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VINEYARD WIND 1 PROTECTED SPECIES OBSERVER ANNUAL REPORT | CONSTRUCTION 2023

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REPORT

VINEYARD WIND 1 PROTECTED SPECIES OBSERVER ANNUAL REPORT | CONSTRUCTION 2023

Approval for issue		
Stephanie Milne	DocuSigned by: stephanie milne A7EB551BB693441...	1 March 2024

Prepared by:

RPS a Tetra Tech Company

Anna Turano
Environmental Project Manager

10 Post Office Square Suite. 1100
Boston, MA 02109

T +1 281 589 7257
E anna.turano@tetratech.com

Prepared for:

Vineyard Wind

Elizabeth Marsjanik
Senior Manager, Environmental Affairs

700 Pleasant Street, Suite 510
New Bedford, MA 02740

T +1 508 446 7326
E emarsjanik@vineyardwind.com

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LIST OF ACRONYMS

AMP	Alternative Monitoring Plan
BBC	Big Bubble Curtain
BiOp	Biological Opinion
BOEM	Bureau of Ocean Energy Management
CZ	Clearance Zone
COP T&Cs	Construction and Operations Plan Approval Terms and Conditions
DBBC	Double Big Bubble Curtain
DEME	DEME Group
EZ	Exclusion Zone
HZ	Harassment Zone
HLV	Heavy Lift Vessel
IHA	Incidental Harassment Authorization
km	Kilometers
LPSO	Lead Protected Species Observer
m	Meters
MMPA	Marine Mammal Protection Act
MZ	PAM Monitoring Zone
NARW	North Atlantic right whale
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
OCS	Outer Continental Shelf
PAM	Passive Acoustic Monitoring
PDMP	Pile Driving Monitoring and Mitigation Plan
PSO	Protected Species Observer
QC	Quality Control
SZ	Shutdown Zone
TL	Trained Lookout
VO	Visual Observer
VSA	Vessel Strike Avoidance
WM	Works Manager

1 INTRODUCTION

Vineyard Wind 1 conducted pile-driving construction activities in Bureau of Ocean Energy Management (BOEM) Lease Area OCS-A 0501 (Lease Area) under the approved Project Permits which include the Construction and Operations Plan Approval Terms & Conditions (COP T&C's) (issued July 15, 2021), as well as the Biological Opinion (BiOp) (issued October 18, 2021) and an Incidental Harassment Authorization (IHA) under the Marine Mammal Protection Act (MMPA) issued May 1, 2023 and valid through April 20, 2024 by the National Oceanic and Atmospheric Administration (NOAA) and National Marine Fisheries Service (NMFS). DEME Group (DEME) was contracted to install wind turbine generator and the electrical service platform foundations using pile-driving equipment, which is subject to monitoring and mitigation conditions outlined in the Project Permits. DEME contracted RPS Group (RPS) to provide the in-situ visual Protected Species Observer (PSO) assets required to meet permit conditions during the 2023 foundation installation campaign phase for the Vineyard Wind 1 offshore wind farm. Additionally, DEME contracted JASCO Applied Sciences (USA) Inc. (JASCO) to provide the sound field verification and real-time Passive Acoustic Monitoring (PAM) during pile installation.

In accordance with IHA Condition 6(f), section 5.7 of the BiOp, and condition 5.7.17.2 of the COP T&C's, the 2023 Protected Species Observer (PSO) Final Report summarizes all monitoring activities undertaken by RPS PSOs deployed on the pile-driving Heavy Lift Vessel (HLV) *Orion* and the PSO support vessels. Also summarized are the real-time PAM activities conducted by JASCO (analyzed by land-based PAM operators) concurrent to visual monitoring.

The HLV *Orion* conducted pile-driving operations resulting in a total of 47 monopiles and one (1) Jacket was installed for Vineyard Wind 1 within the Lease Area from 6 June 2023 to 28 December 2023. Vineyard Wind 1 deployed PSO support vessels to extend visual monitoring efforts throughout certain times (e.g., December) of the year and during a portion of the sound field verification campaign. Two PSO support vessels were used concurrently 24 June 2023 to 23 September 2023 during pile-driving activities throughout a portion of the sound field verification campaign. Additionally, two PSO support vessels were used concurrently from 1 December 2023 to 28 December 2023 as implemented by Vineyard Wind 1 to satisfy increased monitoring efforts outlined in the Enhanced Winter Survey Plan. The Enhanced Winter Survey Plan, as implemented for installation year 2023, is included in Appendix B.

From 24 June 2023 to 23 September 2023, five (5) PSOs provided by RPS were stationed aboard the HLV *Orion* to undertake visual monitoring and implement mitigation protocols in accordance with the requirements in the MMPA IHA, BiOp, and BOEM COP T&C's. Three (3) PSOs on active duty conducted monitoring watch 60 minutes prior to, during, and 30 minutes post-piling during operations. Additionally, three (3) PSOs were aboard each of two PSO support vessels to support monitoring. Two (2) PSOs conducted active monitoring watch on each of the two PSO support vessels 60 minutes prior to, during, and 30 minutes post-piling during operations. Fishing vessel (F/V) *Jack M,* F/V *Saints and Angels,* F/V *Chatham,* F/V *Lily M, and* F/V *Atlantic,* were used interchangeably due to vessel availability. The PSO support vessels were referred to as Support Vessel 1 (SV1) (F/V *Jack M*, F/V *Lily M*, and F/V *Fearless*) and Support Vessel 2 (SV2) (F/V *Saints and Angels*, F/V *Chatham*, and F/V *Atlantic)* throughout the Vineyard Wind 1 2023 foundation installation campaign.

Four (4) PSOs were aboard two PSO support vessels F/V *Saints and Angels* and F/V *Fearless* from 1 December 2023 to 28 December 2023 to support enhanced monitoring measures in accordance with the Enhanced Winter Survey Plan approved by BOEM (Appendix B). Two (2) PSOs on active duty conducted monitoring watch 60 minutes prior to, during, and 30 minutes post-piling operations. In the event of

reduced visibility during piling one (1) additional PSO on active watch would be added to supplement monitoring, resulting in three (3) PSOs on active watch in reduced visibility conditions during active piling as described in the AMP of the PDMP (Appendix B). The dates and durations that each vessel on which PSOs were deployed, is provided in Table 1.

In addition to monitoring during pile-driving activities, PSOs aboard the HLV Orion conducted night-time watches during transit, which included transit to Halifax Canada to retrieve monopiles and perform crew changes. Night-time watches were conducted in accordance with when schedule permitted as to not allow the PSOs to reach maximum allotted monitoring time within a 24-hour period per the stipulations set forth in the MMPA IHA (section 5.d.iii).

Mitigation and monitoring protocols for construction included establishment of PAM monitoring zones (MZ) and Exclusion Zones (EZ); which refers to the area within which mitigation measures must be applied if a protected species is detected and includes; Clearance Zones (CZ), the area that is visually and acoustically monitored for the presence or absence of protected species prior to starting the hammer sound source; Harassment Zones (HZ), the area or volume of water that is ensonified to the Level A or B harassment threshold; and Shutdown Zones (SZ), the area in which equipment shut down or other active mitigation measures must be applied if a protected species is detected approaching or within the zone. These SZs are established around the sound source (e.g., active pile driving). Mitigation actions undertaken during the 2023 construction campaign resulted in the implementation of delay to initiation and/or shutdown of active hammer sound sources, and Vessel Strike Avoidance (VSA) maneuvering for marine mammals.

2 EXECUTIVE SUMMARY

During the Vineyard Wind 1 2023 foundation installation campaign, detailed information was collected concerning visual and acoustic monitoring, mitigation, and VSA efforts for protected species during pile-driving operations and all vessel transits, ensuring consistent monitoring of the established separation distances throughout the campaign. The Quality Controlled (QC) PSO/PAM data forms including monitoring effort, source operations and protected species detections for each vessel are provided as an excel dataset in Appendix A.

PSOs on the HLV Orion conducted a total of 459 hours and 14 minutes of visual monitoring effort; 104 hours and 26 minutes of that time occurred during pile-driving operations from the initiation of the hammer sound source to the final blow. SV1 conducted a total of 103 hours and 33 minutes of monitoring effort; 39 hours and 36 minutes of that time occurred during pile-driving operations from the initiation of the hammer sound source to the final blow. SV2 conducted a total of 107 hours and four minutes of monitoring effort; 39 hours and 36 minutes of that time occurred during pile-driving operations from the initiation of the hammer sound source to the final blow.

There was a total of 99 visual detection events among all PSO vessels that included an estimated 1,261 marine mammals. Species observed included common dolphin (*Delphinus delphis*), bottlenose dolphin (*Tursiops truncates*), unidentified dolphin (*Delphinidae spp*.), humpback whale (*Megaptera novaeangliae*), fin whale (*Balaenoptera physalus*), minke whale (*Balaenoptera acutorostrata*), unidentified non-North Atlantic right whale (NARW) (*Mysticeti*), unidentified baleen whale (*Mysticeti*), and gray seal (*Halichoerus grypus*).

In accordance with stipulations set forth in the Project Permits, there were 50 VSA maneuvers conducted by PSO vessels (pile-driving vessel and PSO support vessels) during the project. Additionally, there were 12 mitigation actions (10 visual detections, two acoustic detections) implemented causing a delay to initiation of the hammer sound source during pile-driving operations. There were two shutdowns requested and implemented during operations, one of which was a shutdown requested for a visual detection of common dolphins in the SZ. The other was an acoustic detection of a blue whale that resulted in a shutdown; however, it was later determined by the acoustic contractor Jasco to have been a false positive detection.

There were two instances where pile-driving continued during low visibility conditions, and one instance where sea state prevented support vessels from conducting a full 60-minute pre-clearance watch with Big Eye binoculars and pile-driving commenced due to safety concerns. These instances are described below:

- On 26 December and 28 December 2023, DEME informed RPS that Vineyard Wind approved pile-driving operations during circumstances of low-visibility during pre-clearance search periods due to safety concerns related to the pile already being stabbed and needing to proceed with pile-driving. RPS was informed that Vineyard Wind had informed the appropriate agencies of the situation. The PSOs on the PSO support vessels were able to complete the 60-minute search period prior to commencement of the hammer sound source using the naked eye and reticle binoculars.
- On 15 December 2023, HLV *Orion* completed touchdown of pile AT-33, at this time the PSO support teams were unable to safely set up the big eyes or conduct watch due to the sea state. At the one-hour notice from *Orion*, the sea state had not improved and the support vessels could not stand watch. PSO support vessels were instructed to provide visual support with naked eye and

handheld binoculars to the greatest extent possible, at which time conditions had improved enough to allow the PSOs to conduct watch with the naked eye and handheld binoculars.

During the Project, other Project vessels were required to report any visual detections of protected species to the Project fleet and indicate if VSAs were performed. The TSV *Atlantic Oceanic*, an offshore supply vessel responsible for deploying the Big Bubble Curtain (BBC), had 34 visual detection events made by visual observers (VO) The visual detection events included sightings of humpback whales, unidentified whales, Atlantic white-sided dolphins (*Lagenorhynchus acutus*), common dolphins, unidentified dolphins, gray seals, and unidentified seals (*Phocidae*). The F/V *Beth Anne*, a fishing vessel used for PAM operations, had one visual detection event by VOs. The visual detection included one sighting of five fin whales.

There were six VSA maneuvers conducted by the TSV *Atlantic Oceanic*. The VSA maneuvers included reduction in speed; change in course and speed; and shift to neutral.

An overview of PSO vessels used and dates of operation are outlined in Table 1.

3 MITIGATION AND MONITORING PROTOCOLS

The baseline Pile Driving Monitoring and Mitigation Plan (PDMP) is included in Appendix B and provides a detailed plan of mitigation and monitoring procedures, however, significant modifications were made to the mitigation and monitoring procedures throughout the course of the foundation installation campaign in 2023. A summary of these changes is provided in Appendix D. The PDMP addresses the regulatory required components including the Alternative Monitoring Plan (AMP), NARW Strike Avoidance Plan, the Enhanced Survey Plan, and the PAM Plan. The PAM Plan is included as an attachment in the PDMP (Appendix B). The Enhanced Winter Survey Plan is included as an attachment in the PDMP (Appendix B) and describes enhanced monitoring procedures implemented for the month of December.

4 RESULTS

4.1 Operation Activity

This section of the report details protected species monitoring effort conducted by PSOs on the pile-driving vessel HLV *Orion* and PSO support vessels (F/V *Jack M*, F/V *Saints and Angels*, F/V *Lily M*, F/V *Chatham*, F/V *Atlantic*, and F/V *Fearless*), and visual and acoustic data for pile-driving activities during the VINEYARD WIND 1 2023 foundation installation campaign. The PSO support vessels were classified as Support Vessel 1 (SV1) and Support Vessel 2 (SV2), SV1 included F/V *Jack M*, F/V *Lily M*, and F/V *Fearless*. SV2 consisted of F/V *Saints and Angels*, F/V *Chatham*, and F/V *Atlantic*. The dates of PSO vessels in operation during the project are included in Table 1.

The monitoring effort, source operations and protected species detections for each vessel are provided as an excel dataset in Appendix A.

Table 1: Dates of vessel operation on project

Vessel	Vessel classification	Dates on Project	Dates of pile-driving activity	Number of monopiles driven	Location
HLV *Orion*	Pile-driving Vessel	01 June 2023 – 30 December 2023	06 June 2023 – 28 December 2023	47	OCS-A 0501
F/V *Jack M*	SV1	24 June 2023 – 11 July 2023 07 September 2023 – 23 September 2023	26 June 2023 – 09 July 2023 05 August 2023 – 07 August 2023 07 September 2023 – 20 September 2023	7	
F/V *Saints and Angels*	SV2	24 June 2023 – 11 July 2023 04 August 2023 – 18 August 2023 01 December 2023 – 28 December 2023	26 June 2023 – 09 July 2023 05 August 2023 – 14 August 2023 01 December 2023 – 28 December 2023	15	
F/V *Lily M*	SV1	13 August 2023 – 19 August 2023	14 August 2023 – 05 September 2023	3	

Vessel	Vessel classification	Dates on Project	Dates of pile-driving activity	Number of monopiles driven	Location
		02 September – 07 September 2023			
F/V *Chatham*	SV2	28 August 2023 – 09 September 2023	03 September 2023 – 07 September 2023	3	
F/V *Atlantic*	SV2	17 September 2023 – 23 September 2023	20 September 2023	1	
F/V *Fearless*	SV1	01 December 2023 – 28 December 2023	01 December 2023 – 28 December 2023	9	

4.2 Monitoring Effort

Visual and acoustic monitoring effort for pile-driving operations during the 2023 Vineyard Wind 1 foundation installation campaign is summarized in Table 2 and Table 3 respectively. The tables provide a detailed summary of visual and acoustic monitoring effort undertaken during pile-driving operations.

Visual monitoring while the hammer sound source equipment was not in operation included pre-clearance monitoring, post-piling monitoring, and monitoring during transit. Visual monitoring was conducted by PSOs on the pile-driving vessel for a total of 459 hours and 14 minutes, a total of 104 hours and 26 minutes of monitoring was conducted during piling operations which included the initiation of the hammer sound source to the final blow. Visual monitoring was conducted by SV1 for a total of 103 hours and three minutes, 39 hours and 36 minutes of which was conducted during pile-driving operations which included the initiation of hammer sound source to the final blow. SV2 conducted visual monitoring for a total of 107 hours and four minutes, 39 hours and 36 minutes of which was conduction during pile-driving operations which included the initiation of the hammer sound source to the final blow. A total of 71 visual pre-clearance searches conducted prior to piling operations.

Acoustic monitoring was conducted for a total of 340 hours and 7 minutes, 104 hours and 7 minutes of acoustic monitoring was conducting during piling operations starting from the initiation of the hammer sound source to the final blow. There was a total of 72 acoustic pre-clearance searches conducted prior to piling operations.

Table 2: Visual monitoring effort during pile-driving operations

Total hours of visual monitoring effort (hh:mm)							
Vessel Type	**Pile-driving Vessel**	**SV1**			**SV2**		
Visual Monitoring Effort	**HLV *Orion***	**F/V *Jack M***	**F/V *Lily M***	**F/V *Fearless***	**F/V *Saints and Angels***	**F/V *Chatham***	**F/V *Atlantic***
Piling operations (initiation of hammer sound source to final blow)	104:26	16:34	05:33	17:29	32:24	05:27	01:45
Total piling operations (initiation of hammer sound source to final blow)	104:26	39:36			39:36		
Monitoring effort during pre-clearance search	140:33	18:12	05:39	12:32	35:34	05:12	01:01
Total monitoring effort during pre-clearance search	140:33	36:23			41:56		
Monitoring effort during post-piling	28:17	3:44	01:30	04:30	07:43	01:30	00:30
Total monitoring effort during post-piling	28:17	09:44			09:43		
Total time of monitoring during the campaign	459:14	41:29	12:42	49:24	90:30	13:19	03:16
Total time of monitoring per vessel type	459:14	103:33			107:04		

Table 3: Acoustic monitoring effort during pile-driving operations

Total hours of acoustic monitoring effort (hh:mm)	
Acoustic Monitoring Effort	**HLV *Orion***
Piling operations (initiation of hammer sound source to final blow)	104:26
Monitoring effort during pre-clearance search	206:33
Monitoring effort during post-piling	28:17
Total time of monitoring during the campaign	340:07

4.3 Visual Sightings

This section of the report summarizes visual sightings of protected species during pile-driving operations for monitoring on pile-driving vessel and PSO support vessels during the project. Detections were recorded regardless of if pile-driving hammer equipment was active or inactive. Each individual detection event is catalogued within the draft weekly and draft monthly PSO reports submitted by RPS and Vineyard Wind, respectively, to the regulatory agencies, and within these reports are details as to the equipment and/or mitigations that took place per vessel. Table 4 shows the total number of visual detection records and the number of individuals detected for each protected species during the project.

There was a total of 99 protected species detection events both inside and outside the Lease Area, consisting of 1,261 marine mammals (Table 4). There were 22 detections made consisting of 398 animals while the hammer sound source was on, and 77 detections made consisting of 863 animals while the hammer sound source was off. Marine mammal sightings consisted of delphinids, whales and pinnipeds. Detections consisted of nine different marine mammal species. There were 43 detections of common dolphins, three detections of bottlenose dolphins, and five detections of unidentified dolphins. There were 36 whale detections consisting of four detections of unidentified non-NARWs, 17 detections of humpback whales, eight detections of fin whales, six detections of minke whales, and one unidentified baleen whale.

There were 12 detections of pinnipeds, all of which were identified as gray seals.

No Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus),* giant manta rays (*Mobula birostris*), or sea turtles (*Chelonioidea*) were sighted during any of the project activities.

Of the 99 detection events, 90 percent (89 events) were of animals that were identified to the species level while the remaining animals (11 detection events) were identified to family level or a higher taxonomic level (classified as unidentified delphinids, and unidentified whales).

There were three visual detections that were concurrent with acoustic detections, they were determined by PAM and PSO teams to be correlated detections, two of which were of common dolphins correlated with one acoustic detection event of unidentified dolphin lasting approximately three hours. The other visual detection determined to be a correlated detection was an acoustic detection of unidentified dolphin occurring at the same time as a visual detection event consisting of common dolphin. The visual detections were made by PSOs on active watch onboard the HLV *Orion*.

