission a temporary pier on the inshore side of Fire Island. Both the temporary pier and the onshore transmission cable will overlap the Great South Bay-East, which is designated as a Significant Coastal Fish and Wildlife Habitat (SCFWH) by the state of New York, and the South Shore Estuary Reserve.

Collectively, these areas host numerous sensitive habitats that provide important ecological functions and support countless estuarine-dependent species in the region. Winter flounder spawning/egg/larvae habitat, sand waves, shellfish beds, SAV, and other sensitive benthic habitats occur in the estuarine/nearshore project areas. The construction and installation of the SRWEC-NYS, onshore transmission cable, and temporary pier will result in direct and indirect adverse effects to the estuary, including sensitive life stages for federally managed species and their prey (e.g., shellfish). Mitigation measures discussed above, including measures to avoid and minimize routing cables and anchoring within sensitive habitats, as well as noise dampening methods will also be important to implement in the nearshore environment to reduce impacts to EFH.

Winter Flounder EFH

Winter flounder may be more vulnerable to project impacts including inshore construction associated with the temporary pier. 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, pile driving, and other sediment disturbing activities. 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. 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. Areas of the proposed project that are 6 m in depth or less are spawning and nursery habitat for winter flounder, which will be degraded via pile driving and turbidity/sedimentation activities.

As stated in the EFH assessment, EFH for winter flounder eggs and larvae was identified within the intracoastal waterways of the project where the temporary pier is proposed to be installed and removed. A Winter Flounder Monitoring and Minimization Plan was developed by Sunrise Wind should installation or decommissioning of the temporary pier occur during the winter flounder restricted window (December 15 through May 31 of any year), however, this plan was not referenced in the EFH assessment or provided to us. A pre-construction SAV survey was identified in the plan as a measure to minimize impacts to winter flounder as SAV provides biogenic structure to which winter flounder eggs may attach. However, winter flounder deposit their eggs in shallow bays and estuaries along the coast, not inclusive of SAV. As a result, an SAV survey is not a suitable mitigation measure to offset impacts to winter flounder early life stages and their EFH. Furthermore, the plan states that in the event New York State Department of Environmental Conservation (NYSDEC) determines lethal impacts to winter flounder will occur as a result of the temporary pier, Sunrise Wind plans to provide 20 acoustic transmitters to Stony Brook University to support ongoing acoustic telemetry research on winter flounder in the coastal waters. Determinations regarding effects to winter flounder made by the NYSDEC have no bearing on our EFH conservation recommendations or our authority under the MSA to provide EFH conservation recommendations to BOEM and USACE. Overall, we do not consider the proposed mitigation to be an effective way to minimize impacts to winter flounder sensitive life stages and should not be conducted in lieu of a time of year restriction. Suspended sediment impacts caused by piles driven into the substrate by impact or vibratory hammers have the potential to negatively impact winter flounder eggs and larvae. Pile installation and removal for the temporary pier or other turbidity/sediment-generating activities should be avoided from January 15 to May 31 of any given year in estuarine/nearshore waters of 6 meters in depth or less within Narrow Bay/Long Island Intracoastal Waterway.

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, 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.

SAV has been mapped near the proposed temporary pier at Smith Point County Park and along the export cable route where HDD methods are proposed under the Great South Bay-East between Smith Point County Park and the Smith Point Marina. On October 12, 2022, the Cornell Cooperative Extension of Suffolk County (CCE) conducted a SAV survey of the proposed Sunrise Wind temporary pier at Smith Point County Park, Narrow Bay, Brookhaven, NY. Underwater video results indicated that eelgrass (*Zostera marina*) was identified at six different locations in the northeastern area of the proposed temporary pier landing site. We recommend a minimum of a 100 ft. set-back from the edge of the SAV bed for mooring, anchoring or staging equipment be maintained at all times. SAV maps should also be provided in the form of maps to vessels/captains to ensure SAV is avoided. In addition, should the project unintentionally impact SAV, compensatory mitigation should be provided at a minimum ratio of 3:1.

