Sunrise Wind Farm Project

Appendix AA2
New York State Benthic Monitoring Plan

Prepared for:

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April 8, 2022

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Sunrise Wind Benthic Monitoring Plan – New York State Waters

April 01, 2022

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1.0 INTRODUCTION

Sunrise Wind LLC (Sunrise Wind), a 50/50 joint venture between Orsted North America Inc. (Orsted NA) and Eversource Investment LLC (Eversource), proposes to construct, operate, and maintain the Sunrise Wind New York Cable Project (the Project). Sunrise Wind executed a 25-year Offshore Wind Renewable Energy Certificate (OREC) contract related to the Sunrise Wind Farm (SRWF) and the Project with the New York State Energy Research and Development Authority (NYSERDA) in October 2019. The Project will deliver power from the SRWF, located in federal waters on the Outer Continental Shelf (OCS), to the existing electrical grid in New York (NYS) (Figure 1). The Project includes offshore and onshore components within NYS and will interconnect at the existing Holbrook Substation, which is owned and operated by the Long Island Power Authority (LIPA).

Power from the SRWF will be delivered onshore via a submarine export cable (SRWEC), which will be located in both federal and NYS waters. Figure 2 provides an overview of the NYS portion of the cable (SRWEC-NYS). The SRWEC-NYS is comprised of one direct current (DC) submarine export cable bundle (320 kilovolt [kV]) up to 5.2 miles (mi) (8.4 kilometers [km]) in length in NYS waters and up to 1,339 feet (ft) (408 meters [m]) located onshore (i.e., above the Mean High Water Line [MHWL], as defined by the United States [US] Army Corps of Engineers [USACE] [33 Code of Federal Regulations (CFR 329)]) and underground, up to the transition joint bays (TJBs).

The Landfall for the SRWEC–NYS will occur at Smith Point County Park, and two potential approaches for the associated horizontal directional drill (HDD) are being considered due to the presence of an existing telecommunications cable in proximity to the landfall location. The Onshore Transmission Cable crosses the Long Island Intracoastal Waterway (ICW) (i.e., the inlet between Bellport Bay and Narrow Bay) from Smith Point County Park to Smith Point Marina and will also be installed via HDD (Figure 2). This is referenced in this monitoring plan as the “ICW HDD”.

This benthic monitoring plan (BMP) has been developed in accordance with recommendations set forth in “Guidelines for Providing Benthic Habitat Survey Information for Renewable Energy Development on the Atlantic Outer Continental Shelf” (BOEM 2019). This benthic monitoring plan will be revised through an iterative process, and survey protocols and methodologies will be refined and updated based on feedback received from stakeholder groups.