There were 35 visual detection events made by TSV *Atlantic Oceanic*, an offshore supply vessel responsible for deploying BBC, and one detection consisting of five fin whale was reported from PAM fishing vessel F/V *Beth Anne*. The visual detection events included sightings of humpback whale, fin whale, unidentified whale, Atlantic white-sided dolphin, common dolphin, unidentified dolphin, gray seal, and unidentified seal. Table 5 shows the total number of detections made by other vessels.

A table of all protected species detections is provided as part of an excel datasheet attachment Appendix A.

Table 4: Visual detections of protected species by all PSO vessels (pile-driving vessel and PSO support vessels) on the Project

	Hammer OFF		Hammer ON	
Species	**Total Number of Detection Records**	**Total Number of Animals**	**Total Number of Detection Records**	**Total Number of Animals**
Dolphins				
Common dolphin	29	717	14	381
Bottlenose dolphin	1	10	2	9
Unidentified dolphin	5	42	0	0
Whales				
Unidentified non-NARW	4	10	0	0
Humpback whale	15	51	2	2
Fin whale	6	15	2	4
Minke whale	6	6	0	0
Unidentified baleen whale	1	1	0	0
Pinnipeds				
Gray Seal	10	11	2	2
Sea turtles				
	0	0	0	0
Total	**77**	**863**	**22**	**398**

Table 5: Visual detections of protected species reported from other Project vessels (F/V *Beth Anne* and TSV *Atlantic Oceanic*)

Species	Total Number of Detection Records	Total Number of Animals
Dolphin		
Common dolphin	9	>66
Atlantic white-sided dolphin	1	>6
Unidentified dolphin	6	>71
Whale		
Humpback whale	3	>17
Fin whale	4	10
Minke whale	2	2
Unidentified whale	4	7
Pinniped		
Gray seal	4	5
Unidentified seal	2	2
Total	**35**	**>186**

4.4 Acoustic Detections

This section of the report summarizes acoustic detections of protected species during pile-driving operations for monitoring.

Detections are recorded regardless of if the hammer is active or not active. Each individual detection event is catalogued within the weekly and monthly PSO reports submitted by RPS to the regulatory agencies, and within these reports are details as to what equipment and/or mitigation was implemented by the vessels. The acoustic detections during pile-driving operations are summarized in Table 6.

There was a total of 253 acoustic detections of protected species during the project. Of the detections, 206 of which were unidentified dolphin, 45 of fin whale, and two of unidentified baleen whale. There were detection events that occurred on multiple buoys that were determined to be the same detection, 13 detection events occurred on two buoys, 10 detection events occurred on three buoys, the remaining 230 detection events occurred on a single buoy.

Two acoustic detections made were determined to be correlated detections with three visual detection events, all of which consisted of common dolphins. These events are described in further detail in Section 4.3.

Of the 253 acoustic detections 18 percent (45 detection events) were of animals that were identified to the species level, all of which were fin whales, while the remaining animals (208 detection events) were identified to family level or a higher taxonomic level (classified as unidentified delphinids, and unidentified baleen whales).

Table 6: Acoustic detections of protected species observed by species

	Hammer OFF	Hammer ON
Species	**Total Number of Detection Records**	**Total Number of Detection Records**
Dolphin		
Unidentified dolphin	163	43
Whale		
Fin whale	36	9
Unidentified baleen whale	2	0
Total	**201**	**52**

4.5 Incidental Harassment Authorization (IHA) Level A and Level B Exposures

NMFS issued an IHA under the MMPA for the Vineyard Wind Construction where a total of 115 Level A exposures and 7,163 Level B exposures were authorized for 15 marine mammal species/species groups. During the 2023 foundation installation campaign, 324 marine mammals from five species/species groups were observed within Level B harassment zone while the hammer sound source was active, constituting potential Level B exposures as defined by this MMPA IHA. There were no potential exposures within the Level A Harassment zone. During the 2023 foundation installation campaign, one fin whale was detected acoustically within the Level B Harassment zone resulting in a potential exposure. Table 8 depicts the total number of authorized Level A and B exposures, and the total number of potential exposures of protected species accumulated for the project.

During the Vineyard Wind 1 2023 foundation installation campaign, there were multiple modifications made to the Level B HZ. The modifications are outlined in **Table 7**. The modifications were made in consultation with NMFS and based on the results of SFV conducted.

Table 7: Level B Harassment Zone modifications

Level B Harassment Zone Modifications

Start Date of Zone Applied	Level B HZ Monopile (m)	Level B HZ Jacket (m)	Number of Piles Driven
06 June 2023	4,121	3,220	1
09 June 2023	5,700	3,200	1
17 June 2023	6,000	3,200	1
20 June 2023 (first pile driven on 26th)	7,100	3,220	11
28 September 2023	5,720	3,220	33
15 December 2023 (Temporary modification- one day)	7,100	3,250	1

Table 8: Potential exposures relative to Level A and Level B authorized exposures

Species common name	Stock	MMPA IHA Authorized Level A Exposures	Total Number of Animals Observed Inside the MMPA IHA-defined Level A Harassment Zone	MMPA IHA Authorized Level B Exposures	Total Number of Animals Observed Inside the MMPA IHA-defined Level B Harassment Zone
North Atlantic right whale	W. North Atlantic	0	0	20	0
Humpback whale	Gulf of Maine	10	0	56	2
Fin whale	W. North Atlantic	5	0	33	2
Sei whale	Nova Scotia	2	0	4	0
Minke whale	Canadian East Coast	2	0	98	0
Sperm whale	W. North Atlantic	0	0	5	0
Long fined pilot whale	W. North Atlantic	9	0	91	0
Bottlenose dolphin	W. North Atlantic, offshore	8	0	96	9
Common dolphin	W. North Atlantic	35	0	4646	309
Atlantic white-sided dolphin	W. North Atlantic	28	0	1107	0
Risso’s dolphin	W. North Atlantic	6	0	12	0
Harbor porpoise	Gulf of Maine/Bay of Fundy	4	0	150	0
Harbor seal	W. North Atlantic	2	0	214	0
Harp seal	W. North Atlantic	2	0	217	0

Species common name	Stock	MMPA IHA Authorized Level A Exposures	Total Number of Animals Observed Inside the MMPA IHA-defined Level A Harassment Zone	MMPA IHA Authorized Level B Exposures	Total Number of Animals Observed Inside the MMPA IHA-defined Level B Harassment Zone
Gray seal	W. North Atlantic	2	0	414	2

4.6 Summary of Mitigation Measures Implemented

4.6.1 Hammer sound source mitigation

Mitigation was implemented, as described in the PDMP included in Appendix B of this report, however, significant modifications were made to the mitigation and monitoring procedures throughout the course of the foundation installation campaign in 2023. A summary of these changes is provided in Appendix D. The purpose of mitigation was to minimize potential adverse impacts to protected species including physical interactions with vessels (VSA mitigation) or from exposure to potentially harmful levels and frequencies of sound (delays to initiation of and shutdowns of active hammer).

There were 12 mitigation actions (10 visual detections, two acoustic detections) implemented causing a delay to initiation of the hammer sound source during pile-driving operations. Nine delays to hammer initiation were incurred due to four visual detections of dolphins, and five visual detections of whales. Two delays to initiation of hammer sound source were due to dolphin detections. The mitigation actions implemented for visual detections and acoustic detections are detailed in Table 9 and Table 10 respectively.

On September 7, 2023, there was one acoustic detection of a blue whale that resulted in a shutdown; however, it was later determined by the acoustic contractor Jasco to have been a false positive detection. This false detection resulted in a shutdown of the hammer sound source at 20:35 UTC, during soft start. The hammer was re-initiated at 21:19 UTC.

There was one visual detection event of common dolphins that resulted in a shutdown of the active hammer on 07 September 2023. A pod of 50 common dolphins were detected moving toward the pile-driving vessel while the hammer was on at full energy pile-driving. The closest distance the animals were detected from the pile (AU-38) was 500 m. The shutdown was called at 22:07 UTC and was implemented within the same minute, at 22:07 UTC. The dolphins were last detected at 22:17 UTC, and the pile driver was reinitiated the same day, 15 minutes after the last detection in the SZ, at 22:33 UTC. A detailed shut down report is included in Appendix C.

Table 9: Mitigations actions implemented for visually detected protected species

Mitigation Action	Dolphins	Whales	Pinnipeds	All Species
Delay to initiation of source	4	5	0	9
Shutdown of active source	1	0	0	1
All mitigation actions	**5**	**5**	**0**	**10**

Table 10: Mitigation actions implemented for acoustically detected protected species

Mitigation Action	Dolphins	Whales	Pinnipeds	All Species
Delay to initiation of source	2	0	0	2
Shutdown of active source	0	0	0	0
All mitigation actions	**2**	**0**	**0**	**2**

4.6.2 Vessel strike avoidance maneuvers

There were 50 instances where the vessels executed VSA maneuvers during protected species detections, due to the animal(s) being within the separation distance. The VSA maneuvers consisted of reduction in speed; keeping course; maintaining speed; shifting engine to neutral; remaining stationary; maintaining speed and altering course; speed reduction and altering course; maintaining speed and keeping course; altering course and reducing speed; keeping course and maintaining speed; reducing speed and keeping course; reducing speed and shifting engine to neutral; and altering course, reducing speed and shifting to neutral to maintain separation distances. VSA maneuvers were conducted 24 times for dolphin, 21 times for whale detections, and five times for pinniped detections. Each VSA maneuver undertaken is described in the collected data forms provided in Table 11.

There were six vessel strike avoidance maneuvers conducted by the TSV *Atlantic Oceanic*. The VSA maneuvers included reduction in speed; change in course and speed; and shift to neutral. Each VSA maneuver undertaken is described in the collected data forms provided in Table 12.

Table 11: Vessel strike maneuvers requested by species on PSO vessels (pile-driving vessel and PSO support vessels)

Species	Speed reduction	Kept course	Maintain speed	Shift to neutral	Remained stationary	Maintain speed, alter course	Speed reduction, alter course	Maintain speed, kept course	Speed reduction, kept course	Speed reduction, shift in to neutral	Alter course, speed reduction, shift in to neutral
Dolphin											
Common dolphin	1	1	1	-	1	1	-	15	-	2	-
Bottlenose dolphin	-	-	-	-	-	-	-	1	-	-	-
Unidentified dolphin	-	-	-	-	-	-	-	1	-	-	-
Whale											
Unidentified non-NARW	-	-	-	-	1	-	-	-	-	1	-
Humpback whale	2	-	-	3	2	-	2	-	-	-	-
Fin whale	-	-	-	2	-	-	1	-	-	-	-
Minke whale	-	2	-	1	1	-	1	-	-	-	1
Unidentified baleen whale	-	-	-	-	-	-	-	-	1		
Pinniped											
Gray Seal	-	-	-	-	1	-	1	3	-	-	-
Total	3	3	1	6	6	1	5	20	1	3	1

Table 12: Vessel strike maneuvers for protected species implemented by other Project vessels (TSV *Atlantic Oceanic*)

Species	Speed reduction	Shift to neutral	Alter course, speed reduction
Dolphin			
Common dolphin	-	1	-
Atlantic white-sided dolphin		-	1
Unidentified dolphin	-	-	-
Whale			
Humpback whale	1	1	1
Fin whale	-	-	-
Minke whale	-	-	-
Unidentified whale	1	-	-
Pinniped			
Gray seal	-	-	-
Unidentified seal	-	-	-
Total	2	2	2

5 SUMMARY

5.1 Interpretation of results

All the marine mammal species that were detected during the Vineyard Wind 1 2023 foundation installation campaign were species that occur commonly and are regularly observed by PSOs in the region. Each species detected was observed within its predicted range with no species encounters occurring outside of that species' normal range.

5.2 Efficacy of all Monitoring Tasks

To minimize the potential impacts to marine mammals PSOs onboard all the project vessels were prepared to implement mitigation measures whenever protected species were detected approaching, entering, or within the designated mitigation zones. Mitigation actions for the hammer sound source were implemented successfully during 12 detection events (10 visual, two acoustic). One visual detection resulted in a successful shutdown of the hammer, nine visual detections resulted in delays to the initiation of the hammer, and two acoustic detections resulted in delays to the initiation of the hammer sound source. PSOs stationed on the pile-driving vessel and the PSOs stationed on the PSO support vessels searched the mitigation zones prior to activation of hammer sound sources. The Lead PSO (LPSO) communicated clearance to the works manager confirming that applicable zones were clear prior to source operations. Clearance was also communicated by the Lead PAM on duty to the PSO team and works manager prior to initiation of hammer ramp-up.

Strike avoidance maneuvering was conducted 50 times to prevent potential physical interactions between the PSO vessels (PSO support vessels and pile-driving vessel) and marine mammals. Additionally, six VSAs were conducted by other vessels on the project, TSV *Atlantic Oceanic* and F/V *Beth Anne*. In each case the maneuvers were executed as necessary. PSOs (Visual Observers (VOs) on TSV *Atlantic Oceanic* and F/V *Beth Anne*) detected the animals in sufficient time to alert the vessel of the need for maneuvering and maneuvering was carried out successfully to avoid physical impacts to the animals.

There were no dead or injured species detected from the PSO support vessels the HLV *Orion*.

Visual observations yielded a total 99 protected species detections both inside and outside the Lease Area during transit and included only marine mammals. While it is likely that PSOs did not identify all the animals present in the area around the vessel, as certain individuals may not have surfaced or vocalized, it is unlikely that protected species were not detected inside the mitigation zones since the radii were relatively small and PSOs were equipped with multiple tools to augment the efficacy of the monitoring.

For the Vineyard Wind 1 2023 foundation installation campaign, a total of 115 Level A exposures, and 7,163 Level B exposures from 15 marine mammal species/species groups were authorized for takes in the MMPA IHA. During pile-driving operations, a total of 324 protected species were observed within the predicted Level B harassment radius. There were no marine mammals detected within the Level A harassment zone during construction operations. Although PSOs likely did not detect all the marine mammals present; it is highly unlikely that the actual number of animals present during pile-driving installation reached anywhere near the fully authorized levels for all species.

Appendix A: Protected Species Observer and Passive Acoustic Monitoring Species Detection Data Form

Appendix A is included as an attachment.

Appendix B: Pile Driving Monitoring and Mitigation Plan

Appendix B is included as an attachment.

Certain proprietary, confidential information is redacted in Appendix B due to commercial interest. The redacted information relates principally to the engineering plans, processes, and procedures established by Vineyard Wind's Contractors to implement regulatory requirements which is tied to competitive interest. The information redacted is customarily and actually treated as private by its owner and was provided to Federal regulators by Vineyard Wind under an assurance of privacy.

Appendix B: PILE DRIVING MONITORING AND MITIGATION PLAN

VINEYARD WIND 1, BOEM Lease Area OCS-A 0501
CONSTRUCTION PHASE

Version 16

rpsgroup.com

VINEYARD WIND 1, BOEM LEASE AREA OCS-A 0501 CONSTRUCTION PHASE

Pile Driving Monitoring and Mitigation Plan

Revision		
Date	**Version**	**Revision made**
20 August 2022	V1	First revision
15 September 2022	V2	Second revision. Reorganized to reflect individual plans required
28 September 2022	V3	Draft final revision
29 September 2022	V4	Final revision
19 November 2022	V5	First revision of VW1 edits
14 December 2022	V6	Second revision of VW1 edits
23 December 2022	V7	Third revision of VW1 edits
28 January 2023	V8	Fourth revision of VW1 edits
03 February 2023	V9	Final revision of VW1 edits
10 March 2023	V10	BOEM revisions
25 April 2023	V11	NMFS revisions
01 May 2023	V12	Additional BOEM/BSEE revisions received 28 Apr
08 May 2023	V13	Additional NMFS revisions received 05 May
10 May 2023	V14	Additional BOEM and BSEE edits received 10 May
15 May 2023	V15	Additional BSEE edits received 12 May
16 May 2023	V16	Additional BSEE/NMFS edits received 15 May

Approval for issue

[redacted]

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Table of Abbreviations

AMP	Alternative Monitoring Plan
BBC	Big Bubble Curtain
BiOp	Biological Opinion
BOEM	Bureau of Ocean Energy Management
COP	Construction and Operations Plan
COP T&C	Conditions of Construction and Operations Plan Approval Terms & Conditions
CR	Vineyard Wind Client Representative
CTV	Crew Transfer Vessel
CZ	Clearance Zone
dB	Decibels
DMA	Dynamic Management Area
DEME	DEME Group
DOI	Department of the Interior
DOUS	DEME Offshore US
ESA	Endangered Species Act
ft	Feet
GARFO	NMFS Greater Atlantic Regional Fisheries Office
HFC	High Frequency Cetaceans
HSD	Hydro Sound Damper
HZ	Harassment Zone
IHA	Incidental harassment Authorization
km	Kilometers
LFC	Low Frequency Cetaceans
LPSO	Lead Protected Species Observer
m	Meters
MCC	Vineyard Wind Marine Coordination Center
MFC	Mid-Frequency Cetaceans

MMPA	Marine Mammal Protection Act
MVCZ	Minimum Visual Clearance Zone
MZ	PAM Monitoring Zone
NARW	North Atlantic right whale
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NVD	Night Vision Device
OCS	Outer Continental Shelf
OPR	NMFS Office of Protected Resources
PAM	Passive Acoustic Monitoring
PPW	Pinniped in water
PDMP	Pile Driving Monitoring and Mitigation Plan
PDOM	DEME Pile Driving Operations Manager
PSO	Protected Species Observer
RPS	RPS Group
SEL	Sound Exposure Level
SFV	Sound Field Verification
SMA	Seasonal Management Area
SZ	Shutdown Zone
TL	Trained Lookout
VO	Visual Observer
USV	Uncrewed Surface Vessel
VSA	Vessel Strike Avoidance
VW1	Vineyard Wind 1
WDA	Wind Development Area
WM	Works Manager

Glossary of Terms

Term	Definition
Alternative Monitoring Plan	A protected species monitoring plan that must be submitted to BOEM, which details monitoring methodology that will be used during nighttime and low-visibility conditions
Big Bubble Curtain (BBC)	A pneumatic barrier system that intentionally disturb the water column to dampen the propagation of sound waves traveling from the sound source equipment by attenuating the noise.
Clearance Zone (CZ)	The area that must be visually or acoustically clear of protected species prior to starting any sound source that could result in Level A or Level B exposures. This applies to construction sources using approved pre-determined distances.
Exclusion Zone (EZ)	An area within which mitigation measures must be applied if a protected species is detected. Exclusion zones (EZ) include CZs, SZs, and HZs. The size of the EZ varies between species.
Harassment Zone (HZ)	Area in which it is determined that marine mammals will be impacted by the sound produced by the sources when active. These zones are specific to each species and hearing group of marine mammals. Any marine mammal within the zone, while the source is active, will be considered a Level A or Level B 'take' pending the exposure decibels and distance.
Level A Harassment Zone	The area within which Level A harassment, defined as the potential to injure a marine mammal, may occur. This includes but is not limited to the area ensonified by a sound source, within which a permanent threshold shift in hearing or other types of non-serious injury can occur.
Level B Harassment Zone	The area within which Level B harassment, defined as the potential to disturb (but not injure) a marine mammal, may occur. This includes but is not limited to the area, ensonified by a sound source, within which a behavioral disturbance or temporary threshold shift in hearing can occur.
Minimum Visual Clearance Zone	The smallest approved area that must be visually or acoustically clear of protected species prior to starting any source that produces sound that could result in Level A or Level B exposures. This applies to construction sources using approved pre-determined distances.
PAM Clearance Zone	The area that must be cleared by acoustic monitoring for marine mammals prior to starting any sound source that could result in Level A or Level B exposures.
PAM Monitoring Zone	The area around any sound source that could result in Level A or Level B exposures which is acoustically monitored for the presence of marine mammals.