Reducing Impacts from HDD Pit Excavation

Sedimentation impacts are more pronounced in estuarine environments and impacts from sedimentation and turbidity will be most impactful for epibenthic invertebrate species and sensitive life stages of fish, such as demersal eggs (i.e., winter flounder, longfin squid) and shellfish habitat found in the project area. The EFH assessment proposes that excavation of the HDD exit pit will be conducted via divers using diver jetting and airlift tools to excavate 731 cubic yards from a 20 ft. by 50 ft. by 10 ft. deep pit with a 3:1 side slope. The discharge end of the tools will be placed approximately 10 to 20 ft. away from the excavation and the materials from the pit will be selectively relocated from the pit. As the material is placed on the seafloor, divers will move the discharge end of the tool to minimize build-up in one location and excavated materials are expected to naturally backfill the exit area excavation. Temporary placement of excavated HDD exit pit sediment on the seabed for a 45-day period may occur. The EFH assessment states model simulations undertaken at the HDD exit pit show that after a 45-day model simulation that included two mobilization events associated with storm activity, 89 percent of the excavated sediment would be within 38 m (125 ft.) of the initial placement.

Should dredging be necessary for excavation of the pit, we recommend dredging be confined within open waters 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 uplands or barges 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. We recommend these plans be developed with particular attention to protecting SAV that has been documented within the Long Island Intracoastal waterway. These plans should be shared with NMFS HESD prior to construction.

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 benthic habitats. 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 benthic habitats. We also recommend that all vessels avoid anchoring/spudding in sensitive benthic habitats in the nearshore project area, consistent with EFH CRs for minimizing impacts from anchoring and impacts to SAV.

Recommendations for Minimizing Operational Impacts and Addressing Uncertainties (EFH CRs 40-41)
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 project impacts is not equal to having no impacts. The Sunrise 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 Sunrise 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 Kerckhof 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. 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 that 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).

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). 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 such as foundation type (Lefaible et al. 2018) and 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).

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 are still not fully understood. As such, impacts should not be assumed to be net neutral or beneficial or promoted as such within the assessment. Increased fish aggregation around turbines does not necessarily imply net or future population growth for the species (Smith et al. 2016), and the assessment should discuss whether the potential increase in fish biomass at artificial 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). 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

Presence of resources within the project area is driven by pelagic habitats as well as 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 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 Sunrise 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 found 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 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. While the EFH assessment acknowledges that "Changes in distribution of finfish eggs and larvae caused by hydrodynamic disturbance could potentially change estimated entrainment at the OCS-DC," it later goes on to suggest that "effects should not lead to population level effects." 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 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. 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 Sunrise 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).

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. Sunrise Wind is proposing to employ HVAC transmission through the construction of 66-kilovolt (kV) transmission cables for the inter-array cables. The SRWEC would consist of one distinct cable bundle consisting of two 320-kV direct current (DC) conductors and one fiber optic cable. 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; similar to what is proposed for the export cable; however, it is unclear how EMF emissions from the HVAC inter-array cables will affect larval life stages for gadids in the project area.

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 (Öhman 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 Sunrise Wind will attempt to bury the cables for this project to a target depth of 6 ft. (2 m) in state waters and 3 to 7 ft. (1 to 2 m) in federal waters where feasible. The EFH assessment estimates that 5 percent of the inter-array cables and 5 percent of the SRWEC-OCS may remain unburied and require scour protection where they cannot be fully buried to the target depth, as well as areas where they cross existing cables. We expect EMF emissions to be greater in those areas, lending further support for avoiding development in areas of complex habitats.