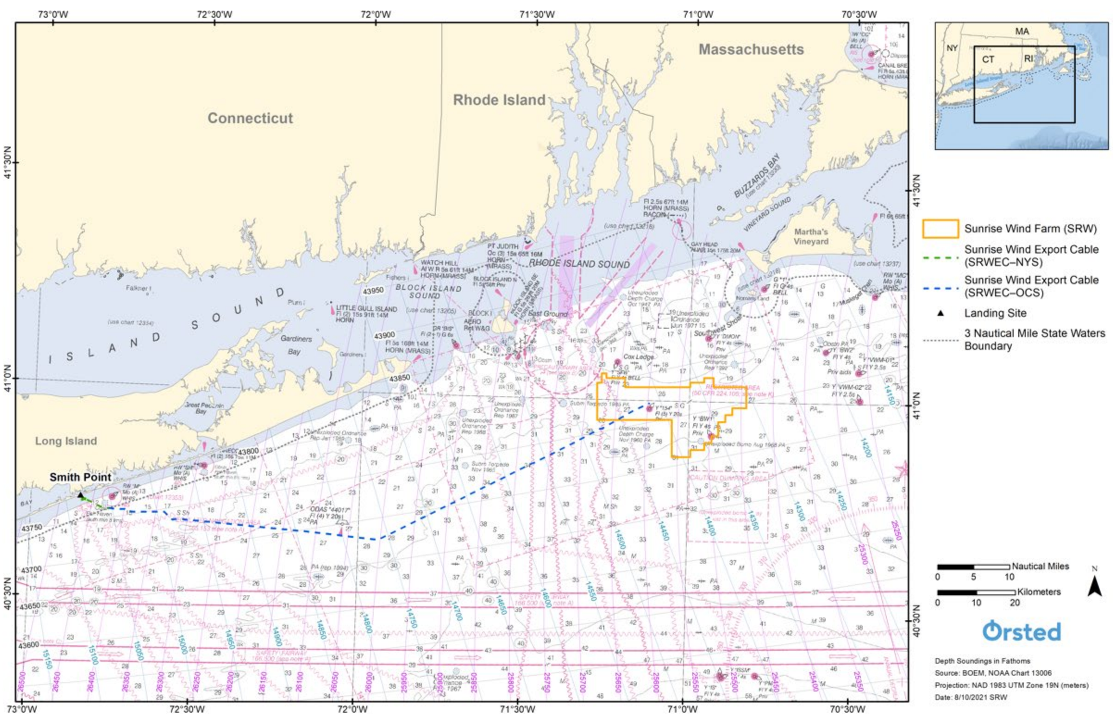

FIGURE 1. Overview of the proposed Sunrise Wind project

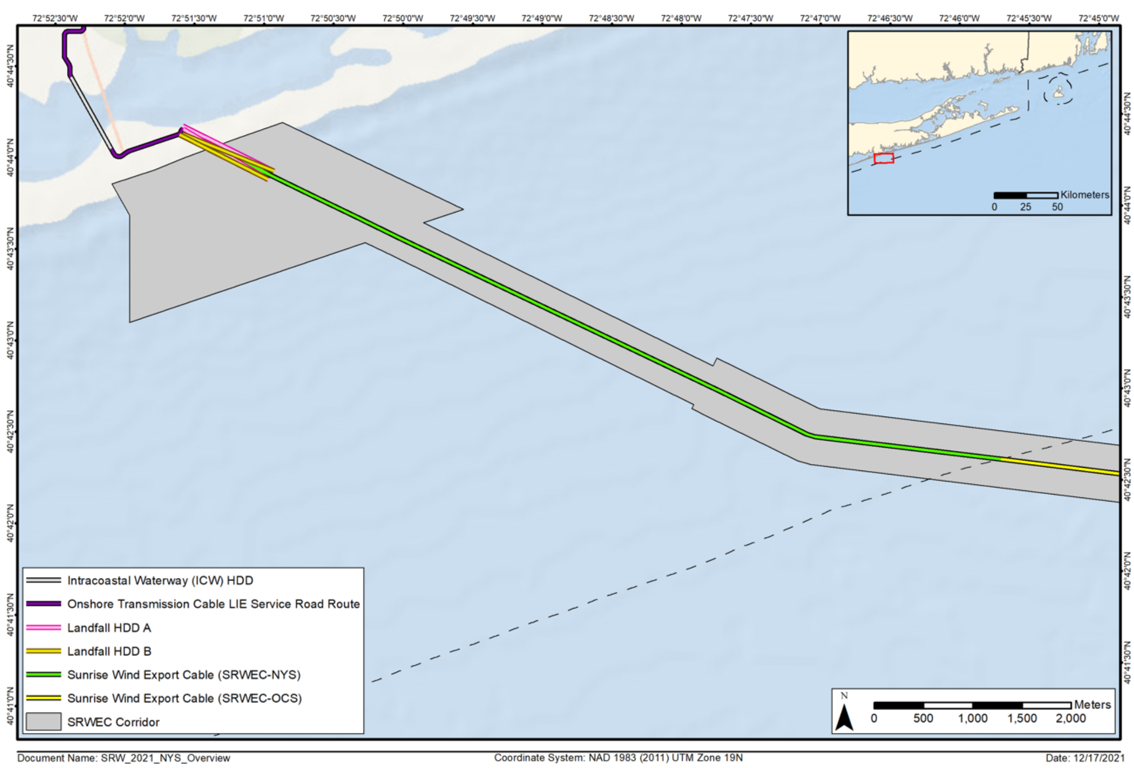

FIGURE 2. Overview of the proposed SRWEC-NYS and ICW HDD routes

2.0 OBJECTIVES

INSPIRE Environmental (INSPIRE) has prepared this draft benthic monitoring plan for characterizing the benthic environment along the proposed SRWEC-NYS corridor. Specifically, the objectives of these surveys are to characterize seafloor conditions, including the collection of geophysical and biological parameters, prior to and after the installation of the SRWEC-NYS. This benthic monitoring plan is designed to summarize baseline benthic conditions that were observed prior to cable installation within New York State waters, and subsequently monitor post-installation benthic conditions to assess any effects resulting from installation activities and operation of the SRWEC-NYS. Sediment profile and plan view imaging (SPI/PV) in combination with sediment grab samples will be used to meet these benthic assessment goals.

3.0 METHODOLOGICAL APPROACHES OVERVIEW

This benthic monitoring plan includes details of the pre-construction and post-construction surveying of soft sediment habitats along the SRWEC-NYS. A combination of SPI/PV imaging and sediment grab sampling will be used to monitor these benthic environments.

SPI/PV is a widely accepted approach to assess the seafloor as it provides an integrated, multi-dimensional view of the benthic and geological condition of the seafloor sediments (Germano *et al.*, 2011). Specifically, SPI/PV imagery provides insight into benthic functioning such as organic matter remineralization (e.g., the depth of bioturbation, aRPD depth) and small-scale biogenic structures (low-relief tubes, burrows, and emergent fauna). Since this method preserves the organism-sediment relationship, it can accurately characterize benthic epifauna and infauna communities in relation to the local environmental context. Pairing SPI and PV images provides a comprehensive depiction of the seafloor that, through standardized analysis and interpretation (e.g., using the BOEM-recommended Coastal and Marine Ecological Classification Standard (CMECS); FGDC, 2012; BOEM, 2019) allows for accurate comparisons to be made before and after installation activity. SPI/PV provides real-time results that can be assessed onboard during the surveys, which allows for rapid adaptive sampling to target locations of interest.

Taxonomic benthic community analysis of sediment grab samples provides quantitative descriptions of soft sediment communities including community structure (beta diversity), abundances of taxa, and community diversity (species richness, alpha diversity). Populations of soft sediment taxa are often dynamic and patchy in nature. However, the natural spatial and temporal patchiness of these communities generally does not influence the overall benthic health or function (e.g., respiration, food provisioning, biogenic structure) of the benthic ecosystem at any given location or time. Drawing inferences about factors that influence changes in benthic community structure is challenging but perhaps obsolete given consistent benthic functioning (e.g., food provision, organic matter remineralization, benthic-pelagic coupling) across taxonomically distinct benthic communities (e.g., Belley and Snelgrove 2016). The benthic community analysis approach will provide an assessment of potential changes in quantitative community diversity metrics and particular species abundances.

4.0 SRWEC-NYS SOFT BOTTOM MONITORING

Hypotheses:

- Physical disturbance of soft sediments from cable installation will temporarily disrupt function of the infaunal community, community function is expected to return to pre-disturbance conditions (e.g., Kraus and Carter 2018).
- Physical disturbance of soft sediments from cable installation will temporarily decrease the abundances and diversity of the infaunal community in close proximity to the cable, infaunal community metrics are expected to return to pre-disturbance conditions.

a. Completed Pre-Construction Baseline Benthic Assessment

A pre-cable installation survey was previously conducted 12-13 August 2020 (SPI/PV collection) and 18 August 2020 (sediment grab collection), prior to commencement of cable installation activities in the area (INSPIRE, 2021a). Thus, the benthic habitats along the SRWEC-NYS are already documented in sufficient detail, and no additional pre-construction benthic monitoring will be conducted. Details on the methods and results of this pre-construction benthic characterization survey are provided in Appendix M2 of the COP (INSPIRE 2021a) and Appendix 4-G of the Article VII Application (Case 20-T-0617) filed in December 2020. Benthic habitat mapping was completed using the point data collected during this August 2020 survey, as well as analysis and interpretation of the high-resolution geophysical data (multi-beam and side scan sonar data) collected in 2019, 2020, and 2021 (Sunrise Wind LLC 2021); detailed habitat mapping methods and results are provided in Appendix M3 of the COP (INSPIRE 2021b). Provided here is a summary of the findings that are detailed in Appendices M2 and M3 of the COP and Appendix 4-G of the Article VII Application (Case 20-T-0617) filed in December 2020 (INSPIRE 2021a and 2021b).

During initial pre-construction benthic survey planning, a Benthic Survey Protocol document was prepared and submitted to federal and state agencies for review in November 2019. Two meetings were held in December 2019 with representatives from BOEM, the National Oceanic and Atmospheric Association (NOAA), National Parks Service, New York State Department of Environmental Conservation (NYSDEC), New York State Energy Research and Development Authority (NYSERDA), New York Department of State (NYSDOS), Massachusetts Division of Marine Fisheries (MADMF), Massachusetts Office of Coastal Zone Management (MACZM), Rhode Island Department of Environmental Management (RIDEM), and Rhode Island Coastal Resources Management Council (RICRMC) to discuss survey logistics, field techniques and equipment, data acquisition systems, parameters to be measured, data processing, analysis and interpretation, and report format. Comments and discussion points generated from that meeting were incorporated into a revised version of the Benthic Survey Protocol and provided to agencies in January 2020. Additional written comments received in January and February 2020 from NYSDEC, NOAA, MADMF, and NYSDOS were incorporated into the Benthic Survey Protocol and an additional revised version was provided to agencies in April 2020. During a webinar in July 2020, the proposed plans for sampling the SRWEC–NYS (SPI/PV, sediment grabs) were discussed with the above-mentioned stakeholders. Following the survey, which was completed in August 2020, preliminary results were shared with federal and state agencies during a webinar in October 2020. A summary of the survey design and results is provided here.