Term	Definition
Protected Species	May refer to multiple taxa, including ESA-listed marine mammals, marine mammals, sea turtles, and Atlantic sturgeon.
Separation Distances	The distances from a vessel within which observation of a protected species would require mitigation. The distances and the required mitigations vary between species.
Shutdown Zone (SZ)	The area in which equipment shut down or other active mitigation measures must be applied, once a source is active, if a protected species is sighted inside the corresponding zone.
Vessel Strike Avoidance (VSA) Monitoring Zone	The area around a vessel that is monitored by PSOs, Visual Observers, or Trained lookouts while the vessel is underway.

Table 1 Regulatory Requirement Reference

Requirement	Source Reference	Plan Location
The Lessee must submit a NARW Strike Management Plan to BOEM and NMFS at least 90 calendar days prior to implementation in order for crew transfer vessels to travel greater than 10 knots (18.5 kilometers per hour) between May 15 and October 31 for periods when DMAs are established. The plan must provide details on how the required vessel and/or aerial-based surveys, and PAM, will be conducted to clear the transit corridor of NARW presence during a DMA. The plan must also provide details on the vessel-based observer protocol on transiting vessels and PAM required between November 1 and May 14, as well as any further efforts to minimize potential impacts. DOI will review the NARW Strike Management Plan and provide comments, if any, on the plan within 30 calendar days of its submittal. The Lessee must resolve all comments on the NARW Strike Management Plan to DOI's satisfaction and receive DOI's written concurrence prior to implementing the plan. The Lessee may conclusively presume DOI's concurrence with the NARW Strike Management Plan if DOI provides no comments on the plan within 90 calendar days of its submittal.	COP 5.5.5	Appendix C
Vineyard Wind must submit a NARW strike avoidance plan 90 days prior to commencement of vessel use. The plan will, at minimum, describe how the required vessel, PAM, or aerial based monitoring will be conducted to ensure the transit corridor is clear of NARWs. The plan will also provide details on the vessel-based observer protocol on transiting vessels and PAM required between November 1 and May 14.	IHA 5(h)	Appendix C
The Lessee must ensure that all vessels, regardless of length, travel at 10 knots (18.5 kilometers per hour) or less within any NMFS-designated DMA, with the following exception for crew transfer vessels, as described in the approved COP. The Lessee must submit a NARW Strike Management Plan to BOEM and NMFS at least 90 calendar days prior to implementation in order for crew transfer vessels to travel greater than 10 knots (18.5 kilometers per hour) between May 15 and October 31 for periods when DMAs are established. The plan must provide details on how the required vessel and/or aerial-based surveys, and PAM, will be conducted to clear the transit corridor of NARW presence during a DMA. The plan must also provide details on the vessel-based observer protocol on transiting vessels and PAM required between November 1 and May 14, as well as any further efforts to minimize potential impacts. DOI will review the NARW Strike Management Plan and provide comments, if any, on the plan within 30 calendar days of its submittal. The Lessee must resolve all comments on the NARW Strike Management Plan to DOI's satisfaction and receive DOI's written concurrence prior to implementing the plan. The Lessee may conclusively presume DOI's concurrence with the NARW Strike Management Plan if DOI provides no comments on the plan within 90 calendar days of its submittal	BiOp 5.5	Appendix C
Acoustic Sound Source Monitoring Reporting: Results of sound field verification of pile driving must be submitted as soon as possible but no	IHA 6(h)	Provided as a separate Sound Field

Requirement	Source Reference	Plan Location
later than within 30 days following completion of acoustic monitoring. The final report must include, at minimum, the following		Verification Plan
Vineyard Wind must prepare and submit a Sound Source Verification Plan to NMFS, USACE, and BOEM for review and NMFS' approval at least 90 days prior to the planned start of pile driving. This plan must describe how Vineyard Wind will ensure that the location selected is representative of the rest of the piles of that type to be installed and, in the case that it is not, how additional sites will be selected for sound source verification or how the results from the first pile can be used to predict actual installation noise propagation for subsequent piles. The plan must describe how the effectiveness of the sound attenuation methodology will be evaluated based on the results. The plan must be sufficient to document sound at the source as well as to document propagation and distances to isopleths of concern to allow for comparison to the distances assessed in the Effects of the Action section of this Opinion (i.e., to the Level A and Level B harassment zones for marine mammals and the injury and behavioral disturbance zones for sea turtles and Atlantic sturgeon).	BiOp 6(c)	Provided as a separate Sound Field Verification Plan
Pile driving must not occur from January 1 through April 30. Pile driving must not occur in December unless unanticipated delays due to weather or technical problems, notified to and approved by the Bureau of Ocean Energy Management, arise that necessitate extending pile-driving through December.	IHA 4(a)	Section 9.8
The Lessee must not conduct any piledriving activities between December 1 and April 30. Pile driving must not occur in December unless unanticipated delays due to weather or technical problems arise that necessitate extending pile driving through December, and the pile driving is approved by BOEM in accordance with the following procedures. The Lessee must notify BOEM in writing by November 1 that the Lessee believes that circumstances require pile driving in December. The Lessee must submit to BOEM (at renewable_reporting@boem.gov) for written concurrence an enhanced survey plan for December 1 through December 31 to minimize the risk of exposure of NARWs to pile-driving noise, including noise from daily preconstruction surveys. BOEM will review the enhanced survey plan and provide comments, if any, on the plan within 30 calendar days of its submittal. The Lessee must resolve all comments on the enhanced survey plan to BOEM's satisfaction 32 and receive BOEM's written concurrence before any pile driving occurs. However, the Lessee may conclusively presume BOEM's concurrence with the enhanced survey plan if BOEM provides no comments on the plan within 90 calendar days of its submittal. The Lessee must also follow the time-of- year enhanced mitigation measures specified in the applicable BiOp. The Lessee must confirm adherence to this time-of-year restriction on pile driving in the piledriving reports submitted with the FIR.	BiOp 5.7	Section 9.8
The Lessee must prepare and submit an Alternative Monitoring Plan to NMFS and BOEM at least 90 calendar days prior to commencing the first pile-driving activities for the Project. DOI will review the Alternative	COP 5.7.2	Section 5

Requirement	Source Reference	Plan Location
Monitoring Plan and must provide comments, if any, on the plan within 30 calendar days of its submittal. The Lessee must resolve all comments on the Alternative Monitoring Plan to DOI's satisfaction prior to implementing the plan. If BOEM provides no comments on the Alternative Monitoring Plan within 90 calendar days of its submittal, then the Lessee may conclusively presume BOEM's concurrence with the plan. The Alternative Monitoring Plan proposed by the Lessee may include deploying additional observers, employing alternative monitoring technologies such as night vision, thermal, infrared, and/or using of PAM technologies, with the goal of ensuring the ability to maintain all clearance and shutdown zones for all ESA-listed species in the event of unexpected poor-visibility conditions.		
Vineyard Wind must submit an Alternative Monitoring Plan to NMFS for NMFS' review and approval at least 90 days prior to the planned start of pile driving (this plan may be included in the Marine Mammal Monitoring Plan). This plan may include deploying additional observers, alternative monitoring technologies (i.e., night vision, thermal, infrared), and/or use of PAM with the goal of ensuring the ability to maintain all exclusion zones for all ESA-listed species in the event of unexpected poor visibility conditions.	IHA 5(b)	Section 5
BOEM must ensure that Vineyard Wind develops and implements measures for enhanced monitoring in the event that poor visibility conditions unexpectedly arise and pile driving cannot be stopped due to safety or operational feasibility. Vineyard Wind must prepare and submit an Alternative Monitoring Plan to NMFS and BOEM for NMFS' review and approval at least 90 days prior to the planned start of pile driving. This plan may include deploying additional observers, alternative monitoring technologies (i.e., night vision, thermal, infrared), and/or use of PAM with the goal of ensuring the ability to maintain all exclusion zones for all ESA-listed species in the event of unexpected poor visibility conditions	BiOp 4(c)	Section 5
In addition to standard daily surveys, the Lessee must submit to BOEM (at renewable_reporting@boem.gov) an enhanced survey plan for May 1 through May 31 to minimize the risk of exposure of NARWs to pile driving noise. BOEM will review the enhanced survey plan and provide comments, if any, on the plan within 30 calendar days of its submittal. The Lessee must resolve all comments on the enhanced survey plan to BOEM's satisfaction prior to implementing the plan. If BOEM provides no comments on the enhanced survey plan within 90 calendar days of its submittal, then the Lessee may conclusively presume BOEM's concurrence with the plan.	COP 5.7.4	Section 11
In addition to standard daily surveys, the Lessee must submit to BOEM (at renewable_reporting@boem.gov) an enhanced survey plan for May 1 through May 31 to minimize the risk of exposure of NARWs to pile-driving noise. BOEM will review the enhanced survey plan and provide comments, if any, on the plan within 30 calendar days of its submittal. The Lessee must resolve all comments on the enhanced survey plan to BOEM's satisfaction prior to implementing the plan. If BOEM provides	BiOp 5.7	Section 11

Requirement	Source Reference	Plan Location
no comments on the enhanced survey plan within 90 calendar days of its submittal, then the Lessee may conclusively presume BOEM's concurrence with the plan.		
At least 90 calendar days prior to commencing the first pile-driving activities for the Project, the Lessee must submit a Pile-Driving Monitoring (PDM) Plan to BOEM (at renewable_reporting@boem.gov), BSEE (at protectedspecies@bsee.gov), and NMFS for review. DOI will review the PDM Plan and provide comments, if any, on the plan within 30 calendar days of its submittal. The Lessee must resolve all comments on the PDM Plan to DOI's satisfaction prior to implementing the plan. If DOI provides no comments on the PDM Plan within 90 calendar days of its submittal, then the Lessee may conclusively presume DOI's concurrence with the plan.	COP 5.7.5	This Plan
Vineyard Wind must prepare and submit Pile Driving and Marine Mammal Monitoring Plans to NMFS for review and approval at least 90 days before the start of pile driving. The plans must include final project design related to pile driving (e.g., number, type of piles, hammer type, sound attenuation systems, anticipated start date, etc.) and all information related to PSO monitoring protocols, respectively.	IHA 5(a)	This Plan
Vineyard Wind must prepare and submit a Pile Driving Monitoring Plan to NMFS for review and approval at least 90 days before start of pile driving. The plan may involve enhanced visual observations (i.e., multiple platforms) and/or PAM (for whales).	BiOp 7	This Plan
Include a PAM Plan with a 75-percent detection confidence by the PAM Analyst to determine that a possible NARW vocalization originated from within the clearance and shutdown zones. Any possible NARW vocalization must be reported as a detection if it is determined by the PSO to be within the clearance and shutdown zones.	COP 5.7.5.1.4	Appendix B
Vineyard Wind must prepare a Passive Acoustic Monitoring Plan that describes all equipment, procedures, and protocols related to the required use of PAM for monitoring. This plan must be submitted to NMFS and BOEM for review and approval at least 90 days prior to the planned start of pile driving.	BiOp 3(f)	Appendix B

1 INTRODUCTION

Vineyard Wind 1 (VW1), the Project, is permitted to conduct pile driving activities under the Bureau of Ocean Energy Management (BOEM) approved Construction and Operations Plan (COP), as well as the Biological Opinion (BiOp) and an Incidental Harassment Authorization (IHA) issued by the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS). DEME Group (DEME) has been contracted to install wind turbine generators and the electrical service platform foundations using pile driving equipment, which is subject to monitoring and mitigation conditions outlined in the Project permits. DEME has contracted RPS Group (RPS) to provide the in-situ visual Protected Species Observer (PSO) assets required to meet permit conditions during the construction phase for the VW1 offshore wind farm. Additionally, DEME has contracted JASCO Applied Sciences (USA) Inc. (JASCO) to provide the sound field verification and real-time Passive Acoustic Monitoring (PAM) during pile installation.

RPS has developed this Pile Driving Monitoring and Mitigation Plan (PDMP) to ensure that monitoring, mitigation, and vessel strike avoidance (VSA) measures are implemented for marine mammals, sea turtles, and other ESA-listed species for the duration of the pile driving activities.

This PDMP addresses the following regulatory required components as described in the applicable regulatory documents and permits, including the IHA and the Project's COP Approval Terms & Conditions (COP T&C):

- Pile Driving and Marine Mammal Monitoring Plan (IHA 5a, COP T&C 5.7.5)
- Alternative Monitoring Plan (IHA 5b, COP T&C 5.7.2 & 5.7.5.1.6)
- Passive Acoustic Monitoring Plan (IHA 5(e)viii, COP T&C 5.7.5.1.4)
- Enhanced Survey Plan for May 1 through May 31 (COP T&C 5.7.4)
- NARW Strike Avoidance Plan (IHA 5h, COP T&C 5.5.5)

Additionally, the Sound Field Verification Plan (IHA 5(f)iii, COP T&C 5.7.7) is being developed as a stand-alone plan.

1.1 Applicable Regulatory Documents and Permits

The VW1 COP T&C contain monitoring and mitigation requirements that apply to marine mammals, sea turtles, and other ESA-listed species.

Additionally, VW1 submitted a request to NOAA for an IHA pursuant to Section 101(a)(5) of the Marine Mammal Protection Act (MMPA; 16 U.S.C. 1371(a)(5)(D)) which is valid for one year from May 1, 2023. The IHA authorizes take incidental to pile driving associated with the construction of the Project in the Atlantic Ocean offshore of Massachusetts within the Wind Development Area (WDA) of Lease OCS-A 0501. These documents are concurrently supported by the NMFS BiOp, Endangered Species Act (ESA) Section 7 Consultation issued on October 18, 2021, which also includes take exemptions for sea turtles.

The pile driving shall be conducted in accordance with the measures stipulated in the IHA, COP T&C and BiOp. This document outlines the monitoring, mitigation and reporting procedures that will be applied during construction activities.

This PDMP considers the monitoring and mitigation requirements described by each of these documents. If the COP T&C terms and conditions are inconsistent with those found in the BiOp, IHA or associated amendments issued for this project, then the conditions and terms in the BiOp and IHA shall prevail in all instances. Activities authorized herein will be subject to any terms and conditions and reasonable and prudent measures resulting from a BOEM-reinitiated consultation for the Project's BiOp (COP T&C 1.3).

1.2 Marine protected species

Marine protected species or protected species refers to any marine species for which dedicated monitoring and mitigation procedures will be implemented, including:

- All marine mammals (whales, dolphins, seals, porpoise)
- Sea turtles
- Manta rays
- Atlantic sturgeon

2 PROTECTED SPECIES OBSERVERS, VISUAL OBSERVERS, TRAINED LOOKOUTS AND MARINE CREW TRAINING

2.1 Staffing Plan

During pile driving, a minimum of two (2) visual PSOs must be on active duty from 60 minutes before, during and for 30 minutes after all pile installation activity concludes. If a North Atlantic Right Whale (NARW) Dynamic Management Area (DMA) or Slow Zone is established during piling that overlaps with the Level B harassment zone (HZ), three (3) PSOs must be on active duty on the pile driving vessel; the primary duty of the third PSO will be to observer for NARWs. During reduced visibility conditions, three (3) PSOs will conduct visual monitoring according to the Alternative Monitoring Plan (AMP). If additional PSOs are required to comply with simultaneous monitoring requirements of a DMA overlapping the Level B harassment zone and AMP monitoring requirements, then those additional PSOs will be added to the team deployed.

For the first pile, VW1 will complete a Sound Field Verification (SFV) for which the results will be immediately reviewed. In the event that the initial field measurements of the SFV indicate that the distances to isopleths of concern are larger than those modeled, additional mitigation (including larger clearance and shutdown zones, bubble curtains, and/or additional PSOs) will be required and approved by BOEM, BSEE and NMFS prior to the next pile being driven (COP T&C 5.7.8). A request to modify the mitigation zones based on the SFV results can be made by VW1, however VW1 does not plan to request a reduction to any of the exclusion zones. If CZs and respective SZs are requested to be expanded, additional review and approval of that request will need to occur at the time of such a request. In the event that the request is approved, the EZs will be expanded to match the actual distances to the isopleths of concern. If the EZs are expanded beyond an additional 1,500 m, supplementary PSOs will be deployed on additional platforms (secondary vessel or other), with each observer responsible for maintaining watch in no more than 180° an area with a radius no greater than 1,500 m. This applies to all protected species (IHA 4(k)ii, BiOp11.3.6(d)).

Pile driving is not planned or anticipated to occur at night, however, a 24-hour monitoring schedule has been provided in the event that piling operations must continue longer than anticipated. During the first load out, enough PSOs will be available on stand-by to ensure 24-hour monitoring is possible while the first few piles are driven. These conditions, in consideration of maximum shift lengths, will require teams of three (3) to five (5) PSOs supplied by RPS, to undertake visual monitoring, implement mitigation and conduct data collection and reporting in accordance with the IHA, BiOp and COP T&Cs (IHA 4(e)i, COP T&C 5.7.10, BiOp 7.1.2).

Visual monitoring will be conducted concurrent to real-time PAM operations. A communication plan describing the in-situ communication between the PSO team and remote PAM Analysts, mode of communication and decision authority is described in Section 10 of this plan.

At least one PSO must be on duty at all times as the designated Lead PSO (LPSO) or as the PSO monitoring coordinator during pile driving. Year round, all vessels transiting over 10 knots in any area must have a dedicated visual observer (VO) monitoring a VSA zone. From June 1 to November 30, a Trained Lookout (TL) for sea turtles is required on all project vessels during all phases of the Project to observer for sea turtles and communicate with the captain to take required avoidance measures as soon as possible if one is sighted.

2.2 Roles and Responsibilities

LPSO

PSO

VO

TL

Relevant Operations and Vessel Crew

MCC

VW1

- Updates Whale Alert and notifies NMFS immediately (as practicable) in the event of NARW detection.
- Report the decision not to shut down pile-driving equipment to BOEM, NMFS and BSEE within 24 hours of the decision.
- Will report any observed takes resulting in injury or mortality to BOEM, BSEE and NMFS immediately.
- Within 24 hours of detection, VW1 must report to BOEM the sighting of all marine mammals and/or sea turtles in the respective SZ that results in a shutdown or a power-down.
- Report dead or injured sea turtles to NMFS as soon as feasible, and within 24 hours to BOEM and BSEE.
- Will immediately report any injured or dead protected species to NOAA Fisheries Marine Mammal and Sea Turtles Stranding and Entanglement Hotline or the NOAA's Dolphin and Whale 911 App. As soon as feasible but no later than 24 hours from the detection, VW1 will make the 24-hour report for the injured or dead animal to NMFS, BOEM and BSEE.