Monitoring Project Effects

Sunrise Wind is proposing to conduct benthic monitoring in the project area on soft and hard bottom habitat as well as along portions of the SRWEC. We reviewed drafts of the monitoring plans submitted to us, and provided comments on these plans on September 24, 2021. In our comments, we raised concerns with some of the proposed studies that should be addressed prior to their commencement and suggested an expansion of the monitoring plan to include existing habitats. We received an updated version of the Benthic Monitoring plan, dated April 8, 2022, that appears to address very few of our previous comments. We remain concerned about the ability to detect significant change in benthic habitat quantity and quality pre and post construction. We also remain concerned about 1) the lack of pre-construction sampling sufficient for establishing baseline conditions, 2) the limited duration of post-construction sampling, 3) the lack of soft-bottom benthic community monitoring, 4) the lack of natural hard-bottom monitoring across the complex suite of hard-bottom habitats that currently exists within the project area, and 5) the insufficient sampling and replication necessary to assess changes in the benthic community structure. As proposed, the benthic monitoring plan is not sufficient to inform project development impacts to EFH because of the limited survey effort devoted to sampling EFH. Omission of natural hard bottom monitoring and exclusive devotion of hard bottom habitat monitoring to introduced hard bottom is a major flaw of the monitoring plan currently proposed. Soft bottom EFH habitats will only be sampled marginally more and only in regards to cable and WTG-associated physical impacts; the proposed monitoring plan will not allow conclusions to be made on impacts to soft bottom habitat EFH outside of areas immediately disturbed by development.

Given the diversity of habitats throughout the project area, and the potential impacts of the project on various life stages of a myriad of species, we consider a well-developed and comprehensive monitoring program to be an important component of this project that will help identify potential impacts of the project on EFH. Further, the monitoring components of lease development should be aligned with the NOAA Fisheries and BOEM Federal Survey Mitigation Implementation Strategy, which identifies alteration of habitats by wind energy developments as one of the four primary impacts to NOAA Federal Surveys. Specifically, until a full, project specific, mitigation plan is developed for each survey impacted by lease development; information generated from project specific monitoring plans may be necessary to supplement or complement existing survey data. As a result, project specific monitoring to fill regional scientific data needs has been identified as one of the six main components of federal survey mitigation. To successfully achieve this component, monitoring plans must provide a thorough and holistic view of how habitats have changed during construction, operation, and decommissioning relative to baseline conditions.

Methratta et al. 2023 examined all of the publicly available project-specific monitoring plans, including the monitoring plan from Sunrise Wind, and found that very few, if any, of the proposed monitoring plans would yield information that could help mitigate impacts to federal scientific surveys. Information limitations are primarily a result of the monitoring plans not necessarily being designed with the intention of providing data to be incorporated directly into a NOAA Fisheries survey time series. However, Methratta et al. 2023 suggests that validation of estimation modeling assumptions of population level responses to habitat change within the zone of impact of wind development could provide a path forward for proposed monitoring plans to align with the federal survey mitigation strategy. Therefore, it is important that the benthic monitoring plan is revised, based on the recommendations provided here, to ensure that the information provided will be sufficient to allow for the validation of modeling assumptions about how species have responded to changes in habitat as a result of lease development. The first step of that effort is ensuring the monitoring plans accurately depict how habitats, both introduced and existing, have changed as a result of project construction, operation, and decommissioning.

We remain concerned that the proposed sampling and replication is not adequate to detect meaningful changes (i.e. the statistical power of the study to detect changes) across the lease area as a result of project construction, operation, and maintenance for a variety of technical survey design limitations and omissions, many of which were previously identified through our comments provided in September 2021. Therefore, we recommend a thorough review and incorporation of our previously provided comments into the monitoring plan. The project area contains a diverse range of habitats, ranging from soft bottom to complex hard habitats, 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, and consistent with previously provided comments, 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. The monitoring plan, as proposed, only identifies habitat type as the basis for the stratified sampling design despite prior recommendations to also include depth. Further, the novel hard bottom monitoring does not clearly define which elevations on the WTG foundations will be surveyed. The soft bottom habitat monitoring relies heavily on SPI/PV imagery however; it does not describe how many images will be taken per station, which severely limits our ability to review the survey's design.