The initial baseline pre-construction survey consisted of a SPI/PV station every 1,000-ft along the proposed SRWEC-NYS route (Figure 3). A total of 35 SPI/PV stations were sampled along the SRWEC-

NYS; three SPI/PV image replicates were collected and analyzed at each station. Additionally, three replicate sediment grab samples were collected at an interval of one every 2,000-ft along the centerline of the proposed SRWEC-NYS route, totaling 18 grab sample stations and 54 total grab samples. Sediment subsamples were collected from each sediment grab sample for grain size analysis and the remaining sediment was processed (i.e., sieved and preserved) onboard the vessel for benthic community analysis (BCA) by standard Environmental Protection Agency approved protocols (Swartz, 2004). BCA results were summarized with metrics for total abundance, species richness, and Shannon-Wiener diversity index. These data were used in a statistical power analysis for the comparison of these metrics between pre- and post-installation time periods and to inform the planned post-construction monitoring survey design (see Section 4.0 c; Attachment A).

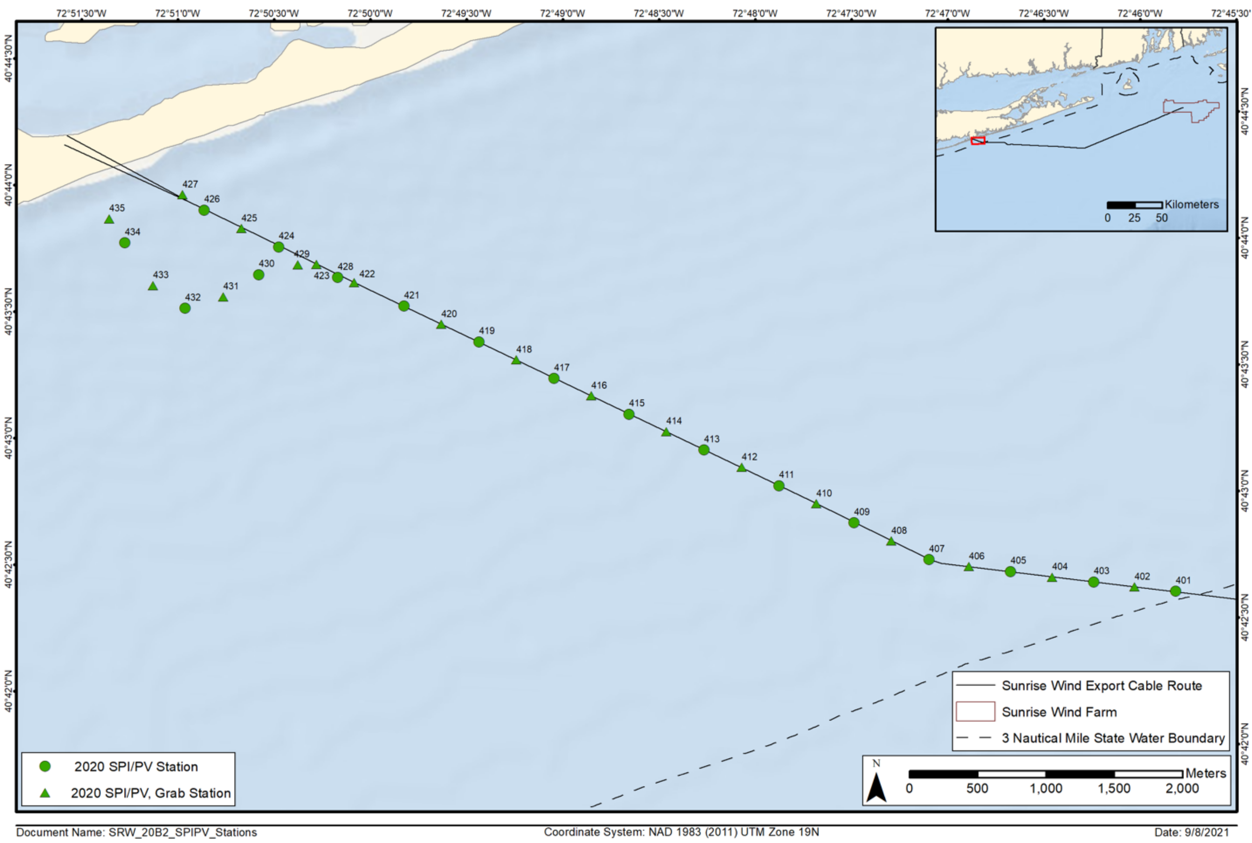

FIGURE 3. Station locations where SPI and PV images and sediment grab samples were collected along the SRWEC–NYS. Map originally from INSPIRE (2021a).

The benthic environment at all the SPI/PV stations along the SRWEC–NYS in August 2020 was characterized as soft sediment habitat. Specifically, four macrohabitat types were observed along the SRWEC–NYS as informed by the sediment composition (CMECS Substrate Subgroup) and inferred small-scale mobility (i.e., bedforms): *sand with ripples*, *sand*, *sand and mud,* or *sand and mud with ripples* (Figure 4). These four macrohabitats are similar in characteristics; specifically, all four consist of sandy sediments ranging from Very Fine Sand to Medium Sand (CMECS Substrate Subgroup) with no gravel. The sediment grab samples collected along the SRWEC–NYS were overwhelmingly dominated by sand (>90%) with minor silt/clay and gravel. Benthic community analysis of the sediment grab samples showed three taxa made up the majority of individuals observed across all replicates along the SRWEC–NYS: (1) the polychaete, *Polygordiidae* (Family) *Polygordius* (Genus, LPIL), (2) the polychaete *Capitellidae (*Family) *Mediomastus* (Genus, LPIL), and (3) the amphipod *Haustoriidae* (Family) *Protohaustorius wigleyi.* No sensitive taxa, species of concern, or non-native species were observed at any of the SPI/PV stations along the SRWEC–NYS during the August 2020 survey.