2.3 PSO Requirements

All PSOs will be provided by a third party and must be approved by NMFS. VW1 will submit the CVs of the initial set of PSO necessary to commence the project to NMFS for approval at least 60 days prior to the first day of pile driving activity and training certificates for individual PSOs to BOEM upon request (IHA 5(c)v, COP T&C 5.7.3, BiOp 3.2.6).All PSOs will have completed a protected species observer training course that meets NOAA Fisheries recommendations (**NOAA Technical Memorandum NMFS-OPR-49, 2013**). At least one (1) PSO on active duty must have prior experience working as PSO in offshore environments. Other PSOs may substitute education or training for experience. One PSO will be designated as LPSO or monitoring coordinator during pile driving (COP T&C 5.7.3).

Any designated crew working as VO or TL must receive training on protected species identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements (COP T&C 5.5.2, BiOp 11.3.5).

2.4 Protected Species Training Requirements

PSOs and/or PAM Analysts must have completed a commercial PSO training program for the Atlantic with an overall examination score of 80 percent or greater (Baker et. al 2013) (COP 5.7.3, BiOp 5.7). RPS will provide a project-specific training to all PSOs which will include the COP Approval Conditions and the IHA requirements in addition to the communication procedures, and data collection and reporting requirements.

All individuals will be trained in protected species identification prior to the start of in-water construction activities (IHA 4(I)v). They will also be trained on the associated regulations and best practices for avoiding vessel collisions to all vessel crew members prior to the start of in-water construction activities, as well as the process for reporting protected species to the designated vessel contact (COP T&C 5.5.1).

All required protected species training and confirmed understanding of the IHA and COP requirements for VW1 personnel, including vessel crew and captains, and PSOs, will be documented on a training course log sheet and reported to NMFS (itp.daly@noaa.gov) prior to initiation of project activities. The log sheet must also be provided to BOEM upon request (IHA 6(c), COP T&C 5.5.1).

All Project personnel (including PSOs, VOs, TLs) will take the VW1 Site Induction Training, which includes all permit required training, and all health and safety training. Training is conducted in person, led by a VW1 Package Compliance Manager as the preferred method, or remote via the VW1 Marine Coordination Center system (RSL), where in person trainings are not possible. The training is approximately 3-4 hours in length. The training includes a series of PowerPoint presentations followed by a brief quiz following each module to test the attendee's understanding of the material. At the conclusion of the training, attendees are required to sign or acknowledge electronically their responsibility (e.g., as trained VOs or TLs). All environmental training courses expire within 1 year and require re-training. The training content breakdown is included in Appendix A.

2.5 Training Compliance Report

By January 31 of each year, the Lessee must submit to the Department of Interior (DOI) an annual report that describes its marine trash and debris awareness training process and certifies that the training process has been followed for the previous calendar year. VW1 must send the reports via email to BOEM (at renewable_reporting@boem.gov) and to BSEE (at marinedebris@bsee.gov) (COP T&C 5.1.3.2). Additionally, confirmation of the marine mammal training and understanding of the IHA requirements will be documented on a training course log sheet and reported to NMFS. All required training for VW1 personnel, including vessel crew and captains, and PSOs must be reported to NMFS (itp.daly@noaa.gov) prior to initiation of project activities (IHA 4(c) and 6(c)).

3 VISUAL MONITORING EQUIPMENT

3.1 Daytime monitoring equipment

The PSOs on duty will monitor for marine protected species using the naked eye, hand-held reticle binoculars (7x) and high-magnification (25X) binoculars to search continuously for marine mammals (IHA 5(d)(vii)).

Digital single-lens reflex camera equipment will be provided to record sightings and verify species identification. Electronic data recording devices (e.g., laptop) will also be deployed (COP T&C 5.7.3.3).

Laptops will be used by the PSOs to enter the project data into excel during periods when not actively conducting visual watches. The excel forms will be configured to contain all of the required data fields as outlined in Section 12.2.1. (Note that PAM Analysts will complete excel forms with the required data fields and will submit those forms to RPS to be combined with the visual effort, operations, and visual sightings data). A template of the data forms is provided in Appendix I.

Visual and acoustic detections observed by PSOs and PAM Analysts will be entered into Mysticetus software platform in real time (the date, time, and GIS co-ordinates of the detection) as they perform their monitoring watches such that the detection data is shared with all other Project vessels. MCC will then broadcast the detections via VHF to all other Project vessels, as some vessels will not have access to Mysticetus.

3.1.1 Low visibility monitoring equipment

During periods of low visibility (e.g., darkness, rain, fog, etc.), PSOs will use alternative technology to monitor CZs (Figure 1, Figure 2, Figure 3, and Figure 4) (e.g., night vision devices, IR/Thermal camera, fixed FLIR cameras) (IHA 5(d)vii). This is described in further detail in the Alternative Monitoring Plan (AMP) in Section 5. This visual monitoring equipment is deployed with redundancies and is supplemented with the continuous acoustic monitoring that will be conducted as described in the PAM Plan (Appendix B).

3.1.2 Distance estimation and calibration of visual monitoring equipment

Reticle binoculars have the capability to localize the distance to detected animals.

Monitoring equipment will be calibrated, during construction monitoring at least once a week using the pile-driving vessel's navigation radar system, by comparing estimated distances to known distances and will be conducted during varying sea states and both at night and during the day. The PSOs on the enhanced monitoring PSO Support Vessel will calibrate their equipment using that vessel's navigation radar system.

At night, if reticles cannot be used to localize a detection, distance to detected animals will be determined using range finder sticks or by comparing the location of the animal to known distances, such as the length of the vessel.

3.2 Monitoring data collection and informational tools

All monitoring data collected by PSO/PAMs will be entered into an Excel data sheet and the GIS co-ordinates of protected species detections will be entered into Mysticetus software. The data collection tools will be supported by a real-time notification system headed by the MCC that will allow for data sharing between all project vessels in the event of a protected species detection (COP T&C 5.7.3.1.6 & IHA 5.5.3). Real-time notifications of protected species sightings will be communicated to the MCC via radio who will distribute the information to project associated vessels. Data categories will include Project, Operations, Monitoring Effort, and Detection and will consist of the data identified in Section 12.2.

[redacted]

4 VISUAL MONITORING PROCEDURES

4.1 Visual Monitoring

The following guidelines apply to the PSO teams on the pile driving and enhanced monitoring vessel:

- PSOs must not exceed four consecutive watch hours on duty at any time and must have a minimum two-hour break between watches (IHA 5(d)(iii)) (COP T&C 5.7.3.1.7).
- PSOs must not exceed a combined watch schedule of more than 12 hours in a 24-hour period (IHA 5(d)(iii)) (COP T&C 5.7.3.1.8).
- PSOs will be located at the best vantage point(s) during vessel transit and on the pile driving vessel in order to observe the entire CZs, while still considering human safety, and have no other construction-related tasks (IHA 5(d)(iii)).
- PSOs will maintain an unobstructed 360° coverage surrounding the vessel (COP T&C 5.7.3.2).
- If the EZs are expanded beyond an additional 1,500 m, additional PSOs must be deployed on additional platforms, with each observer responsible for maintaining watch in no more than 180° an area with a radius no greater than 1,500 m (IHA 4(k)ii).

The following guidelines apply to VO and TL:

- When monitoring is required during vessel transit, VO/TL must be stationed at the best vantage point, while still considering observer safety (IHA 5(d)ix).
- Maintain a designated watch for the duration of transit activity (COP T&C 5.5.2).

[redacted]

The PAM Plan provides a more detailed PAM monitoring schedule in Appendix B.

4.2 Monitoring During Reduced Visibility

Reduced visibility is defined as times during the project when the construction activity specified EZs are obstructed by environmental factors like heavy rain, fog, and darkness. The LPSO will have the authority to determine when there is reduced visibility (i.e., when the EZ is not fully visible) and when the additional monitoring measures outlined in the AMP will be implemented.

Pile driving may only commence when the visual EZs (Section 9) are fully visible (i.e., are not obscured by darkness, rain, fog, etc.) for at least 30 minutes immediately prior to beginning pile driving, as determined by the LPSO, between 1 hour after civil sunrise and 1.5 hours before civil sunset (IHA 4(e)iv, COP T&C 5.7.2). The AMP will not be utilized during the 60-minute clearance period before pile driving is initiated. Monitoring requirements are described in further detail in the AMP in Section 5.

PAM will be used in support of visual observations but cannot be utilized as the sole clearance method for EZ establishment during periods of reduced visibility.

All requirements surrounding watch durations and break periods will be adhered to during these periods.

The PSO team and vessel/construction crew will work together to coordinate monitoring to the best of their abilities to minimize any operational downtime during reduced visibility for all construction activities.

5 ALTERNATIVE MONITORING PLAN

This AMP will only be implemented after pile driving commences and the visual CZs and respective SZs are fully visible (IHA 4(e)iv). The AMP will not be utilized during the 60-minute clearance period before pile driving is initiated, in accordance with the IHA (Section 5b, Section 4(e)(ii)), COP T&C (5.7.2, 5.7.10) and BiOp (3.2.6). This AMP details the monitoring methods to be applied during pile driving activities in reduced visibility conditions. The following additional measures will be implemented to effectively maintain all respective CZ and SZs in reduced visibility conditions (i.e., during fog, heavy rain, and nighttime). This plan includes deploying alternative monitoring technologies (night vision, thermal, infrared, fixed cameras) to the PSOs actively monitoring on visual watches and use of PAM with the goal of ensuring the ability to maintain all EZs for all ESA-listed species in the event of unexpected, poor visibility conditions (IHA 5(b)). PAM detection of a NARW within the CZ surrounding a pile must be treated the same as a visual detection and trigger any required delays in pile installation, unidentified whales should be treated as a NARW and will fall under guidance from section 9.2.1.1. These measures for enhanced surveying will be implemented in the event that poor visibility conditions unexpectedly arise after pile driving has commenced and when pile driving cannot be stopped due to human safety or pile driving operational feasibility (BiOp 11.3.4, COP T&C 5.7.2).

Night Vision Devices (NVD), FLIR M364, and Infra-Red (IR) equipment are included in Appendix F.

Alternative monitoring technology will not be used during the 30-minute clearance before pile driving is initiated as the full CZs must be fully visible using the standard day-time monitoring equipment (hand-held reticle binoculars and big-eye binoculars) in order for the visual clearance search to be conducted and completed prior to pile driving.

The AMP applies as follows:

1. During periods of low visibility that begin after pile driving has commenced (e.g., darkness, rain, fog etc.), as determined by the LPSO, who will assess the weather conditions, using their experience in monitoring, and then decide if the respective CZs and SZs are fully visible. If the LPSO determines that the zones are not, then the LPSO will implement the decreased visibility procedures whereby PSOs must use the alternative technology to assist in monitoring the SZs (IHA 5(d)ii). The PSOs will use the most appropriate of the technologies (night vision, thermal, IR) for the conditions present, the technology that best supports monitoring to the furthest distance possible, see Table 2.

2. Nighttime observations by PSOs, conducted when pile driving was started during the day but could not be completed before darkness, will be conducted from a location with no visual barriers or reflectivity from bridge windows and in a location away from other structures that could interfere with

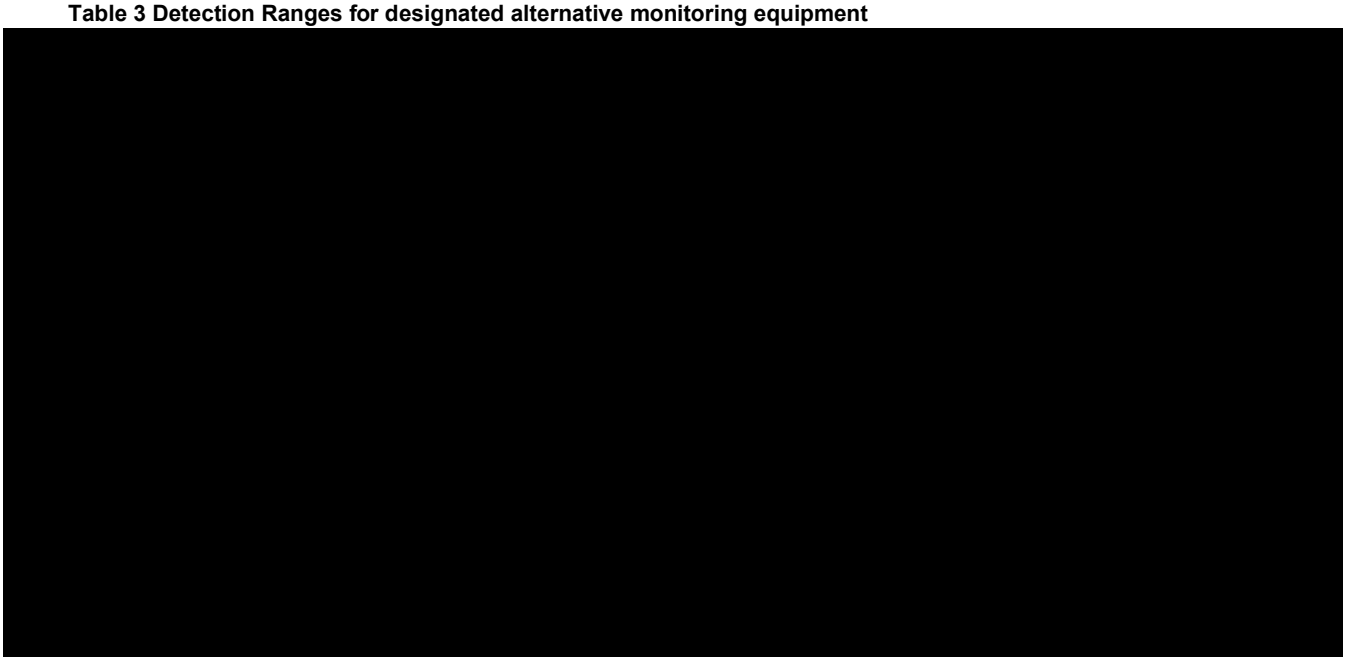
night vision. Lighting on the pile driving vessel will be minimized, and lighting necessary for safe operations will be downshielded and dimmed as much as safely feasible to minimize any negative affect to the PSOs ability to monitor the CZs and SZs.

The equipment that is available to the PSO to use under the above defined reduced visibility conditions is provided below in Table 2.

Table 2 Reduced visibility monitoring equipment available for different monitoring conditions

Reduced visibility condition	Equipment
Fog	Thermal monocular and/or thermal clip for NVD, fixed FLIR cameras, and PAM
Rain/inclement weather	Thermal monocular and/or thermal clip for NVD, fixed FLIR cameras, and PAM
Darkness	NVD and thermal monocular and/or thermal clip for NVD, fixed FLIR cameras, and PAM

Table 3 Detection Ranges for designated alternative monitoring equipment



PAM Analyst(s) will work in coordination with the PSO to support construction activities by continuing acoustic monitoring during periods when visibility is reduced such that the SZs are not fully visible. The PAM system will be configured and operated such that the maximum extent of the largest EZ will be monitored. If a NARW is detected acoustically during a period of reduced visibility, but cannot be localized, all pile driving operations will cease where this same requirement applies to periods when visibility is not reduced.

6 PASSIVE ACOUSTIC MONITORING PLAN

See Appendix B

Additionally, Vineyard Wind will implement in-air noise monitoring as requested by BSEE. Specifically, Vineyard Wind will measure ambient and MPIT tool in-air noise using a handheld sound level meter such as an NTI XL-2, Norsonic Nor140, REED R8070SD or similar device based upon supplier availability, specifications provided in Appendix J. These instruments follow IEC 61672-1:2002 type1/2 standards and have internal and external memory to ensure sufficient capacity to collect required data. Parameters available for measurement include SPL, Leq, Lmax, Lmin, LE and Lpeak up to a 120 dB dynamic range,

depending on the chosen model and also include a wide range of sample rate/data collection options. Vineyard Wind's Compliance Representative will conduct oversight of the monitoring approximately every 30 minutes and record photos and any notable information regarding the operations and monitoring. The equipment will sample at a rate of every 1 minute. If sampling at this rate is deemed not possible, we will confirm an alternative sampling rate with BSEE (Graham Tuttle). Any deviation from this threshold sample rate will be reported on the weekly report, see Section 12.

Measurements will be obtained in proximity to the pile gripper as close as feasible to a distance of 30 m from the sound source. Exact location and installation configuration of the placement of the sound level meter will be determined with input from vessel QHSE and Works Manager based on the configuration of installation equipment on the deck and so as to not interfere with safe operations during foundation installation works. Measurements will be observed during installation of the first foundation.

Sound level measurements will be documented immediately prior to and during and after MPIT air release. Vineyard Wind also will document timing of air release and note other equipment operating and sources of other vessel and equipment noise in addition to the MPIT that may influence sound level measurements. Sound level measurements with and without MPIT air release also will be included in the weekly pile driving reports, see Section 12.

7 STRIKE AVOIDANCE: NARW

See Appendix C

8 STRIKE AVOIDANCE: NON-NARW MARINE MAMMALS AND SEA TURTLES

The following measures apply to all project vessels. These measures do not apply in cases where compliance would create an imminent and serious HSE threat to a person or vessel or to the extent that a vessel is restricted in its ability to maneuver and, because of that maneuverability restriction, cannot comply (IHA 4(l)). This does not apply to any vessel towing gear or any vessel that is navigationally constrained (IHA 4(l)xviii).

On vessels assigned TLs, the TL must check seaturtlesightings.org prior to each trip and report any detections of sea turtles in the vicinity of the planned transit to all captains and lookouts on duty that day (COP T&C 5.5.2).

When marine mammals are sighted while a vessel is underway, the vessel shall take action as necessary to avoid violating the relevant separation distance (e.g., attempt to remain parallel to the animal's course, avoid excessive speed or abrupt changes in direction until the animal has left the area). If marine mammals are sighted within the relevant separation distance, the vessel must reduce speed and shift the engine to neutral, not engaging the engines until animals are clear of the area (IHA 4(l)xviii). The event will be documented, and any VSA maneuvers will be documented accordingly in the data.

Vessels not employing PSOs will transit 10 knots or less when the 500-meter vessel strike avoidance zone is not fully visible (e.g., visibility is obscured due to fog, rain, darkness), as safety permits. Vessel employing PSOs will implement the alternative monitoring plan should the 500-meter vessel strike avoidance zone be obscured by fog, rain, or darkness.

8.1 Non-NARW Whales, *Kogia spp.,* and Beaked Whales

All vessels must maintain a minimum separation distance of 500 m from sperm whales, non-NARW whales, *Kogia spp.*, and beaked whales (BiOp 3.2.6, COP 5.5.8.1).

Upon notification by trained crew or PSO of a non-NARW whale, beaked whale, or *kogia spp.*, the vessel captain must immediately implement vessel strike avoidance procedures to maintain a separation distance of 500 meters or to reduce vessel speed to allow the animal to travel away from the vessel.

- The vessel must come to a full stop when a non-NARW whale, beaked whale, or kogia spp. is sighted within 200 m of an underway vessel, except when taking such a measure would threaten the safety of the vessel or crew.
- The vessel operator must implement VSA measures when any non-NARW whale, beaked whale, or *Kogia spp*. is sighted within a 180-degree radius of the forward path of the vessel (90 degrees port to 90 degrees starboard) at a distance of 500 m or less from a vessel. The vessel operator will immediately implement VSA procedures to maintain a separation distance of 500 m or to reduce vessel speed to allow the animal to travel away from the vessel.