Across all surveys in the monitoring plan, as previously commented, the lack of or extremely limited pre-construction sampling (in the case of the soft-bottom monitoring, a single survey prior to construction) is a major limitation of the surveys as proposed. As described above, in order for monitoring plans to adhere to the guidelines and principles set forth in the federal survey mitigation strategy, monitoring activities should provide robust information on how benthic and pelagic habitats have changed in and around wind energy development. Describing and analyzing the extent of habitat change will not be possible without a thorough description of baseline habitat conditions prior to construction which requires at least 3-5 years of surveys to account for interannual variability.

The current Benthic Monitoring Plan is severely limited in its ability to describe fully impacts of lease development due to the omission of natural, pre-existing, habitat types in the various survey designs. Both disturbed (relocated boulders) and undisturbed hard bottom habitats should be included in the monitoring plan to further describe how habitat quantity and quality have been impacted by lease development. Undisturbed soft bottom habitats (i.e. habitats outside the inter-array cables and SRWEC) should be included in the monitoring plan, alongside adequate grab sampling, to investigate impacts of cumulative lease development on soft sediment community composition and function. While the evaluation of the successional stage of soft-bottom habitats may provide useful information, no method (i.e. benthic grabs) has been 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. The inclusion of undisturbed soft bottom habitat is critical to contextualize the results from the proposed soft bottom monitoring. As proposed, soft bottom monitoring will end once conditions are indistinguishable from the baseline; however, as pointed out in previous comments, due to the cumulative impact of lease development, the previously observed baseline may never return. Monitoring existing, undisturbed, soft bottom habitat will provide critical information about what the new baseline may be post-construction. Adequately sampling and monitoring of changes in the benthic community structure are necessary in order to understand the effects of the proposed project in both soft and hard bottom habitats. 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.

We note that the Sunrise Wind Benthic Monitoring Plan 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 colonies 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 and insufficient collection of baseline data will limit the ability to draw conclusions about lease-wide project effects on invasive species colonizations and fragmentation. There is high 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.

Finally, the Benthic Monitoring Plan should also include measures to evaluate and quantify lease-wide physical changes to the benthic habitat including depth, hardness, rugosity, slope, and other morphometrics through post-construction acoustic surveys (bathymetry, multibeam backscatter and side scan sonar). Post construction acoustic surveys should be able to answer a multitude of questions related to the physical habitat impact from lease development. Specifically, acoustic surveys should be able to answer not only the total amount of each habitat type that has been impacted (through alteration, conversion, or fragmentation) but also the relative distribution of habitat types across the lease in relation to one another pre and post construction. Further, acoustic surveys should provide information on construction related impact assumptions; specifically, if sand wave habitats have naturally been restored after construction. Incorporation of the proposed monitoring plan comments, here and from the September 2021 communication, as well as the expansion of the monitoring plan to include the components identified here would ensure the monitoring efforts at Sunrise Wind align with federal mitigation strategies. Finally, the updated plan should more fully describe the extent habitats across the lease have changed as a result of development, which is the first step towards validating the assumptions of how species respond to habitat change within the zone of wind development impact.

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 Sunrise 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 American lobster, Atlantic cod, Atlantic sea scallops, black sea bass, Jonah crab, monkfish, ocean quahog, silver hake, scup, skates, and summer flounder. These monitoring studies should be developed in partnership with the NOAA Fisheries 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 Sunrise Wind, in and around Cox Ledge and across the OCS in a relatively short period of time, it is important that BOEM require a thoughtful and scientifically robust monitoring program at each project to address these data gaps. Methratta et al. (2023) identifies NOAA Fisheries priority research questions and offers recommended temporal scales, resolution, and available methods and approaches to address questions relevant to understanding impacts of the Sunrise 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).