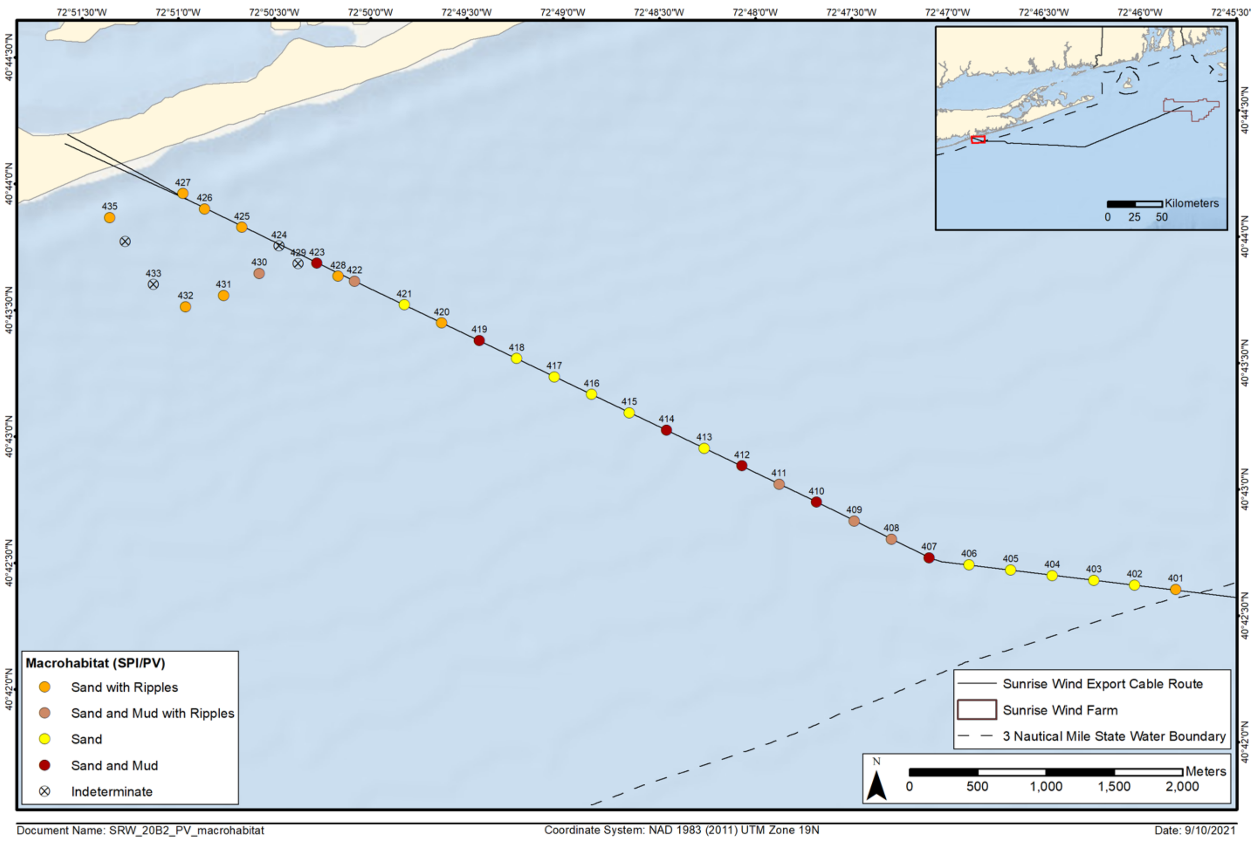

FIGURE 4. Macrohabitat type classifications along the proposed SRWEC-NYS route as characterized by SPI/PV imagery. Map originally from INSPIRE (2021a).

Using the results of the SPI/PV and sediment grab sample survey and analysis and interpretations high-resolution geophysical data collected along the corridor (Sunrise Wind LLC 2021), the benthic habitats along the SRWEC-NYS were characterized and mapped (INSPIRE 2021b). Detailed methods and results of habitat mapping are described in the Habitat Mapping Report, which is Appendix M3 of the COP (INSPIRE 2021b). The majority of the benthic environment surrounding the SRWEC-NYS and along the planned SRWEC-NYS route was sand and muddy sand (Figure 5). Areas of coarse sediment occurred near shore in discrete striated patches oriented approximately perpendicular to shore. The benthic environment was more mobile closer to shore.