If a whale is observed but cannot be confirmed as a species other than a NARW, the vessel operator must assume that it is a NARW and perform the require VSA measures to avoid the animal, see the NARW Strike Management Plan (Appendix C).

8.2 Delphinoid Cetaceans and Pinnipeds

All vessels will maintain a separation distance of 50 m or greater from small cetaceans (delphinoids) and pinnipeds (IHA 4(I)xvii).

- All vessels must, to the maximum extent practicable, attempt to maintain a minimum separation distance of 50 m from all small cetaceans and pinnipeds, with an exception made for those that approach the vessel voluntarily (e.g., bow riding dolphins) (COP T&C 5.5.8.2).
- In order to maintain a 50 m separation distance when small cetaceans and pinnipeds are sighted while a vessel is underway, the vessel operator must attempt to remain parallel to the animal's course and avoid excessive speed or abrupt changes in vessel direction until the animal has left the area, except when taking such measures would threaten the safety of the vessel or crew (IHA 4(I)xvii, COP T&C 5.5.8.2).
- If small cetaceans and pinnipeds are sighted within the 50 m separation distance, the vessel operator must reduce vessel speed and shift the engine to neutral, not engaging the engines until animals have moved outside the vessel's path are beyond 50 m from the vessel (IHA 4(I)xvii, COP T&C 5.5.8.2).

8.3 Sea Turtles

All vessels must maintain a minimum separation distance of 100 m from sea turtles (COP T&C 5.5.9, BiOp 3.2.6).

- If a sea turtle is sighted within 100 m of the operating vessel's forward path, the vessel operator must slow down to 4 knots and may resume normal vessel operations once the vessel has passed the sea turtle. If a sea turtle is sighted within 50 m of the forward path of the operating vessel, the vessel operator must shift to neutral when safe to do so, and then proceed away from the turtle at a speed of 4 knots or less until there is a separation distance of at least 100 m, at which time normal vessel operations may be resumed.
- Between June 1 and November 30, vessels must avoid transiting through areas of visible jellyfish aggregations or floating vegetation lines or mats. In the event that operational safety prevents avoidance of such areas, vessels must slow to 4 knots while transiting through such areas.
- PSOs, VOs, TLs must check seaturtlesightings.org prior to each trip and report any detections of sea turtles in the vicinity of the planned transit to all vessel operators/captains and lookouts on duty that day.

8.4 Vessel Communication for non-NARW Protected Species VSA

If a non-NARW protected species is visually detected within the respective separation distance, communications will occur using the following pathway:

9 MARINE MAMMAL MONITORING PLAN: EXPOSURE MITIGATION

9.1 Pile Driving Final Project Design

This plan includes final project design information related to pile driving (e.g., number, type of piles, hammer type, sound attenuation systems, anticipated start date, etc.) (IHA 5a).

In total, 62 monopile foundations will be installed with a 4000 kJ hammer from May 2023, and 1 post-pilled jacket foundation (consisting of 4 piles) with a 2000 kJ hammer in June or July 2023. The goal is to complete the installation of all foundations by November 30, 2023; however, this is contingent upon weather, equipment, and technical delays.

9.2 Pile Driving Monitoring and Mitigation Zones

Marine mammals observed within a CZ or respective SZ must be allowed to remain in the zone (i.e., must leave of their own volition), and their behavior must be monitored and documented (IHA 4(i)ii).

9.2.1 Pre-Driving Clearance Zone (CZ) and PAM Monitoring Zones (MZ)

Radial distance from pile that must be visually and acoustically monitored prior to initiating pile driving activities. Detection information will be communicated as described in Section 10 and externally reported as detailed in Section 12. Detections of a protected species inside the permit-defined CZ or MZ will result in mitigation-related actions as described below.

9.2.1.1 NARW CZ & MZ

VW1 will use PSOs to visually observe for NARWs 60 minutes prior to, during, and 30 minutes after all pile driving (IHA 4(f)i). PSOs are stationed on board the pile driving vessel and the enhanced monitoring vessel to monitor these zones per the IHA and other permit requirements.

PAM monitoring will be implemented 60 minutes prior and concurrent to visual monitoring in anticipation of pile driving activities. From May 1-14 and Nov 1- Dec 31, the PAM system will be operated 24/7, if the pile driving vessel is on site and pile driving is planned, and MZ must not be less than 10km (IHA Table 2). The PAM Plan provides a more detailed PAM monitoring schedule (Appendix B).

Table 4 Radial Distances to NARW CZs and PAM MZs (IHA Table 2)

Clearance and PAM MZs				
Time of Year	**Pile Type**	**Visual CZ[+] is any distance, but at minimum** (Monopile/Jacket)	**PAM CZ** (Monopile/Jacket)	**PAM MZ**
May 1 - May 14	All	10km	10 km	10 km
May 15 - May 31	Monopile/jacket	2 km /1.6 km***	5 km /3.2 km***	10 km
June 1 - Oct 31	Monopile/jacket	2 km /1.6 km***	5 km /3.2 km***	5 km
Nov 1 – Dec 31**	Monopile/jacket	2 km /1.6 km***	10 km	10 km

[+]At any time of year, a visual detection of a NARW by a PSO on the pile driving vessel triggers a delay/shutdown in pile driving.
** additional authorization required to pile drive in the month of December.
*** upon receipt of an interim SFV report, NMFS may adjust the CZs to reflect SFV measurements such that the minimum visual CZs represent the Level A (SEL) zones, and the PAM CZs represent the Level B HZs. However, zone sizes will not be decreased less than 1 km from June 1- Oct 1 and not less than 2 km during May 15-May 31 or if a DMA or Slow Zone is established that overlaps with the Level B HZ.

- **ANY DISTANCE [Visual]** – At any time of year, a visual detection of a NARW by a PSO on the pile driving vessel triggers a delay in pile driving.
- **1,000 m [Visual]** – any large whale detected within this distance of a pile that cannot be identified to species must be treated as if it were NARW.

If a PSO located on the pile driving vessel visually observes a NARW at any distance, pile driving shall not begin until PSOs have confirmed they have not detected a NARW from the pile driving vessel for at least 30 minutes (IHA 4(f)ii). PSOs will not provide clearance to the PDOM to begin pile driving in the event that a NARW is detected at any distance where the communication procedures that will be followed to initiate pile driving are outlined in Section 10.3.

A confirmed PAM detection of a NARW within the PAM MZ described in **Table 1** must be immediately relayed to visual PSOs to increase situational awareness and to be considered as pile driving is planned. At any time of year, a PAM detection (75% confidence) of a NARW within the PAM CZ must be treated as a visual detection, triggering a delay in pile driving (IHA 4(g)viii). PAM detections of NARW will be conveyed to PSOs on the pile driving vessel in real-time using the communication procedures described in Section 10.3.

Unidentified whales within 1,000 m of the pile should be treated as a NARW both for clearance and shutdown purposes (**Table 1)**.

9.2.1.2 Other Protected Species CZ

VW1 must use PSOs to visually observe for all other protected marine species 30 minutes prior to, during and 30 minutes after all pile driving (IHA 4(i)i). PSOs are stationed on board the pile driving vessel to monitor these CZs per the requirement.

- **500 m [Visual] –** Non-NARW mysticete whales (including humpback, sei, fin, minke), sperm whales (IHA Table 4) and sea turtles (COP T&C 5.7.9)
- **120 m [Visual] –** Harbor porpoise (IHA Table 4)
- **50 m [Visual]–** All other marine mammals (including dolphins and pinnipeds) (IHA Table 4)

Unidentified whales within 1,000 m of the pile should be treated as a NARW both for clearance and shutdown purposes (**Table 1**).

Hereunder, figures depicting the different CZ, SZ and MZ radial distances per listed species group, per specific year-period for all types of pile driving activity. In the center, the pile driving activity location (blue star) and where applicable the PSO support monitoring track.

Figure 1 CZs and SZs implemented from May 1-14 for all types of pile driving activity (note NARW SZ is at any distance)

Figure 2 CZs and SZs implemented from May 15-31 for all types of pile driving activity (note NARW SZ is at any distance)

Figure 3 CZs, SZs and HZs implemented from June 1-October 31 for monopile driving activity (note NARW SZ is at any distance)

Figure 4 CZs, SZs and HSZs implemented from June 1-October 31 for ESP jacket pile driving activity (note NARW SZ is at any distance)

Figure 5 CZs and SZs implemented from November 1 - December 31 for all types of pile driving activity (note NARW SZ is at any distance)

9.2.2 Shutdown Zone (SZ)

If a marine mammal is visually observed or acoustically detected entering or within the respective SZ after pile driving has commenced, a shutdown of pile driving must be implemented when technically feasible. Shutdown Procedures are described in Section 9.7. The following are the respective radial distances for shutdown, per species group:

- **3,200 m –** NARW (IHA Table 3)
- **500 m –** Non-NARW mysticete whales (including humpback, sei, fin, minke), sperm whales (IHA Table 4) and sea turtles (COP T&C 5.7.9)
- **120 m –** Harbor porpoise (IHA Table 4)
- **50 m –** All other marine mammals (including dolphins and pinnipeds) (IHA Table 4)

9.2.3 Harassment Zones (HZ)

Level A and Level B HZs, applicable to the acoustic sources used during the construction, are broken down by foundation and attenuation type in Table 3 and Table 4.

Table 5 Radial distances (m) to Level A Harassment Thresholds for Each Foundation Type with 6 dB and12 dB Sound Attenuation (BiOp Table 7.1.9)

Foundation Type	Hearing Group	Level A Harassment (peak)		Level A Harassment (SEL)	
		6dB attenuation	12 dB attenuation	6dB attenuation	12 dB attenuation
One 10.3 m (33.8 ft) monopile	LFC	17	8.5	3,191	1,599
	MFC	5	2.5	43	0
	HFC	119	49	71	71
	PPW	19	10	153	71
Four 3 m (9.8 ft) jacket piles	LFC	4	2.5	7,253	3,796
	MFC	1	0.5	71	56
	HFC	26	13.5	564	121
	PPW	5	2.5	977	296

Table 6 Radial Distances (m) to the Level B Harassment Threshold (160 dB rms) for Each Foundation Type with 6 dB and 12 dB Sound Attenuation Incorporated (BiOp table 7.1.10)

Foundation Type	6dB attenuation	12 dB attenuation
10.3 m (33.8 ft) monopile	4,121	2,739
Four, 3 m (9.8 ft) jacket piles	3,220	2,177

Note: Shutdowns must be implemented prior to incursion into a HZ for any species for which takes were not granted OR where takes were granted but have been exceeded.

Table 7 Radial distance (m) to acoustic thresholds used to evaluate behavioral responses of sea turtles to pile driving noise resulting from modeling of 10.3 m monopile with various levels of attenuation (BiOp Table 7.1.20)

Foundation Type	6dB attenuation	12 dB attenuation
10.3 m (33.8 ft) monopile	2,944	1,912

Although mitigation will be applied for animals detected in the aforementioned CZs and respective SZs, observations will extend to the furthest observable distances.

9.3 Visual Search Periods

Pile driving must only commence when all CZs are fully visible (i.e., not obscured by darkness, rain, fog, etc.) for at least 30 minutes, between 1 hour after civil sunrise and 1.5 hours before civil sunset. The LPSO must determine when sufficient light exists to allow effective visual monitoring in all cardinal directions. The LPSO must call for a delay until the CZ is visible in all directions. If conditions (e.g., darkness, rain, fog, etc.) prevent the visual detection of marine mammals in the CZs, VW1 will not initiate construction activities until the full extent of all CZs are fully visible as determined by the LPSO (COP T&C 5.7.2).

Two (2) PSO will be monitoring actively aboard the pile driving vessel:

- 60 minutes prior to pile driving activities,
- During pile driving activities and
- 30 minutes after pile driving activities.

In the event that visibility conditions unexpectedly become poor, the AMP should be implemented to ensuring the ability to maintain all EZs for all ESA-listed species, when pile driving cannot stop due to feasibility/safety (IHA 5(b)).

9.4 Delays to Pile Driving Activities

Prior to the start of pile driving activity, the CZs (Figure 1, Figure 2, Figure 3, Figure 4, and Figure 5) will be monitored for 60 minutes for all protected species, which includes sea turtles.

At any time of year, a visual detection of a NARW at any distance by a PSO on the pile driving vessel triggers a delay in pile driving (**Table 1**).

A confirmed PAM detection of a NARW within the PAM MZ described in **Table 1** must be immediately relayed to the LPSO to increase situational awareness and for consideration as pile driving is planned (IHA 4(g)viii).

Pile driving must be delayed upon a confirmed PAM detection of a NARW, if the detection is confirmed to have been located within the relevant PAM CZ (Table 1 and Table 4) (IHA 4(g)vi). At all times of the year, any unidentified whale sighted by a PSO within 1,000 m of the pile must be treated as if it were a NARW.

If a non-NARW marine mammal is observed entering or within the relevant CZ, 30 minutes prior to the initiation of pile driving activity, pile driving activity must be delayed (IHA 4(i)i).

If a sea turtle is observed approaching or entering the CZ prior to the start of pile driving operations, pile driving activity will be delayed until:

- the sea turtle has voluntarily left the respective CZ and been visually confirmed beyond the CZ

OR

- 30 minutes have elapsed without re-detection of the animal (BiOp 7.1.3)

After detection, pile driving may commence when:

- **NARW**
  - May 1- May 14: the following day or after a follow-up vessel-based survey confirmed that all NARW(s) have departed the 10km extended PAM and visual CZs for any foundation type (COP T&C 5.7.15.1) **or;**
  - May 15 - October 31: until 30 minutes of monitoring confirms that all NARW(s) have left the2 km CZ (monopiles) of the 1.6 km CZ (jacket piles) (COP T&C 5.7.15.2) **or;**
  - November 1 - December 31: until the following day, or after a vessel-based survey confirms that NARW(s) have left the 10 km extended PAM and visual CZs for any foundation type (as determined by the LPSO) (COP T&C 5.7.15.3)
- **Non-NARW** marine protected species have voluntarily left the respective CZ and been visually confirmed beyond that CZ

  OR

- When a marine protected species was not observed exiting the CZ, an additional time period has lapsed with no further visual or acoustic detections within the relevant CZ (this time is additional to the 60-minute clearance search)

  - **30 minutes** for non-NARW mysticetes, sperm whales, Risso's dolphins, pilot whales, and sea turtles (IHA 4(i)iii, COP T&C 5.7.14.2, BiOp 7.1.3)
  - **15 minutes** for all other marine mammals (IHA 4(i)iii, COP T&C 5.7.14.3, BiOp 3.2.6).

Both the clearance search period and the mandatory delay for animals observed within the CZ must be completed before pile driving initiation. The communications flow chart that outlines these procedures are found in Section 10.3 10.3of this document.

9.5 Pile Driving Soft Start Procedure

Soft start is required at the beginning of driving a new pile and at any time following a cessation of impact pile driving of 30 minutes or longer (IHA 4(j)ii, BiOp 3.2.6). Soft start technique must be documented each time it is implemented.

The pile driving vessel must implement soft start techniques for impact pile driving. The soft start must include an **initial set of three strikes** from the impact hammer at reduced energy, **followed by a one-minute waiting period**. This process must be **repeated a total of three times** prior to initiation of pile driving (IHA 4(j)i). The soft start technique will be documented each time it is implemented. Per the VW-FOU-GOS-MA-9010-MP Installation Manual, the soft start will begin with a reduced hammer energy of less than 40% of the total hammer energy level (4000 kJ), where the initial strikes will be approximately less than 1600 kJ.

If a protected species is sighted withing the respective SZ, soft start activities will be shut down until animal is seen exiting the respective zone or the proper time period has passed with no further sighting (30 min) (IHA 4(i)iii, BiOp 7.1.2) and the conditions of Section 9.7 are met. VW1 must confirm the use of a soft start technique for pile driving and document the timing of each application in PSO reports and in pile driving reports submitted with the Fabrication and Installation Report (COP T&C 5.7.6).

9.6 Short Breaks in Pile Driving Operations

Soft start is required any time following a cessation of impact pile driving of 30 minutes or longer (IHA 4(j)ii).

9.7 Shutdown Procedures

If a marine mammal or sea turtle is visually observed or acoustically detected entering or within the animal's respective SZ (specified in Figure 1, Figure 2, Figure 3, and Figure 4) after pile driving has commenced, an immediate shutdown of the hammer will be requested by the PSO team. If there is any uncertainty regarding identification, PSOs must use best professional judgement in making the decision to call for a shutdown. The communications flow chart that outlines these procedures are found in Section 10.4 of this document.

9.7.1 Restart guidance for following pile driving shutdown for all protected marine species

Following a shutdown, pile driving may not commence, until either the animal has voluntarily left and been visually confirmed beyond the relevant CZ, or, when 30 minutes have elapsed without re-detection for mysticetes (including NARW), for sperm whales, Risso's dolphins and pilot whales and sea turtles, or 15 minutes have elapsed without re-detection for all other non-NARW marine mammals (IHA 4(i)vi, COP T&C 5.7.14, BiOp 7.1.3).

If an individual from a marine mammal species for which authorization has not been granted, or a species for which authorization has been granted but the authorized take number has been met, is observed entering or within the CZ, pile driving activities must shut down immediately (when technically feasible as described above). Activities must not resume until the animal has been confirmed to have left the relevant CZ (Section 9.2.1.2) or the observation time period (Section 9.4), has elapsed with no further sightings (IHA 4(i)vii).

If a shutdown is requested but not implemented, the decision not to shut down pile driving operations must be reported to BOEM and NMFS within 24 hours of the decision, with a detailed explanation of the imminent risk presented and the animals potentially impacted as required per (COP T&C 5.7.13). The protocol is outlined in Section 12.14.

9.8 Pile Driving Seasonal Restrictions

Pile driving operations are subject to the following seasonal restrictions:

January 1 through April 30 – Pile driving is not allowed during this time period (COP T&C 5.7.1, IHA 4(a)).

December 1 through December 31 – Pile driving must not occur in December unless unanticipated delays due to weather or technical problems arise that necessitate extending pile driving through December, and the pile driving is approved by BOEM in accordance with the following procedures. VW1 will submit to BOEM (renewable_reporting@boem.gov) for written concurrence an Enhanced Survey Plan for December 1 through December 31 to minimize the risk of exposure of NARWs to pile-driving noise, including noise from daily pre-construction surveys (COP T&C 5.7.1).

9.9 Pile Driving Daily Restrictions

Pile driving must not commence until **at least one (1) hour after civil sunrise** to minimize the effects of sun glare on visibility. The Lessee must not commence pile driving **within 1.5 hours of civil sunset** (IHA 4(b)). To minimize the potential for pile driving to continue after civil sunset when visibility will be impaired (COP T&C 5.7.2).

9.10 Pile Driving Operational Restrictions

- No more than two monopiles may be driven per day (IHA 4(c))
- No more than four jacket piles may be driven per day (IHA 4(c)); but VW1 maximum design envelope for the project consists of only two jacket foundations

- For in-water construction, heavy machinery activities other than pile driving, if a marine mammal comes within 10 m of equipment, VW1 must cease operations until the marine mammal has moved more than 10 m and, on a path, away from the activity (IHA 4(i)viii).