We recommend the development of a thorough monitoring program to address these important questions be required as a stipulation of COP approval. Incorporation of this monitoring recommendation would further align the monitoring efforts at Sunrise Wind with the NOAA Fisheries and BOEM Federal Survey Mitigation Strategy, which has evaluation and integration of wind energy monitoring studies with NOAA Fisheries surveys as a primary goal. Methratta et al. 2023 identifies project-level monitoring, which validates assumptions about how populations respond to habitat change resulting from wind energy development, as a path forward to incorporate project-level monitoring into the federal survey mitigation strategy. Targeted, in situ, monitoring studies aimed at supporting estimation based modeling assumptions in areas where existing long-term federal surveys can no longer operate, are critical to mitigating federal survey impacts and understanding impacts to EFH from the development at Sunrise Wind. In tandem, the above described improved and expanded benthic monitoring and in situ monitoring, of identified stressors and biological effects on sensitive life stages and commercially important species, will align the monitoring activities at Sunrise Wind with NOAA's Mitigation Policy for Trust Resources as well as the goals of the NOAA Fisheries and BOEM Federal Survey Mitigation Strategy.

Recommendations to minimize impacts from contaminants (EFH CRs 42 and 43)

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 increased risk of accidental spills from this traffic, discharges from wastewater treatment plants and cooling water from platforms, artificial scour protection materials, atmospheric emissions from diesel generators, spills (e.g. fire on platform and the use of firefighting foams or accidental spills of oil, lubricants or coolants), the re-mobilization of contaminated sediment due to seabed disturbance by subsea cable and foundation construction, and direct chemical emissions. 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. Drill cutting piles produced around the base of wells are also often contaminated with hydrocarbons and heavy metals (Breuer et al., 2008). It should be noted that the risk of emissions or accidental release of these chemicals could 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 or 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). Organic compounds may also be leached from methods such as anti-corrosion paints or coatings. 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).

The use of anti-corrosion coatings (paints) may significantly reduce the necessary anode material, potentially reducing the emissions of an offshore wind farm with Al anodes by 19-25 tons of Al per year (Kirchgeorg et al. 2018). However, anti-corrosion coatings are still a source of concern themselves. Anti-corrosion/organic coatings may release organic substances due to weathering and/or leaching. Vermeirssen et al. (2017) and others have demonstrated the release of large amounts of bisphenol A (BPA) from epoxy resin-based anti-corrosion coatings on onshore infrastructure. Additionally, coatings should be applied and hardened onshore in order to reduce emissions and avoid the release of not fully-cured coating material directly into the water. However, it is unknown how frequently coatings are maintained offshore, which may be an additional source of emissions. To minimize adverse impacts to EFH, best management practices for reducing spills should be implemented should anti-corrosion coatings be reapplied offshore.

Recommendations for Project Decommissioning (EFH CR 44)
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 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

Recommendations for 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 effects 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. Horseshoe crabs are frequent spawners on Long Island beaches as the New York Horseshoe Crab Monitoring Network annually monitors spawning horseshoe crabs along the Fire Island National Seashore within the vicinity of the project area. Avoiding disturbances along the Long Island beaches including the Fire Island National Seashore from May 15 to July 15 will minimize impacts to horseshoe crab spawning.

Mitigating impacts to NOAA Scientific Surveys

NOAA Fisheries long-term scientific surveys are essential to meet our statutory authorities to manage sustainably 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 NOAA Fisheries- BOEM Federal Survey Mitigation Strategy - Northeast U.S. Region[4].

Survey mitigation should be consistent with the NOAA Fisheries-BOEM Federal Survey Mitigation Strategy. As per NOAA Fisheries 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 NOAA Fisheries-approved survey mitigation agreement. The developer will implement this plan in order to provide NOAA Fisheries with data that are

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

calibrated with and equivalent to the data collected by NOAA Fisheries for the following impacted surveys:

- Spring and Fall multi-species bottom trawl,
- Ocean quahog & surfclam dredge,
- Atlantic sea scallop,
- North-Atlantic right whale aerial and shipboard 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 NOAA Fisheries and the data will be provided to NOAA Fisheries 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 NOAA Fisheries 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 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 Fisheries 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 NOAA Fisheries and the public can be informed as soon as possible and locations can be provided while nautical charts are being updated.