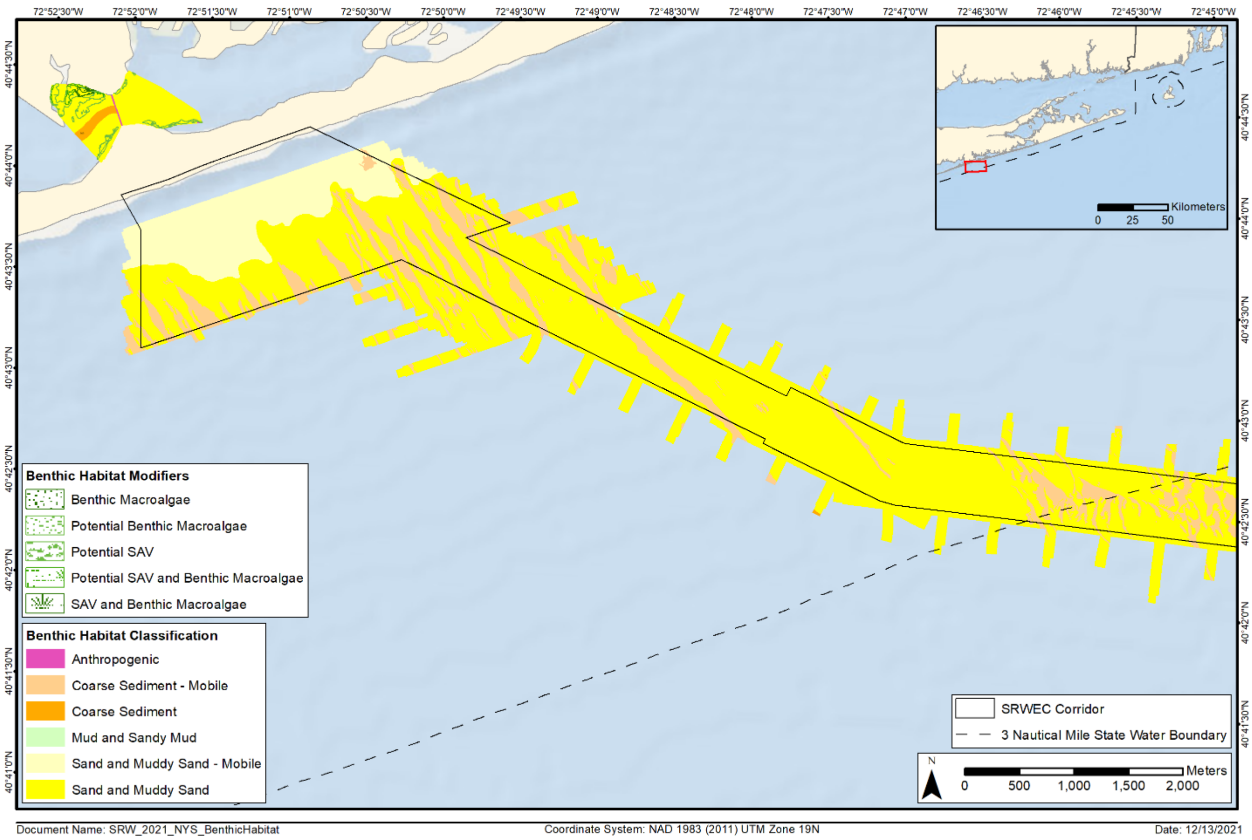

FIGURE 5. Benthic habitat classifications interpretated from high resolution multi-beam acoustic data and SPI/PV data as detailed in INSPIRE (2021b). Map modified from INSPIRE (2021b).

b. Post-Construction Benthic Monitoring

At least two field sampling events will occur after the proposed SRWEC-NYS has been installed. Post-construction monitoring surveys will occur between August 1st and October 31st each year within 24 months of the Sunrise Wind Farm Project's commercial operational date. During the post-cable installation surveys, three stations will be sampled with SPI/PV in a transect perpendicular to the SRWEC-NYS, with one station as close as practicable to the centerline and one station approximately 100-ft on either side (Figure 6). These transects will repeat at 1,000-ft intervals from the HDD exits offshore to the territorial limit of NYS waters. At each SPI/PV station a minimum of three replicate images shall be collected and analyzed. At each SPI/PV station, a Conductivity, Temperature, Depth sensor will be used to measure the salinity and temperature through the water column to the sediment surface. Additionally, the temperature of the sediments will be measured at each SPI/PV station. The SPI/PV sampling will be supplemented with sediment grab stations located at transects every 2,000-ft along the SRWEC-NYS centerline, with one grab sample station as close as practicable to the centerline and one grab sample station approximately 100-ft on the eastern side of the cable. At each grab station three replicate grab samples will be collected, sieved onboard, and preserved. One replicate grab sample from each grab station will be analyzed for BCA by standard Environmental Protection Agency approved protocols (Swartz, 2004); the other two replicate grab samples will be archived and analyzed if greater precision is needed to determine if an ecological meaningful difference exists between pre-construction and post-construction communities (see below).

Benthic community data will be statistically compared across years and distance from the cable, with a specific focus on total infaunal abundances, Shannon-Weiner Index, and total number of species as response variables. SPI/PV imagery-derived metrics will be statistically compared across years and distance from the cable. The water column profile data will be used as potential explanatory variables to inform the post-construction comparison between the benthic habitat and community at stations along the centerline of the cable versus those located 100-ft from the cable centerline. Sediment temperature measurements collected during the post-construction monitoring surveys at stations along the centerline of the cable will be compared to those measurements collected 100-ft from the cable centerline, using distance from shore and depth as potential covariates.

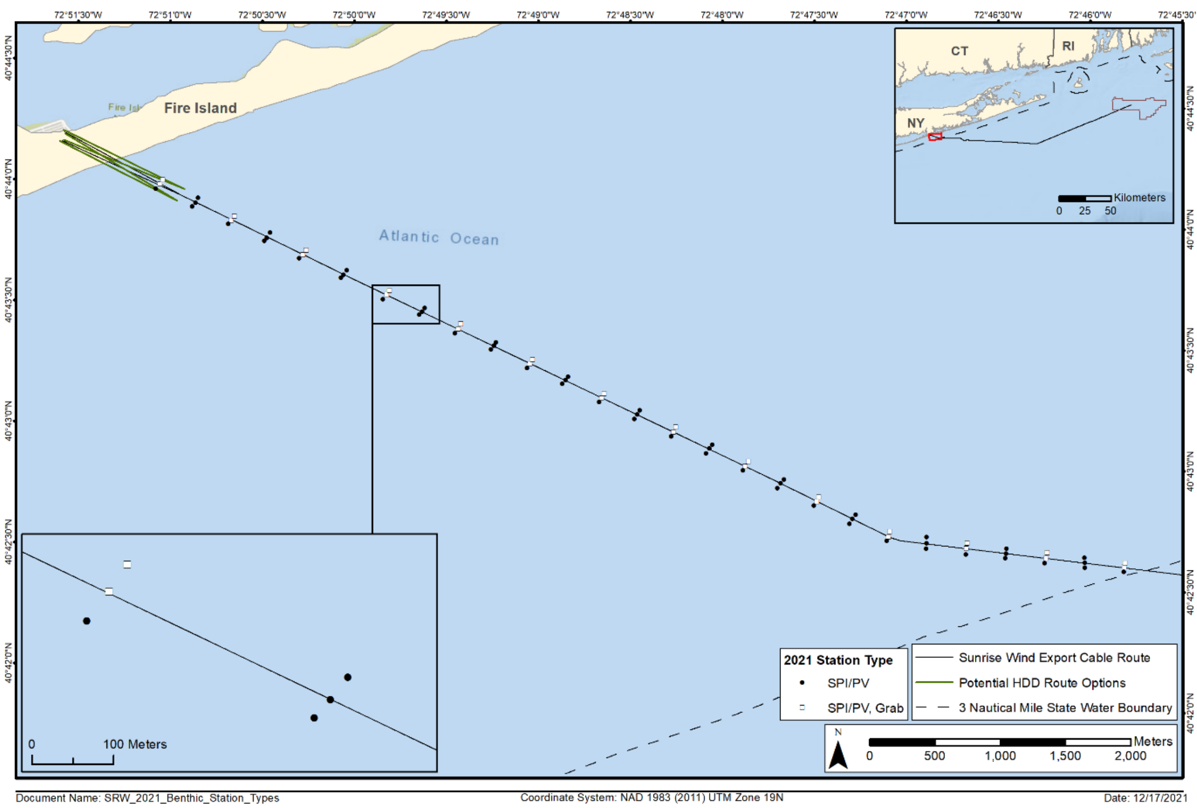

FIGURE 6. Targeted SPI/PV and sediment grab sample locations within NY state waters along the proposed SRWEC-NYS for the post-installation survey. This is a conceptual representation of the planned station locations for one of the landfall HDD route options.