9.11 Noise Attenuation Devices

If the initial SFV measurements indicate that the distances to isopleths are larger than those modeled assuming a 6 dB reduction (Table 4, Table 5 and Table 6), VW1 must apply additional sound attenuation measures before additional piles are installed (IHA 4(k)i).

Noise attenuation devices will be deployed around each pile driving activity in an effort to reduce the sound levels produced by the impact hammer during pile driving, hence reducing the potential impact on protected species in the event that they approach the construction site.

The methodology for noise attenuation assumes the use of a Hydro Sound Damper (HSD) system from Off Noise Solutions GmbH in combination with a Single Big Bubble Curtain (BBC) from Hydrotechnik Lubeck which are considered as state-of-the-art and have been used and accepted on previous projects.

The BBC must distribute air bubbles around 100 percent of the piling perimeter for the full depth of the water column. Additionally, the bubble ring must be in contact with the seafloor for the full circumference of the ring, and the weights attached to the bottom ring must ensure 100 percent seafloor contact. No parts of the ring or other objects may prevent full seafloor contact (IHA 4(k)iii).

Construction contractors must train personnel in the proper balancing of air flow to the bubblers. Construction contractors must submit an inspection/performance report for approval by VW1 within 72 hours following the performance test. Corrections to the attenuation device to meet the performance standards must occur prior to impact driving (IHA 4(k)iv).

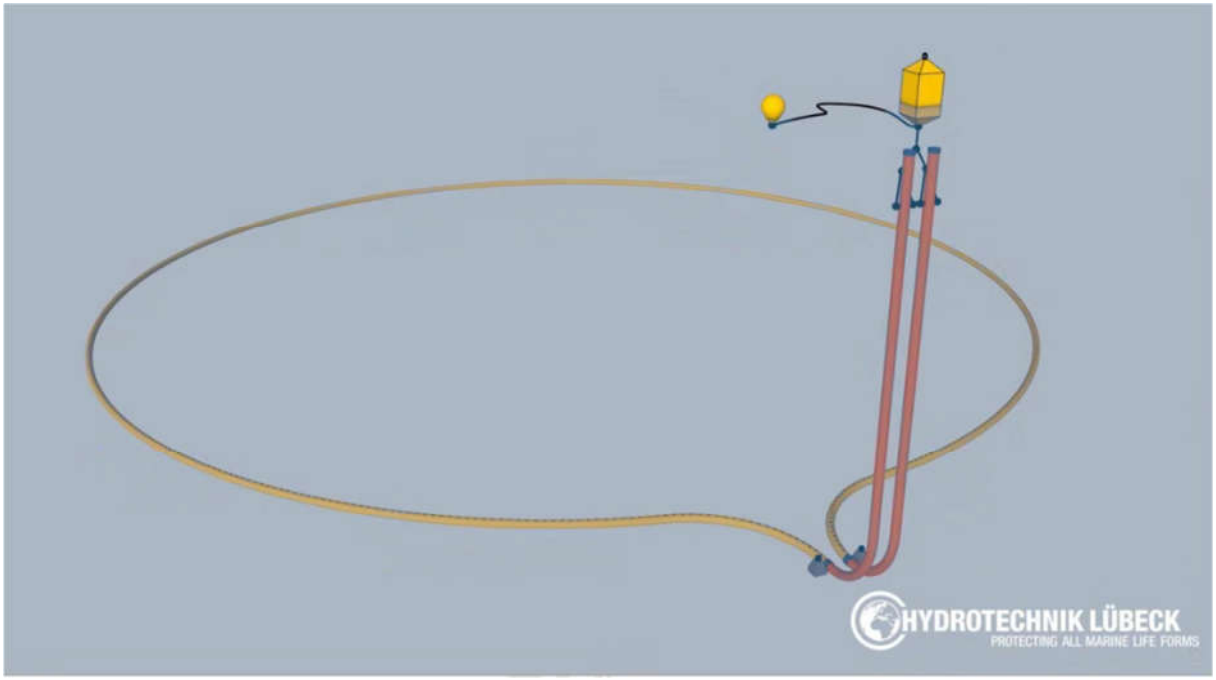


Figure 6 Big bubble curtain diagram as it would appear when deployed.

10 COMMUNICATION PLAN

10.1 DMA and Slow Zone Notifications

A daily MCC call will be held which all project vessel captains attend and where the status of any DMAs and Slow Zones will be included on the agenda.

Also, project vessels and its crew are trained to consistently monitor the NOAA website for updates.

PSOs will check the NOAA website and Whale Alert prior to the start of every monitoring shift for the presence of DMAs and/or Slow Zones.

10.2 Project Crew Briefings

Pre-project briefings between construction supervisors and crews and the PSO team will be conducted prior to the start of all pile driving activities, and when new personnel join the work, in order to explain responsibilities, communication procedures, protected monitoring protocol, and operational procedures (IHA 5(d)i).

All vessel crew members must be briefed in the identification of sea turtles and in regulations and best practices for avoiding vessel collisions. Reference materials must be available aboard all project vessels for identification of sea turtles (Appendix D). The expectation and process for reporting of sea turtles (including live, entangled, and dead individuals) must be clearly communicated and posted in highly visible locations aboard all project vessels, so that there is an expectation for reporting to the designated vessel contact (such as the lookout or the vessel captain), as well as a communication channel and process for crew members to do so (BiOp 11.3.5d).

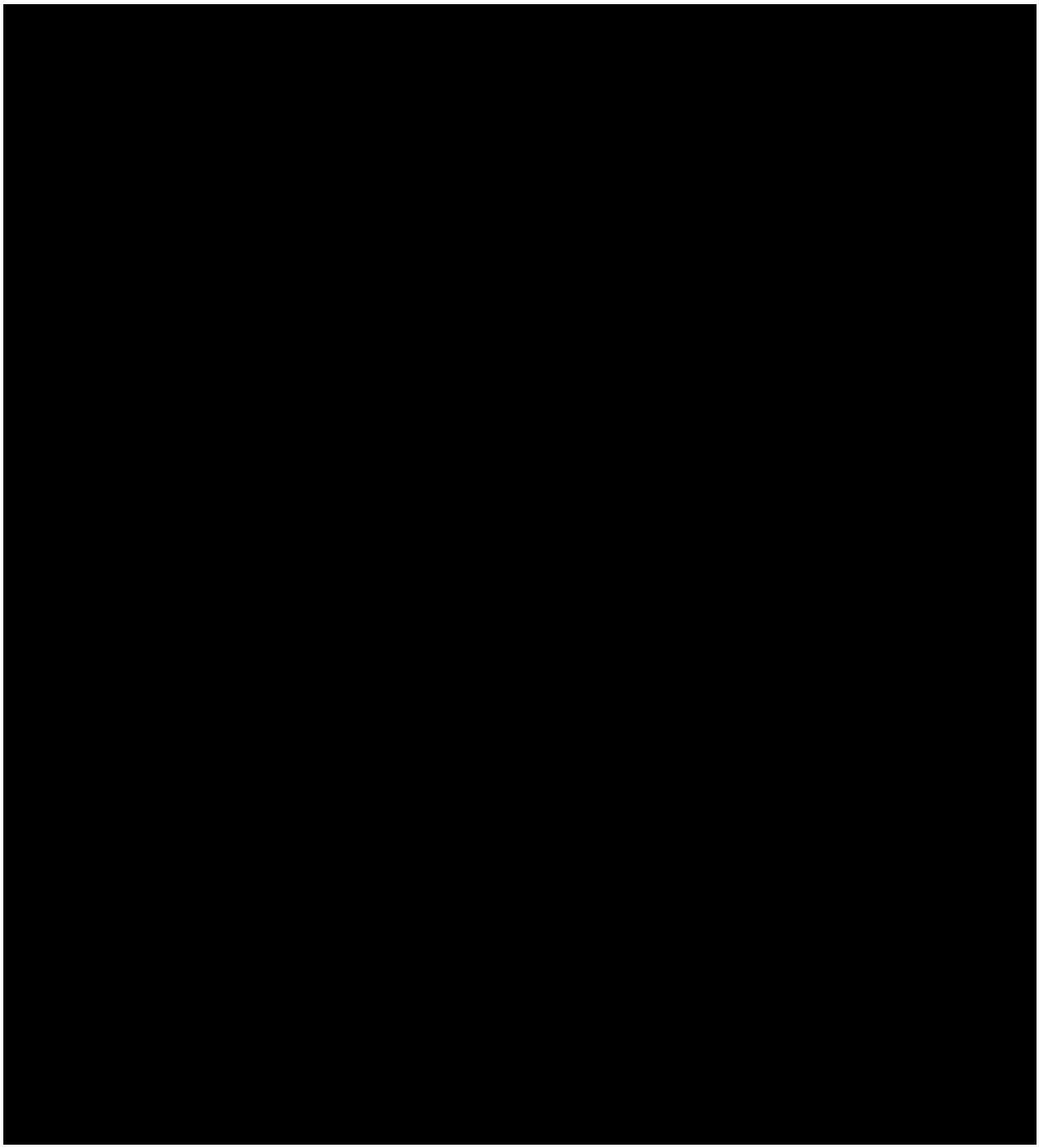
These briefings will include the following content:

10.3 Soft Start Communication Procedure

[redacted]

10.4 Shutdown Request Communication Procedure

[redacted]



10.5 Protected Species Incident Notification Communication Procedure

11 ENHANCED SURVEY PLAN

The Enhanced Survey Plan describes the monitoring and mitigation requirements during construction, specific to the NARW between the dates of May 1 and May 31 (COP T&C 5.7.4). Vineyard Wind will submit an updated Enhanced Survey Plan before August 1, 2023, for BOEM and NMFS concurrence for any foundation installation activities planned for December 1 to December 31 (COP T&C 5.7.1). **Please note, Vineyard Wind will not conduct any pile-driving operations during the period of May 1 through May 14, 2023 and this Enhanced Survey Plan will only cover the time period of May 15 through May 31.**

During the period of May 15 through May 31, PSOs on the pile-driving vessel will conduct visual monitoring using the equipment proposed including hand-held binoculars and big-eye binoculars to monitor the visual CZ as required per IHA Table 2, Table 8 below. From May 15 through May 31 an extended PAM MZ of 10 km will be established for NARWs. A confirmed PAM detection of a NARW within the PAM MZ described in **Table 1 and 8** must be immediately relayed to the LPSO to increase situational awareness and to be considered as pile driving is planned.

In the event that a NARW is detected at any distance by the PSOs on the pile driving vessel or by any other individual within the visual CZ, pile driving will be postponed and must not commence until the following day or until a follow-up vessel-based survey confirms that all NARWs have voluntarily departed the visual CZ zone (COP T&C 5.7.10.2.1).

Table 8 Radial Distances to NARW CZ and PAM MZ (IHA Table 2)

Time of Year	Pile Type	Minimum Visual CZ	PAM CZ	PAM MZ
May 15 – May 31	Monopile/Jacket	2 km/ 1.6 km[1, 2]	5 km/3.2 km[3]	10 km

[1]Upon receipt of an interim SFV report, NMFS may adjust the clearance zones to reflect SFV measurements such that the minimum visual clearance zones represent the Level A (SELcum) zones and the PAM clearance zones represent the Level B harassment zones. However, zone sizes will not be decreased less than 1km from June 1- Oct 1 and not less than 2 km during May 15-May 31 or if a DMA or Slow Zone is established that overlaps with the Level B harassment zone.
[2] If a DMA or Slow Zone overlaps the Level B harassment zone, Vineyard Wind will employ a third PSO at the pile driving platform such that 3 PSOs will be on duty. The primary duty of the 3rd PSO is to observe for NARWs.

Figure 7 below, as also shown in the PAM Plan, demonstrates how the PAM monitoring zones encompass the seasonal clearance and shut-down zones during the Enhanced Monitoring Plan from May 15 – May 31.

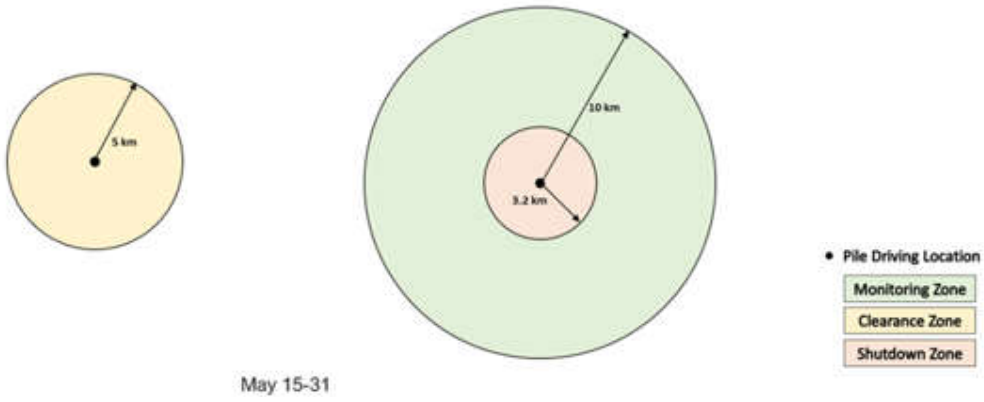


Figure 7 Monopile NARW CZ, MZ and SZ Pre & Post Pile Driving (left) and During Pile Driving (right)

12 REPORTING

12.1 Reporting Flow Chart

Any reportable events pertaining to protected species during operations will be transferred by the LPSO to the appropriate parties. Reportable events are explained in more detail in the following sections of this plan. Throughout this section, where a report, notification, or submittal is required per a Project permit, VW, it's Contractor or their delegates will report to the issuing authority. All marine mammal related reports will be submitted to both NMFS OPR and GARFO.

The following communication flow is a general example of how information will proceed from the field to the necessary parties. More detailed examples can be found in Sections 8,10 and 12 of this PDMP, as well as in the NARW Strike Management Plan.

12.2 Data Forms

PSOs, VOs and TLs will utilize standardized data forms that have been provided to, and approved by, BOEM and NMFS. These forms will contain, at minimum, all of the data elements listed below, and data will be recorded in the field daily.

A template of the data forms is provided in Appendix I, along with the BOEM Standard Field Codes and Units.

12.2.1 PSO Data Forms

Project Information

- Project Name
- Lease Number
- State Coastal Zones
- Construction Contractor
- PSO/PAM Contractor
- Vessel Name(s)
- Hammer type used (make and model)
- Reporting start and end dates (YYYY-MM-DD)- (YYYY-MM-DD)

- Visual monitoring equipment used (e.g., bionics, magnification, IR cameras, etc.)
- Distance finding method used
- PSO/PAM names (last, first) and training
- Observation height above sea surface (m)

Operations Information

- Date (YYYY-MM-DD)
- Pile identifier and pile numbers for the day (e.g., pile 2 of day 3)
- Pile locations (latitude and longitude)
- Pile diameters (m)
- Pile length (m)
- Greatest hammer power used for each pile (kJ)

Monitoring Effort Information

- Date (YYYY-MM-DD)
- Noise source (ON = Hammer On, OFF = Hammer Off)
- PSOs (Last, First) & affiliations
- How many visual PSOs on watch at one time
- Start time (HH:MM) and latitude/longitude (decimal degrees) of observations
- End time (HH:MM) and latitude/longitude (decimal degrees) of observations
- Vessel heading and speed (if applicable) at beginning and end of visual PSO duty shifts
- Vessel activity (i.e., transit, soft start, etc.)
- Duration of visual observation (HH:MM)
- Environmental conditions at beginning and end of PSO shift and whenever conditions change significantly
  - Wind speed (knots), from direction
  - Swell (m)
  - Sea state (glassy, slight, choppy, rough, or Beaufort scale)
  - Water depth (m)
  - Visibility (km)
  - Glare severity
  - Precipitation
  - Cloud coverage (%)
- Block name and number
- Time clearance visual monitoring began in UTC (HH:MM)
- Time clearance visual monitoring ended in UTC (HH:MM)
- Time clearance PAM monitoring began in UTC (HH:MM)
- Time PAM monitoring ended in UTC (HH:MM)
- Duration of clearance visual monitoring and PAM (HH:MM)
- Time soft start began (HH:MM)
- Time equipment full power was reached (HH:MM)
- Duration of soft start (HH:MM)
- Time pile driving activity began per pile (hammer on) (HH:MM)
- Time pile driving activity ended per pile (hammer off) (HH:MM)
- Pile driving duration (HH:MM)
- Did a shutdown/power down occur?
- Time shutdown was called for in UTC (HH:MM)
- Time equipment was shut down in UTC (HH:MM)
- Dates of departures and returns to port with port name (YYYY-MM-DD)
- Inhibiting factors of observations (e.g., vessel traffic)
- Habitat or prey observations, including latitude and longitude
- Marine debris sighted, including latitude and longitude

Detection Information

- Date (YYYY-MM-DD)

- Sighting ID (V01, V02, or sequential sighting number for that day) (multiple sightings of same animal or group should use the same ID)
- Start time at first detection in UTC (HH:MM)
- End time at last detection in UTC (HH:MM)
- PSO name(s) who detected the animal (Last, First)
- Platform PSO/PAM is on
- Effort (ON=Hammer On; OFF=Hammer Off)
- Latitude (decimal degrees), longitude (decimal degrees)
- Compass heading of vessel (degrees)
- Vessel speed (kts)
- Water depth (m)
- Swell height (m)
- Beaufort scale (B0-B12)
- Wind speed (kts)
- Wind direction
- Precipitation
- Visibility (km)
- Cloud coverage (%)
- Glare strength
- Species identification including common name, scientific name, or family
- Certainty of identification
- Number of adults
- Number of juveniles
- Number of yearlings
- Number of calves
- Group composition (if mix of species)
- Total number of animals (high/low/best)
- Distance and bearing of each marine mammal observed relative to the pile being driven for each sighting (if pile driving was occurring at time of sighting)
- Description (include features such as overall size; shape of head; color and pattern; size, shape, and position of dorsal fin; height, direction, and shape of blow, etc.)
- Detection narrative (note behavior, especially changes in relation to construction activity and distance from vessel)
- Direction of travel/first approach (relative to vessel)
- Behaviors observed: indicate behaviors and behavioral changes observed in sequential order (use behavioral codes)
- Pace of animal
- Range from vessel
- If any bow-riding behavior observed, record total duration during detection (HH:MM)
- Initial heading of animal(s) (degrees)
- Final heading of animal(s) (degrees)
- Construction activity at time of sighting (i.e.. ramp-up, active pile driving, delay etc.)
- SZ size during detection (m)
- Was the animal inside the respective SZ?
- Animal's closest distance from the pile being driven (meters) and estimated time spent within the HZ (HH:MM)
- Time at closest approach to vessel in UTC (HH:MM)
- Time at closest approach to pile being driven in UTC (HH:MM)
- Time animal entered EZ in UTC (HH:MM)
- Time animal left EZ in UTC (HH:MM)
- Description of any mitigation-related actions called for but not implemented in response to a sighting (e.g., delay, shutdown, etc.), including time, location, and the reason why the mitigation-related action was not implemented
- If observed/detected during soft start: first distance (reticle distance in meters), closest distance (reticle distance in meters), last distance (reticle distance in meters), behavior at final detection
- Detections with PAM
- Watch Status (sighting made by PSO on watch, opportunistic, crew)
- Marine mammal occurrence within relevant Level A or Level B HZs must be documented

- Duration of detection (HH:MM)
- Did a shutdown/power down occur?
- Time shutdown was called for in UTC (HH:MM)
- Time equipment was shut down in UTC (HH:MM)
- Time pile driving restarted in UTC (HH:MM)
- Event was communicated to other project vessels (Y/N)
- Photograph taken (Y/N)

Port Call Information

- Vessel name
- Date of arrival/departure (YYYY-MM-DD)
- Time of arrival/departure (YYYY-MM-DD)
- Port location
- Reason

12.2.2 VO & TL Data Forms

For vessels operating in association with the construction project, where monitoring is required during vessel transit, designated observers will be stationed at the best vantage point (while still considering observer safety), to ensure maintenance of separation distances between protected species and vessels. When an observation of a protected species occurs during vessel transit, the animal will be reported to the MCC, and observers must record the following on the Visual Observer Log (IHA 5(d)ix):

- Time (HH:MM), date (YYYY-MM-DD) and location (latitude and longitude);
- The vessel's activity, heading (degrees) and speed (kts);
- Sea state, water depth (m) and visibility;
- Protected species identification to the best of the observer's ability (e.g., NARW, whale, dolphin, seal, sea turtle);
- Initial distance protected species was observed from the vessel (m) and closest point of approach (m); and
- Any avoidance measures taken in response to the protected species sighting.