Recommendations for Cross-Verifying Biological Samples Collected
The draft NPDES permit currently requires ichthyoplankton monitoring as part of the permit condition for biological monitoring. In an effort to further align monitoring activities to the goals and objectives presented in the NOAA Fisheries and BOEM Federal Survey Mitigation Strategy, we recommend coordination with our NEFSC staff from the EcoMon survey prior to and throughout the first year of ichthyoplankton sampling to cross-verify the identification of collected samples. Coordination with NEFSC staff will verify collected samples and ensure consistent protocols to potentially allow for direct incorporation of monitoring efforts and data with the NEFSC EcoMon survey.

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Appendix B
Sunrise Wind Offshore Wind Energy Project
NOAA Fisheries Essential Fish Habitat Comments
on EPA Draft NPDES Permit No. MA0004940

The lessee has applied to the Environmental Protection Agency (EPA) for a National Pollutant Discharge Elimination System (NPDES) permit under the Clean Water Act (CWA). Our EFH Conservation Recommendations (CRs) # 7, 8, 9, and 10 and our Fish and Wildlife Coordination Act (FWCA) Recommendation # 4 are associated with operation of the proposed offshore converter station- direct current (OCS-DC). We note that should BOEM determine it infeasible to relocate the OCS-DC outside of areas important for cod spawning (as recommended in EFH CR 7), the remaining recommendations (EFH CRs 8, 9, 10) associated with operation of the OCS-DC are critical to understanding operational effects and identifying and implementing measures to reduce those affects to EFH. Below we provide additional comments and technical assistance recommendations specific to the draft NPDES permit and associated Fact Sheet for the Sunrise Wind OCS-DC.

Attachment A Biological and Thermal Monitoring Requirements

- We acknowledge that the proposed full water column sampling (within about 15 feet of the bottom) with a 61-centimeter Bongo net towed in an oblique manner through the depth zone is consistent with the sampling methods used in NOAA's Ecosystem Monitoring (EcoMon) Program.
- In an effort to further align monitoring activities to the goals and objectives presented in the NOAA Fisheries and BOEM Federal Survey Mitigation Strategy, we recommend coordination with our Northeast Fisheries Science Center (NEFSC) staff from the EcoMon survey prior to and throughout the first year of ichthyoplankton sampling to cross-verify the identification of collected samples. Coordination with NEFSC staff will verify collected samples and ensure consistent protocols to potentially allow for direct incorporation of monitoring efforts and data with the NEFSC EcoMon survey.
- The draft NPDES permit states that a discrete depth plankton sampling system must be used to collect data from the intake zone, however provides no further information on sampling methodology. We recommend that, in addition to Bongo net sampling, a tucker trawl be used for depth discrete sampling to target ichthyoplankton at the hydraulic zone of influence (HZI). However further detail is needed on tucker trawl gear and tow/sample collection protocols in order to inform if the lessee can collect integrated water column data with the tucker trawl samples that can be compared to a Bongo, and the EcoMon Bongo. The permit should specify;
    - The mouth opening size of the tucker trawl.
    - The mesh size of the nets used on the tucker trawl.
    - The number of nets that will be used.
    - Clarification of the depth strata to be sampled. We recommend full water column sampling that includes sampling at the intake depth. Typically, a tucker travel has three nets. Net 1 samples from the surface to the deepest depth (near bottom). Net 2 samples from the bottom to mid-layer depth (bottom to mid-water column). Net