Results of the post-cable installation SPI/PV benthic sampling events (including the collected water column CTD data and sediment temperature data) shall be submitted to the New York State Department Public Service, New York State Department of State, New York State Department of Agriculture and Markets, and the New York State Department of Environmental Conservation in a final written report within 6 months of the completion of each sampling event. The results of the BCA will be provided as a supplement of the report within 9 months of the completion of each sampling event. All data collected under this plan will be made publicly available in shapefile and PDF format. An addendum to this benthic assessment report that integrates the results of an independent electric and magnetic field (EMF) study with the results of these benthic surveys, including a discussion of potential EMF impacts to the benthic habitat, will be included when the EMF data collection, processing, and interpretation are finalized and become available.

c. Estimating Minimum Detectable Difference

For the power analysis, the 2020 baseline data were bootstrapped by selecting two replicates (without replacement) for each station, this was repeated 1,000 times and the Coefficient of Variation (CV) across the 18 station means was calculated from each bootstrap replicate. This analysis revealed that for a sample design with 18 stations (2 replicate sediment grabs per station), the minimum detectable differences (MDD) for total infaunal abundances, Shannon-Weiner Index, and total number of species, were 69%, 29%, and 31% of the means (using the upper 90th percentile CV as a conservative estimate), respectively (details in Attachment A).

This power analysis was repeated but with one replicate sediment grab per station. This analysis revealed that for a sample design with 18 stations (one replicate sediment grab per station), the MDD for total infaunal abundances, Shannon-Weiner Index, and total number of species, were 90%, 32%, and 36% of the means (using the upper 90th percentile CV as a conservative estimate), respectively (details in Attachment A).

These MDD (both the one and two replicate scenarios) were then compared to an estimated ecologically meaningful difference for this region and 'biotope' or habitat. To identify what constitutes an ecologically meaningful difference for this habitat, available regional data were evaluated to quantify natural spatial/temporal variability in the area. Infauna data reported in Byrnes et al. (2004) were used as regional data (details in Attachment A). However, since this dataset was limited in spatial and temporal replication and scale, the derived ecologically meaningful differences should be considered rough estimates; any additional regional data provided or obtained in the future should be used to refine these estimates. This analysis revealed that ecologically meaningful difference estimates in this region for total infaunal abundances, Shannon-Weiner Index, and total number of species were 68%, 49%, and 57% of the means, respectively (red dashed lines in Figure 4). This suggests that a post-construction study design of 18 stations, each with 2 replicate sediment grab samples (0.04 m^2), will be able to detect an ecologically meaningful difference in total infaunal abundances, Shannon-Weiner Index, and total number of species.

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Attachment A - Power Analysis Using Pre-cable Installation Baseline Benthic Sampling Survey (Completed in 2020)

A pre-cable installation survey occurred in August 2020, prior to commencement of cable installation activities in the area (Figure A-1) (INSPIRE 2021). This initial baseline survey consisted of an SPI/PV station every 1,000 feet along the proposed SRWEC-NYS route. At each SPI/PV station, three SPI/PV image replicates were collected and analyzed. Additionally, three replicate sediment grab samples were collected at an interval of one every 2,000 feet along the centerline of the proposed SRWEC-NYS route. Sediment subsamples were collected from each sediment grab sample for grain size analysis and the remaining sediment was processed (*i.e.* sieved and preserved) onboard the vessel for benthic community analysis (BCA) by standard Environmental Protection Agency approved protocols (Swartz, 2004). BCA results were summarized with metrics for total abundance, species richness, and Shannon-Wiener diversity index. The variance estimated from these data were used in a statistical power analysis for the comparison of these metrics between pre- and post-installation time periods.

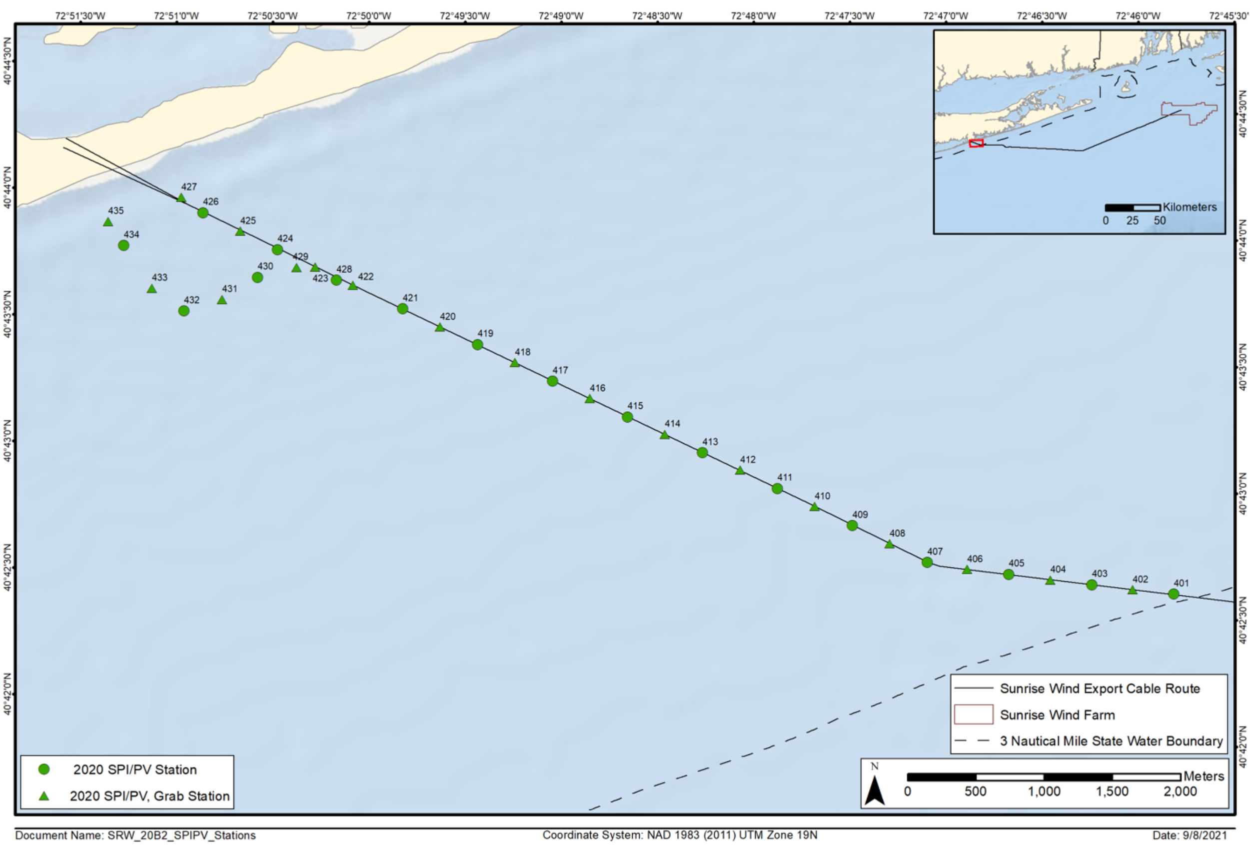

Figure A-1. Sampled SPI/PV and grab sample locations within NY state waters along the proposed SRWEC-NYS for the pre-cable installation baseline survey conducted in August 2020.