12.2.3 Opportunistic Sightings

Any opportunistic detections by crew will be brought to the PSO/VO/TL if present. For vessels without PSO/VO/TL, (i.e. any non-pile driving and non-geophysical survey vessels transiting less than 10 knots, from December 1 to May 31, when there is no DMA/SMA/Slow Zone), RPS will provide DEME and support crew with basic list of data items to document utilizing the Visual Observer Log at the time of the detection, in addition to notifying MCC of sighting:

- Time (HH:MM), date (YYYY-MM-DD) and location (latitude/longitude);
- The vessel's activity, heading (degrees) and speed (kts);
- Sea state, water depth (m) and visibility;
- Protected species identification to the best of the observer's ability (e.g., NARW, whale, dolphin, seal, sea turtle);
- Initial distance protected species was observed from the vessel (m) and closest point of approach (m); and
- Any avoidance measures taken in response to the protected species sighting.

12.3 Reporting NARW Detections

The report must include the project name, date (MM-DD-YYYY), unique identifier, time (HH:MM), location, and number of animals (COP T&C 5.5.7).

[redacted]

[redacted]

VW1 will immediately report the detection to BOEM, NMFS to the NOAA Fisheries 24-hour Stranding Hotline number: (866) 755-6622, WhaleAlert, and NMFS North Atlantic right whale Passive Acoustic Reporting System email and website (acoustic detections only) (COP T&C 5.5.7, IHA 5(i), BiOp 11.3.16b). Visual and acoustic detections will be reported as soon as feasible, but no longer than 24hrs after the detections (IHA 6(a)).

[redacted]

12.4 Injured/Dead Bird and Bat Reporting

[redacted]

The report must contain the following information:

A. Name of species

B. Date found (YYYY-MM-DD)
C. Location
D. Picture to confirm species identity (if possible)
E. Any other relevant information

Any deceased birds should not be disposed of until a positive ID has been confirmed. Thereafter, based on the species, disposal methodology will be advised accordingly.

Any occurrence of dead ESA birds or bats must be reported to BOEM, BSEE, and USFWS (newengland@fws.gov) as soon as practicable (taking into account crew and vessel safety), but no later than 24 hours after the sighting, and if practicable, carefully collect the dead specimen and preserve the material in the best possible state for transfer to USFWS. For immediate reporting to BSEE, a notification will be submitted to protectedspecies@bsee.gov and as noted in Appendix B under JOINT NTL 2023-N01.

VW1 in cooperation with contractors is required to submit annual reports by January 31 each year to BOEM (at renewable_reporting@boem.gov) and BSEE (at protectedspecies@bsee.gov) and USFWS documenting any dead (or injured) birds or bats found on project related vessels during construction, and operations. Carcasses with Federal/research bands must also be reported to United States Geological Survey Bird Band Laboratory, at https://www.pwrc.usgs.gov/bbl/ (COP T&C 5.2.4, Joint NTL 2023-N01 Appendix B).

12.5 Sighting and Reporting of Injured or Dead Marine Mammals

VW1 will immediately report the injured or dead animal to NOAA Fisheries Marine Mammal and Sea Turtles Stranding and Entanglement Hotline by phone (866-755-6622) or the NOAA's Dolphin and Whale 911 App.

As soon as feasible but no later than 24 hours from the detection, VW1 will make the 24-hour report (301-427-8401) for the injured or dead animal to NMFS (Protected Resources Division, nmfs.gar.incidental-take@noaa.gov), BOEM (renewable_reporting@boem.gov) and BSEE (protectedspecies@bsee.gov) (Joint NTL 2023-N01 Appendix B).

If the death or injury was clearly caused by the specified activity, VW1 must immediately cease the activities until NMFS OPR is able to review the circumstances of the incident and determine what, if any, additional measures are appropriate to ensure compliance (IHA 6(i)i).

Report will include:

A. Time (HH:MM), date (YYYY-MM-DD), and location (latitude/longitude) of the first discovery (and updated location information if known and applicable);
B. Species identification (if known) or description of the animal(s) involved;
C. Condition of the animal(s) (including carcass condition if the animal is dead);
D. Observed behaviors of the animal(s), if alive;
E. If available, photographs or video footage of the animal(s); and
F. General circumstances under which the animal was discovered.

12.6 Sighting and Reporting of Injured or Dead Marine Mammals- Vessel Collision

Vessel collisions with marine protected species must be immediately reported by VW1 to NOAA Fisheries Marine Mammal and Sea Turtles Stranding and Entanglement Hotline by phone (866-755-6622) or the NOAA's Dolphin and Whale 911 App, as well as the U.S. Coast Guard via Channel 16. An incident report must be provided as soon as practicable but no later than 24 hours to NMFS OPR, GARFO (301-427-8401), BOEM and BSEE. As soon as practicable notification (but no later than 24 hours) goes to NMFS Protected Resources Division (nmfs.gar.incidental-take@noaa.gov), BOEM (renewable_reporting@BOEM.gov), BSEE (protectedspecies@bsee.gov) (Joint NTL 2023-N01 Appendix B).

VW1 must immediately cease the activities until NMFS OPR is able to review the circumstances of the incident and determine what, if any, additional measures are appropriate to ensure compliance (IHA 6(i)ii).

The incident will be reported to VW1 Compliance Manager.

Report will include:

Time, date, and location (latitude/longitude) of the incident;

A. Species identification (if known) or description of the animal(s) involved;
B. Vessel's speed during and leading up to the incident (kts);
C. Vessel's course/heading (degrees) and what operations were being conducted (if applicable);
D. Status of all sound sources in use;
E. Description of avoidance measures/requirements that were in place at the time of the strike and what additional measures were taken, if any, to avoid strike;
F. Environmental conditions (e.g., wind speed (kts) and direction, Beaufort Sea state, cloud cover (%), visibility) immediately preceding the strike;
G. Estimated size and length of animal that was struck;
H. Description of the behavior of the marine mammal immediately preceding and following the strike;
I. If available, description of the presence and behavior of any other marine mammals immediately preceding the strike;
J. Estimated fate of the animal (e.g., dead, injured but alive, injured and moving, blood or tissue observed in the water, status unknown, disappeared); and
K. To the extent practicable, photographs or video footage of the animal(s).
L. Lessee and vessel information

12.7 Sighting and Reporting of Injured or Dead Sea Turtles: Non-Vessel Strike

In the event of an injured or dead sea turtle, VW1 will immediately report the incident to NOAA Fisheries Marine Mammal and Sea Turtle Stranding and Entanglement Hotline (866-755-6622), then report within 24 hours to NMFS (Protected Resources Division, nmfs.gar.incidental-take@noaa.gov), BOEM (renewable_reporting@boem.gov) and BSEE (protectedspecies@bsee.gov) (Joint NTL 2023-N01 Appendix B).

The report will include the following information:

A. Time, date, and location (latitude/longitude) of the first discovery (and updated location information if known and applicable);
B. Species identification (if known) or description of the animal(s) involved;
C. Condition of the anima(s) (including carcass condition if the animal is dead);
D. Observed behaviors of the animal(s), if alive;
E. If available; photographs or video footage of the animal(s);
F. General circumstances under which the animal was discovered;
G. Lessee and vessel(s) information;
H. Vessel's speed during and leading up to the incident;
I. Vessel's course/heading and what operations were being conducted (if applicable);
J. Status of all sound sources in use (if applicable);
K. Estimated size and length of animal (m);
L. Estimated fate of the animal (e.g., dead, injured but alive, injured and moving, blood or tissue observed in the water, status unknown, disappeared); and
M. To the extent practicable, photographs or video footage of the animal(s).

Staff responding to the hotline call will provide any instructions for handling or disposing of any injured or dead animals, which may include coordination of transport to shore, particularly for injured sea turtles.

12.8 Sighting and Reporting of Injured or Dead Sea Turtles: Vessel Strike

In the event of a suspected or confirmed vessel strike of a sea turtle by any project vessel, VW1 will report the incident to NMFS (NMFS Protected Resources Division, nmfs.gar.incidental-take@noaa.gov; and NMFS New England/Mid-Atlantic Regional Stranding Hotline (866-755-6622)) as soon as feasible (BiOp 11.3.16b).

Then report within 24 hours to NMFS (Protected Resources Division, nmfs.gar.incidental-take@noaa.gov), BOEM (renewable_reporting@boem.gov) and BSEE (protectedspecies@bsee.gov) (COP T&C 5.6.1, Joint NTL 2023-N01 Appendix B).

The report will include the following information:

A. Time (HH:MM), date (YYYY-MM-DD), and location (latitude/longitude) of the incident;
B. Species identification (if known) or description of the animal(s) involved;
C. Vessel's speed during and leading up to the incident;
D. Vessel's course/heading and what operations were being conducted (if applicable);
E. Status of all sound sources in use;
F. Description of avoidance measures/requirements that were in place at the time of the strike and what additional measures were taken, if any, to avoid strike;
G. Environmental conditions (e.g., wind speed (kts) and direction, Beaufort scale, cloud cover (%), visibility) immediately preceding the strike;
H. Estimated size and length of animal that was struck (m);
I. Description of the behavior of the animal immediately preceding and following the strike;
J. Estimated fate of the animal (e.g., dead, injured but alive, injured and moving, blood or tissue observed in the water, status unknown, disappeared);
K. To the extent practicable, photographs or video footage of the animal(s);
L. Lessee and vessel information.

12.9 Reporting Marine Mammal and Sea Turtles in the Pile-Driving SZ

The data collection platform will track the number of animals that entered the respective SZ during pile driving activities. as well as the number totaled for the construction on a daily basis. The PSO provider must submit the data report (raw data collected in the field) and must include the daily form with the date, time, species, pile identification number, GPS coordinates, time and distance of the animal when sighted, time the shutdown or power-down occurred, behavior of the animal, direction of travel, time the animal left the respective SZ, time the pile driver was restarted or powered back up, and any photographs that may have been taken.

Potential exposure detection narratives will be reviewed by the RPS Project Manager, who will update the Project Total Potential Exposures on the daily report form, identifying the remaining number of potential takes.

Within 24 hours of detection, VW1 will report to BOEM (at renewable_reporting@boem.gov) the sighting of all marine mammals and/or sea turtles in the respective SZ that results in a shutdown or a power-down (COP T&C 5.7.16).

The authorized Level A and Level B Harassment takes specific to pile driving operations associated with Lease OCS-A 0501 are outlined in table 8 per the NMFS approved IHA.

Table 9 Tracking Numbers of Incidental Take of Marine Mammals Authorized (IHA Table 1)

Species	Authorized Takes by Level A Harassment	Authorized Takes by Level B Harassment
Fin whale	5[1]	33[1]
Humpback whale	10	56
Minke whale	2	98
North Atlantic right whale	0	20[1]
Sei whale	2[1]	4[1]
Sperm whale	0	5[1]
Atlantic white-sided dolphin	28	1107
Bottlenose dolphin	8	96
Long-finned pilot whale	9	91
Risso's dolphin	6	12

Common dolphin	35	4646
Harbor porpoise	4	150
Gray seal	2	414
Harbor seal	2	214
Harp Seal	2	217

[1]For ESA-listed marine mammals, the amount of take authorized may not exceed the amount of take authorized in the corresponding Incidental Take Statement issued pursuant to the ESA. Therefore, if the ITS authorizes less take than provided here, actual take may not exceed the amount of take in the ITS. In accordance with the ITS, BiOp, page 383, the ESA-listed marine mammal take authorization aligns with the take authorized in the IHA.

12.10 Reporting Observed Impacts to Protected Species

[redacted] VW1 will in turn report any observed takes resulting in injury or mortality to BOEM, BSEE and NMFS immediately (COP 5.6.1, Joint NTL 2023-N01 Appendix B).

Any take in a manner other than authorized in the IHA (i.e., non-auditory injury or mortality) must be immediately reported to NMFS OPR and GARFO.

12.11 Reporting Detected and/or Impacted Non-ESA Listed Fish

Any occurrence of dead, non-ESA-listed fish of 10 or more individual fish within established shutdown and/or MZs will also be reported to VW1 as soon as practicable (accounting for crew and vessel safety), but no later than 24 hours after the sighting (COP T&C 5.6.2). The DOUS Project QHSE Manager will be copied on all such reports.

12.12 Reporting Intent to Pile Drive

VW1 will alert the agencies (NMFS, GARFO, OPR, USACE, BOEM, BSEE), of intention to initiate pile drive, via email notification 24 hours prior to the start of the first pile to be driven.

12.13 Reporting Shutdown Decisions

VW1 will report the decision not to shut down pile-driving equipment to BOEM, NMFS and BSEE within 24 hours of the decision, with a detailed explanation of the imminent risk presented and the animals potentially impacted (COP T&C 5.7.13, Joint NTL 2023-N01 Appendix B). The process for reporting is included in the flow chart in Section 10.4.

12.14 24-Hour Reporting

A daily summary of protected species related events will be provided to VW1, highlighting the following events, as required by the IHA, COP T&C, BiOp and Appendix B under Joint NTL 2023-N01:

- Marine Mammal and Sea Turtles in the Pile-Driving respective SZ
- North Atlantic Right Whale Sightings
- North Atlantic Right Whale PAM Detections (minimal reporting)
- Injured/Dead Marine Mammals and Sea Turtles
- Vessel Strikes
- Dead/Impacted Non-ESA listed Fish
- Shutdown Decisions
- All sighting data

12.15 Weekly Reporting

During pile driving activities, weekly reports will be compiled and submitted to VW1, that document the daily start and stop of all pile driving activities, any mitigation actions or if mitigation actions could not be undertaken, the start and stop of associated observation periods by the PSOs, details on the deployment of PSOs, and a record of all observations of marine mammals and sea turtles, which will include:

- Time (UTC)/date for each sighting,
- species,
- platform/vessel name,
- vessel activity,
- any mitigation measures taken,
- distance to animal/initial sighting distance (meters), and
- confirmation of detection relay via What's App (noting any transmittal delays)

RPS will submit the weekly reports directly to BOEM (renewable_reporting@boem.gov), NMFS (nmfs.gar.incidental-take@noaa.gov; PR.ITP.MonitoringReports@noaa.gov; and itp.daly@noaa.gov), and BSEE (protectedspecies@bsee.gov) per the permit stipulations.

The weekly report summarize pile driving activities for the previous week including:

- vessel name
- vessel operations (including port departures, number of vessels, type of vessel(s), and route);
- protected species sightings;
- vessel strike-avoidance measures taken; and
- any equipment shutdowns or takes that may have occurred.

This report will be completed for each vessel with PSOs onboard, and the file name will follow the format Lease#_ ProjectName_PSOData_YearMonthDay to YearMonthDay. Weekly reports are due on Wednesday for the previous week (Sunday – Saturday) and will be submitted in an Excel format (IHA 6(d), COP T&C 5.7.17.3.1, BiOp 11.3.16d).

For the first monopile installation, Vineyard Wind will measure the ambient and MPIT tool in-air sound level immediately prior to and during and after MPIT air release. Vineyard Wind will report these results on the first weekly report. Data reported will include:

- Photo and description of the location of the meter in relation to the MPIT tool nozzle (including distance [m] to the MPIT nozzle)
- Name of Compliance Representative (Vineyard Wind) present during MPIT noise monitoring
- Description of any potential obstructions that could influence the sound pressure levels received by the meter including any other equipment operating simultaneously
- Start and end time of the monitoring
- Start and end time of the MPIT operation (including the air release intervals)
- SPL and additional parameters pending the selected model (e.g., Leq, Lmax, Lmin, LE, and Lpeak up to a 120 dB dynamic range)
- Compliance Representative monitoring notes
- Sampling rate

12.16 Monthly Reporting

PSO and PAM data will be collated monthly starting on the 1st and ending on the last day of the month. These reports will include a summary of all information in the weekly reports including project activities carried out in the previous month, including vessel transits (number, type of vessel, and route), piles installed, occurrence of aerial/vessel surveys (including with survey results) and all observations of marine mammals. These datasheets containing the combined RPS/JASCO data will be submitted to DOUS Project QHSE Manager monthly, with VW1 in copy, by the 7th of the following month for review and to be submitted to VW1 for submission to NMFS on the 15th of the month (IHA 6(e), BiOp 11.3.16e).

RPS will oversee the monthly reporting on behalf of DEME for all DEME contracted vessels including those that will not carry PSOs.

12.17 Final Report

The PSO team will develop a final report summarizing the construction activities and all visual and acoustic observations for pile driving operations. The RPS Project Manager will coordinate with JASCO PAM team to include all acoustic detections into finalized report along with all PSO sightings.

The RPS Project Manager will provide the first draft of the report to DEME, who will provide the report to the VW1 Compliance Manager within 45 days of project completion for review.

Two separate reports will be generated from the final report, one for NMFS to cover the final report requirements in the IHA including only marine mammals (to be submitted to PR.ITP.MonitoringReports@noaa.gov, nmfs.gar.incidental-take@noaa.gov and itp.daly@noaa.gov) and one to BOEM (at renewable_reporting@boem.gov) and BSEE (at protectedspecies@bsee.gov) which will include all protected species ((IHA 6(f) and 6(g), COP T&C 5.7.17.2, Joint NTL 2023-N01 Appendix B).

The RPS Project Manager will submit the final reports to DEME who will review and then submit to VW1 for review. RPS and DEME will support response to comments in the final report, due 30 days after receipt of comments on the draft final report that VW1 will submit to NMFS.