  3 samples from mid-water to surface. However, other tow protocols are possible, especially based on the number of nets on the gear.
  - Depths for temperature and salinity measurements. We recommend temperature and salinity be recorded during ichthyoplankton sampling.
- The proposed DNA sequencing will help ensure reliable identification of cod during the spawning season. However, while it is important to accurately identify cod eggs in the samples, the proposed quarterly sampling frequency will not allow for an evaluation of the effects of the OCS-DC operation on Atlantic cod spawning success in the project area.
- We recommend the monitoring be expanded to include additional sampling to allow for the evaluation of impacts to cod early life stages from the operation of the OCS-DC within an area of cod spawning activity. The frequency of sampling, currently required for standard impingement/entrainment monitoring, is insufficient to evaluate impacts of the OCS-DC operation on early life stages of cod. See our full rationale in Appendix A, *Recommendations to Minimize Impacts from Operation of the Offshore Converter Station*. At a minimum, we recommend that ichthyoplankton monitoring frequency be increased from quarterly sampling to weekly sampling during peak egg and larval presence between December through April of each year. We understand this sampling frequency is greater than required for standard ichthyoplankton monitoring; however, this level of sampling would be necessary to draw any conclusions about impacts to early life stages of cod from siting the OCS-DC in a cod spawning area.

3. Ambient Monitoring

A. Biological Monitoring

- The draft NPDES permit states that after four years of monitoring the Permittee may request a reduction in ichthyoplankton monitoring frequency. We recommend ichthyoplankton monitoring be conducted for the life of the project or as long as an open loop cooling system is operating. The goal of ichthyoplankton monitoring should be to develop abundance estimates of ichthyoplankton in the project area and to further estimate entrainment by operation of the OCS-DC and estimate potential population level effects. An extended time series is necessary, as ichthyoplankton distribution may shift as a result of project operation. Additionally as stated in the draft NPDES permit, changing water temperatures associated with climate change could also lead to shifts in the assemblage of aquatic organisms in the area of the Facility, which could change the species being entrained. Entrainment monitoring over the permit term will provide valuable information about any changes in the densities of early life stages at the OCS-DC over time.
- We recommend that the permittee begin to collect baseline data for both standard and cod egg and larvae sampling as soon as possible prior to construction and operation of the project as the presence of the structures in the lease area could potentially alter the distribution and transport due to effects on hydrodynamic processes. We typically recommend three years of baseline data.
- The permittee should be required to share all biological monitoring data with NOAA Fisheries including both raw data, through-screen velocity at the entrance of the CWIS, and entrainment estimates.

3. Ambient Monitoring

B. Thermal Monitoring

- The draft NPDES permit states that ambient thermal monitoring must be conducted during the spring of the second year of full-scale operation to verify the assumptions of the thermal model and document the extent of the thermal plume. CORMIX modeling results show that at a modeled outfall at 12 m depth, and at a maximum discharge temperature of 90 degrees Fahrenheit, there is variation in the seasonal thermal plume. We recommend ambient thermal monitoring be conducted for two seasons (winter and spring) to validate the thermal model and extent of the thermal plume. Winter and spring would be important due to the potential impacts to cold pool formation in winter and potential impacts to the spring bloom.
- The permittee should be required to share all ambient thermal monitoring data with NOAA Fisheries.

2.3 Cooling Water Intake Structure Requirements

- It is our understanding from the draft NPDES permit that Under Section 316(b) of the CWA, NPDES permit requirements for point source dischargers that operate a cooling water intake system (CWIS) must require that the location, design, construction, and capacity of the CWIS reflect the "best technology available for minimizing adverse environmental impact" (BTA). 33 U.S.C. § 1326(b). Further, The CWA specifies that the NPDES permit is valid for five years from the date of issuance and that the permit may be reissued upon expiration. Given the extensive life span of the project, at least 25 years, and the unmitigated effects of the proposed operation, we recommend that the OCS-DC CWIS be retrofitted with a closed-cycle cooling system when the technology is made commercially viable. The feasibility of upgrading the proposed CWIS with a closed-cycle cooling system and/or incorporating best available technologies should be evaluated every five years upon re-application of the NPDES permit for operation of the OCS-DC. This should be included as a condition of the NPDES permit.