Estimating the Minimum Detectable Differences with Sampling Effort

The 2020 BCA data were used to estimate the minimum detectable differences (MDD) with sampling effort (i.e., number of stations). MDD were then compared to an estimate of an ecologically meaningful difference, as discussed below. The power analysis was conducted twice, once assuming one replicate grab sample analyzed per station and a second time assuming two replicate grab samples analyzed per station, to determine the influence of replication on precision and MDD. For the power analysis, the 2020 baseline data were bootstrapped by selecting either one or two replicates (without replacement) for each station, 1000 times; the CV across the 18 station means was calculated from each bootstrap replicate. This was completed with and without Station S402. Station S402 had one replicate with very high abundances of a Polygordius (LPIL) (885 individuals per 0.04 m^2), relative to the other two replicates at this station (355 and 220 individuals per 0.04 m^2) as well as compared with the other 17 stations (ranged from 0 to 276 individuals per 0.04 m^2), which caused substantial skew in the dataset and inflated CVs (Table A-1).

Table A-1. Summary of CVs for abundance, observed number of taxa, and Shannon-Weiner Index, including observed and bootstrapped datasets for n=18 stations and n=17 stations (excluding S402)

	Excludes Station S402 (n=17)			All stations (n=18)		
Percentile	**Abundance**	**Number of Taxa**	**Shannon**	**Abundance**	**Number of Taxa**	**Shannon**
From distribution of 1,000 station means, each based on **one replicate per station** (bootstrapped without replacement)						
90th	0.76	0.43	0.33	1.06	0.42	0.38
50th (median)	0.68	0.38	0.28	0.72	0.38	0.34
From distribution of 1,000 station means, each based on **two replicates per station** (bootstrapped without replacement)						
90th	0.65	0.37	0.28	0.81	0.37	0.34
50th (median)	0.61	0.34	0.26	0.75	0.34	0.32
Observed CV, from the **three replicates per station**						
Observed	0.58	0.33	0.25	0.68	0.32	0.31

The median and upper 90th percentile of the bootstrapped distribution of CVs, with and without Station S402 (Table A-1), were used to estimate the MDD with 90% confidence and 80% power for a study design that utilizes either one or two replicates and between two and twenty stations (Figure A-2). This analysis revealed that for a sample design with 18 stations (1 replicate sediment grabs per station), the minimum detectable differences based on a two-sample t-test for total infaunal abundances, Shannon-Weiner Index, and total number of species, were 90% (64% excluding Station S402), 32% (28% excluding Station S402), and 36% (36% excluding Station S402) of the means (using the upper 90th percentile CV as a conservative estimate), respectively. For a sample design with 18 stations (2 replicate sediment grabs per station), the minimum detectable differences for total infaunal abundances, Shannon-

Weiner Index, and total number of species, were 69%, 29%, and 31% of the means (using the upper 90th percentile CV as a conservative estimate), respectively. These MDD estimates are based on a two-sample t-test, with residual variability determined from the two groups. However, the analysis comparing baseline to post-construction will have three groups (baseline, post-construction centerline, and post-construction 100-ft off-set) each with 18 stations to estimate the residual variability. Using residual variability from three groups will make the tests more powerful than the results presented here, exactly how that will look cannot be determine a priori, so these results are presented as conservative estimates of the predicted power.

These MDDs for a survey with 18 stations was then compared to an estimated ecologically meaningful difference, derived from a spatially and temporally limited regional dataset, to determine the number of stations required for analysis in the post-installation surveys (red dashed lines, Figure A-2).

To identify what constitutes an ecologically meaningful difference for this habitat, available regional data were mined to quantify natural spatial/temporal variability in the area. Infauna data reported in Byrnes et al. (2004) were used as regional data. This study sampled infaunal communities across six broad areas, all deemed as potential sand borrow sites, with all sample collection occurring prior to any impact from sand excavation activity. The six areas were located off the northern coast of New Jersey and the southwestern coast of Long Island, New York. These sampling areas were in the same general region, depth range (<20 m), and sediment type (fine to coarse sand) as the proposed SRWEC-NYS route. Each of these six areas were sampled twice, September 2001 and June 2002, capturing some degree of natural temporal variability. Sample sizes within the six areas ranged from three to ten each year. The temporal change was calculated for each of the dependent variables of interest (abundance, total number of species, and Shannon-Wiener index) as a relative percent difference (RPD) by area:

$$RPD = abs(X_{2001} - X_{2002})/\bar{X}$$

where X_{2001} is the station mean from 2001, X_{2002} is the station mean from 2002, and $\bar{X}$ the mean of the two years. The threshold statistic chosen as the estimate for an ecologically meaningful difference was the 90% upper confidence limit on the 90th percentile (90/90 Upper Tolerance Limit [UTL]). It is assumed that any difference that statistically exceeds this threshold does not fit with the distribution of these pairwise comparison deltas (n = 6) derived from Byrnes et al. (2004). This analysis estimated ecologically meaningful differences in this region for total infaunal abundances, Shannon-Weiner Index, and total number of species were 68%, 49%, and 57% of the means, respectively (red dashed lines in Figure 4). This suggests that the study design (18 stations, 2 replicates per station) will likely be able to detect an ecologically meaningful difference in total infaunal abundances, Shannon-Weiner Index, and total number of species.

Results of this statistical power analysis and estimation of ecologically meaningful difference will be presented to NYSDEC for review prior to the post- cable installation sampling surveys. If additional regional datasets characterizing infaunal abundances become available, these will be used to refine the ecologically meaningful difference estimation.

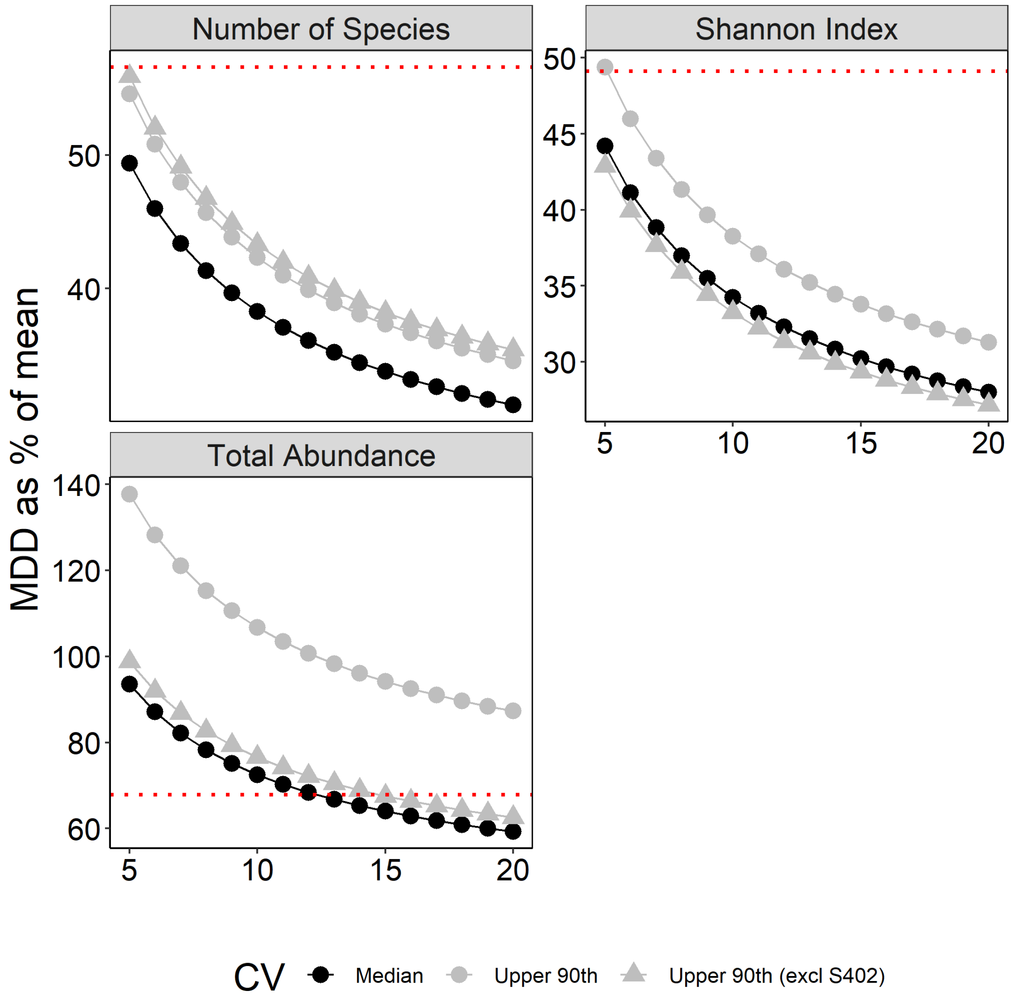

Figure A-2. Minimum detectable differences (MDD) as a function of sampling effort (number of stations) for total number of species, Shannon-Weiner Index, and total infaunal abundance. The median and upper 90th percentile of the bootstrapped distribution of CVs, with and without Station S402 were used to estimate the MDD with 90% confidence and 80% power for a study design that utilizes one replicate and between five and twenty stations. Red line represents an estimated ecologically meaningful difference derived from regional infaunal data reported in Byrnes et al. (2004), as detailed in the text.

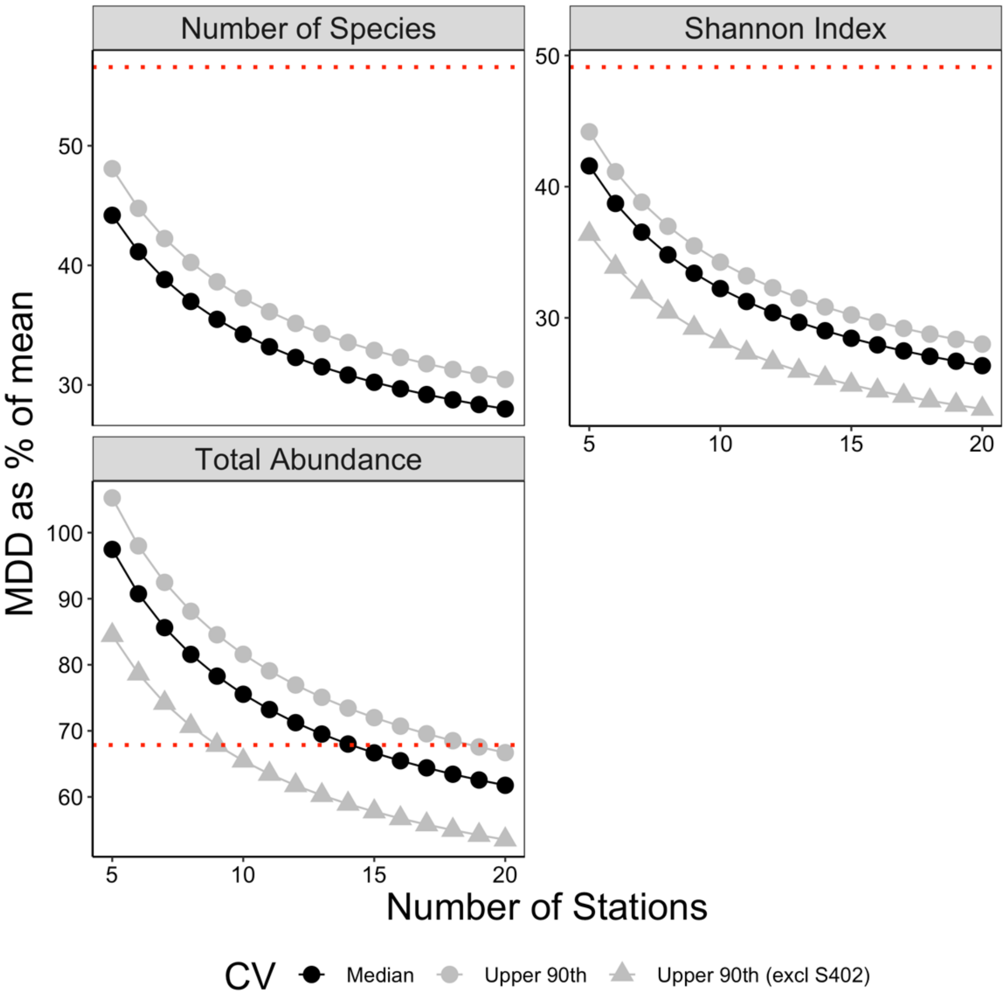

Figure A-3. Minimum detectable differences (MDD) as a function of sampling effort (number of stations) for total number of species, Shannon-Weiner Index, and total infaunal abundance. The median and upper 90th percentile of the bootstrapped distribution of CVs, with and without Station S402 were used to estimate the MDD with 90% confidence and 80% power for a study design that utilizes two replicates and between five and twenty stations. Red line represents an estimated ecologically meaningful difference derived from regional infaunal data reported in Byrnes et al. (2004), as detailed in the text.