13 RESOURCES

NMFS - Incidental Harassment Authorization (June 25, 2021)

NMFS – ESA Section 7 Consultation Biological Opinion (October 18, 2021)

BOEM Construction and Operations Plan Approval Lease Number OCS-A 0501 (July 15, 2021)

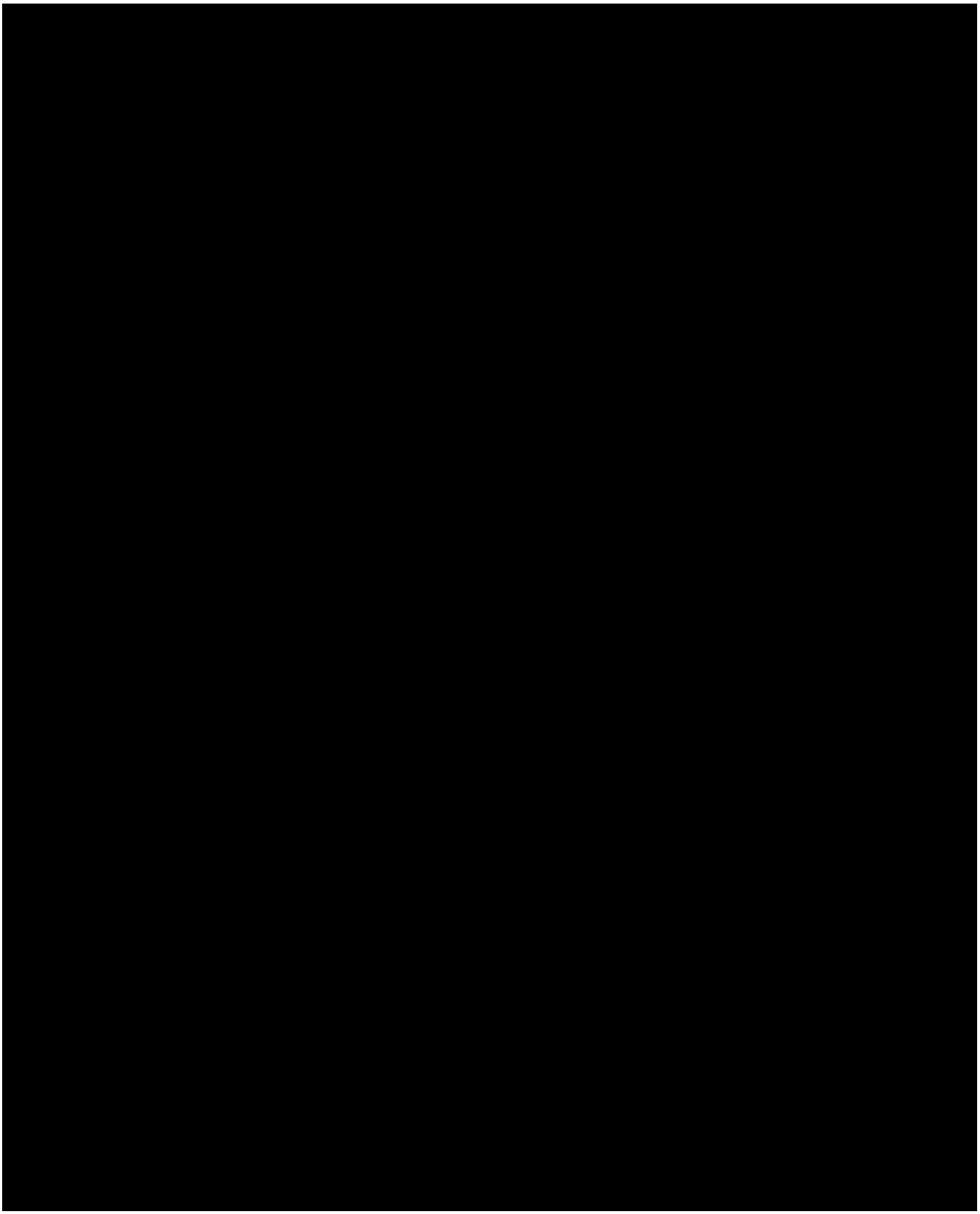
Joint NTL 2023-N01 Appendix B

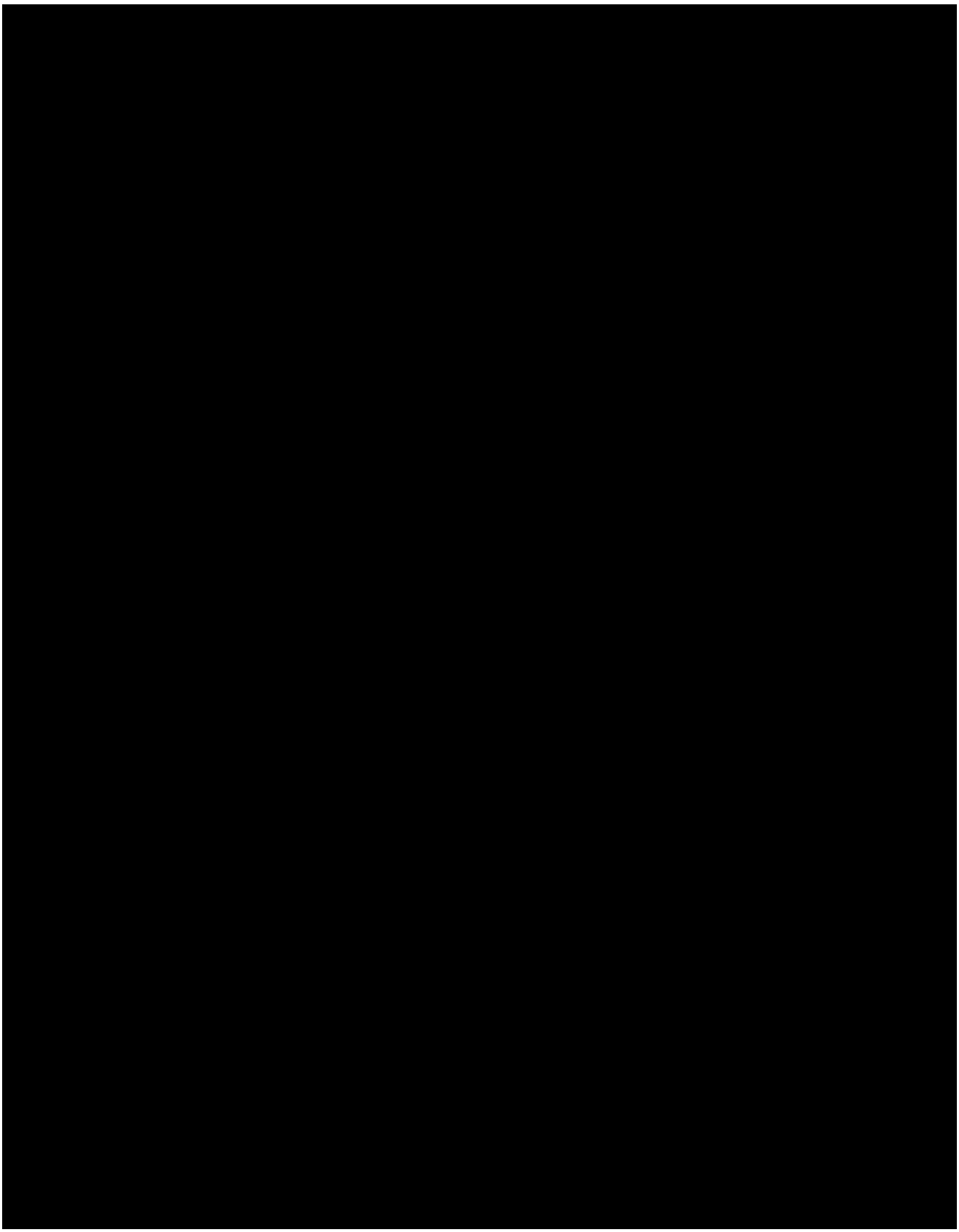
NOAA Technical Memorandum NMFS-OPR-49. National Standards for a Protected Species Observer and Data Management Program: A Model Using Geological and Geophysical Surveys (**November 2013**)

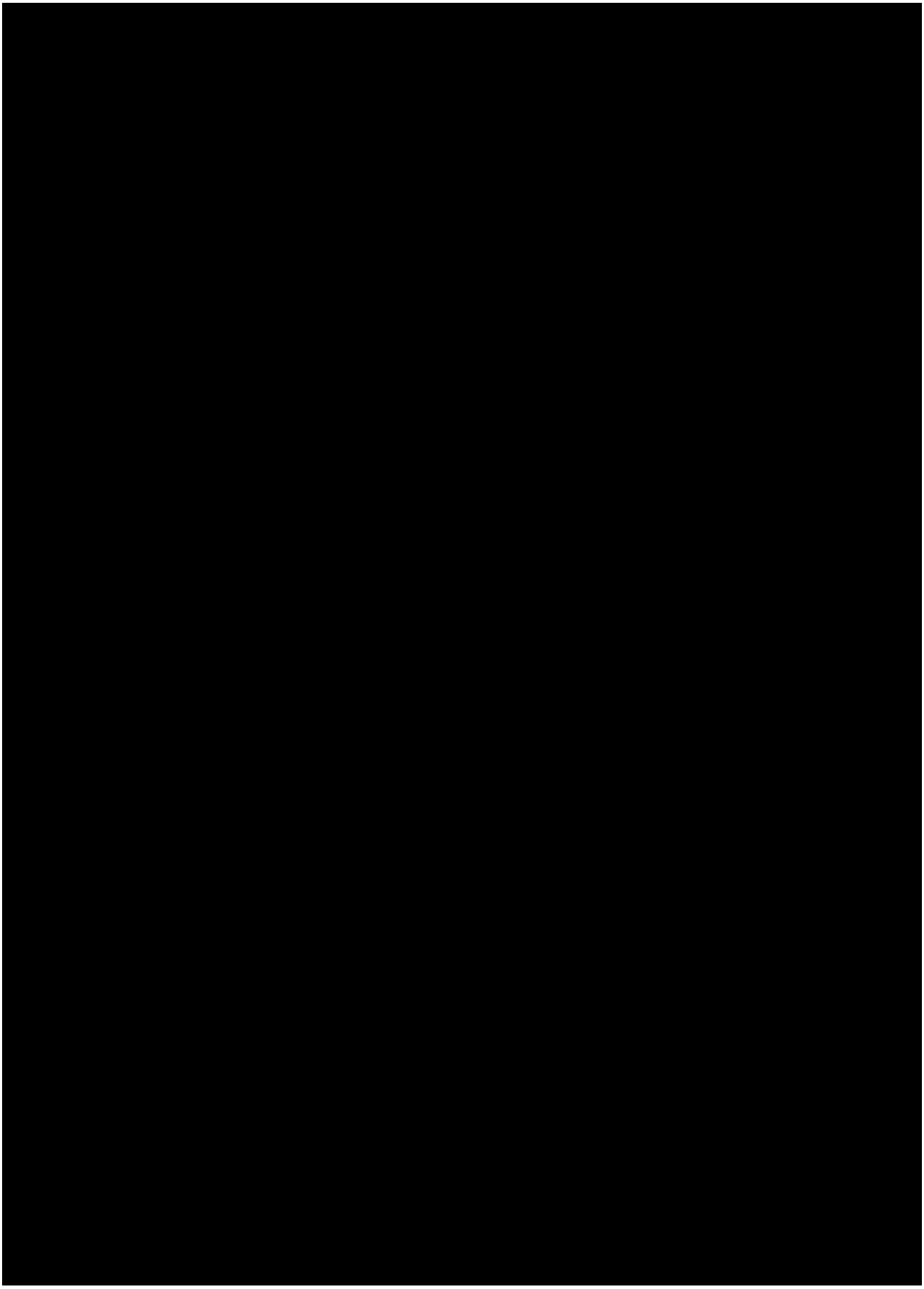
National Marine Fisheries Service. 2018. 2018 Revisions to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts. U.S. Dept. of Commerce, NOAA. NOAA Technical Memorandum NMFS-OPR-59, 167 p

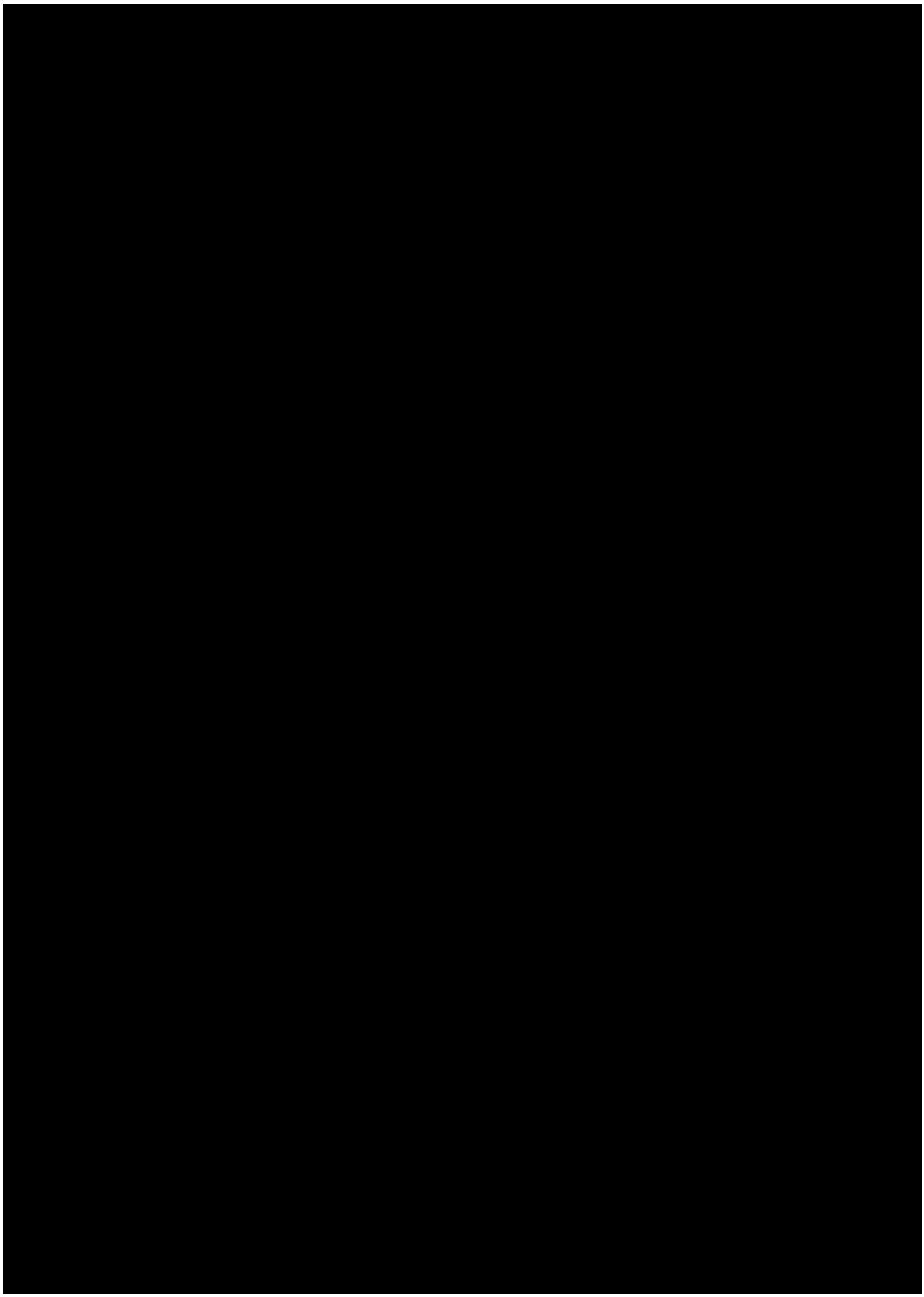
Rugh et. al. 2002. Evaluation of high-powered binoculars to detect inter-year changes in offshore distribution of eastern North Pacific gray whales. *Journal of Cetacean Research and Management*. 4(1):57–61.

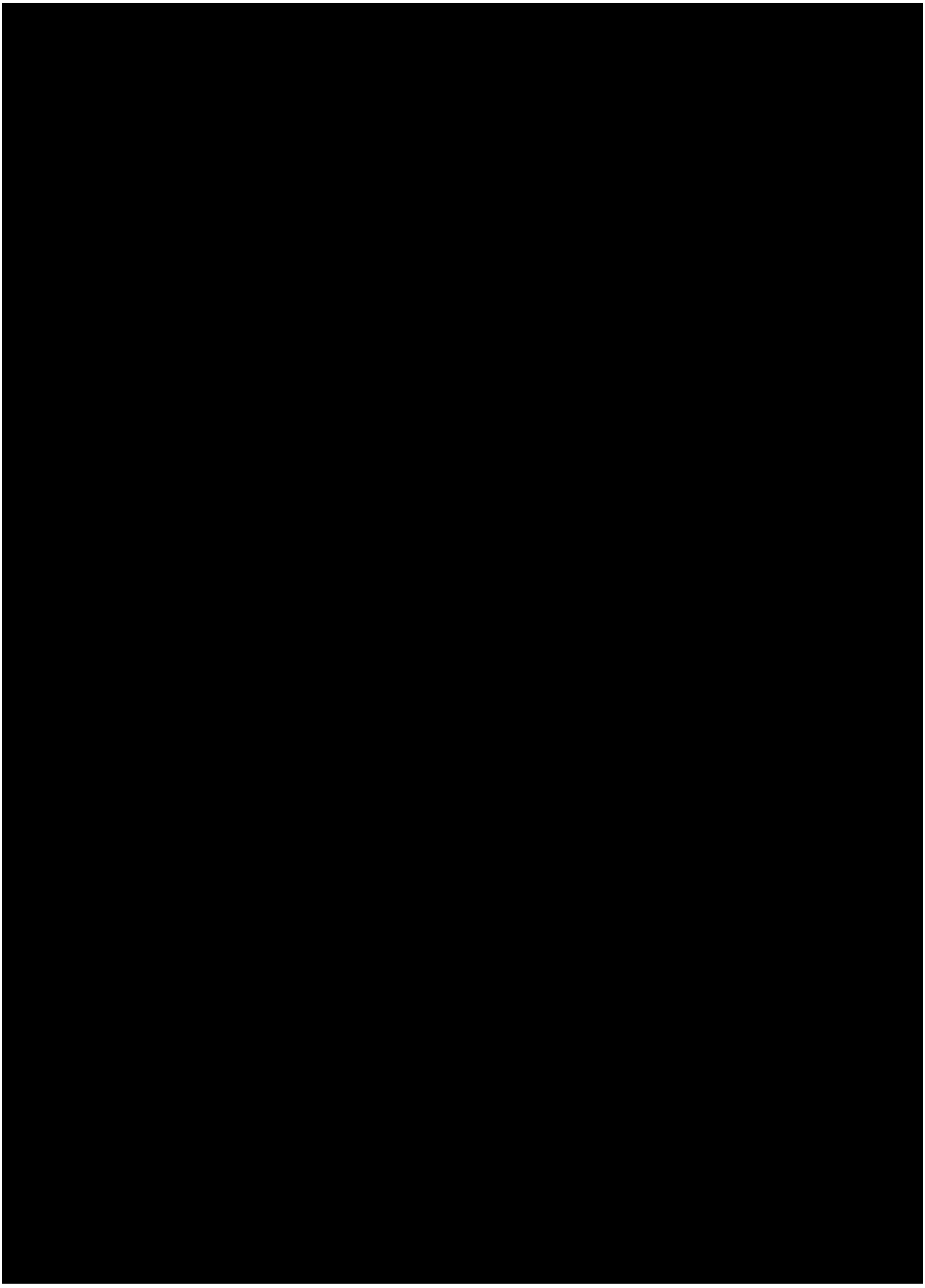
Appendix A PSO, VO and TL Training Syllabus

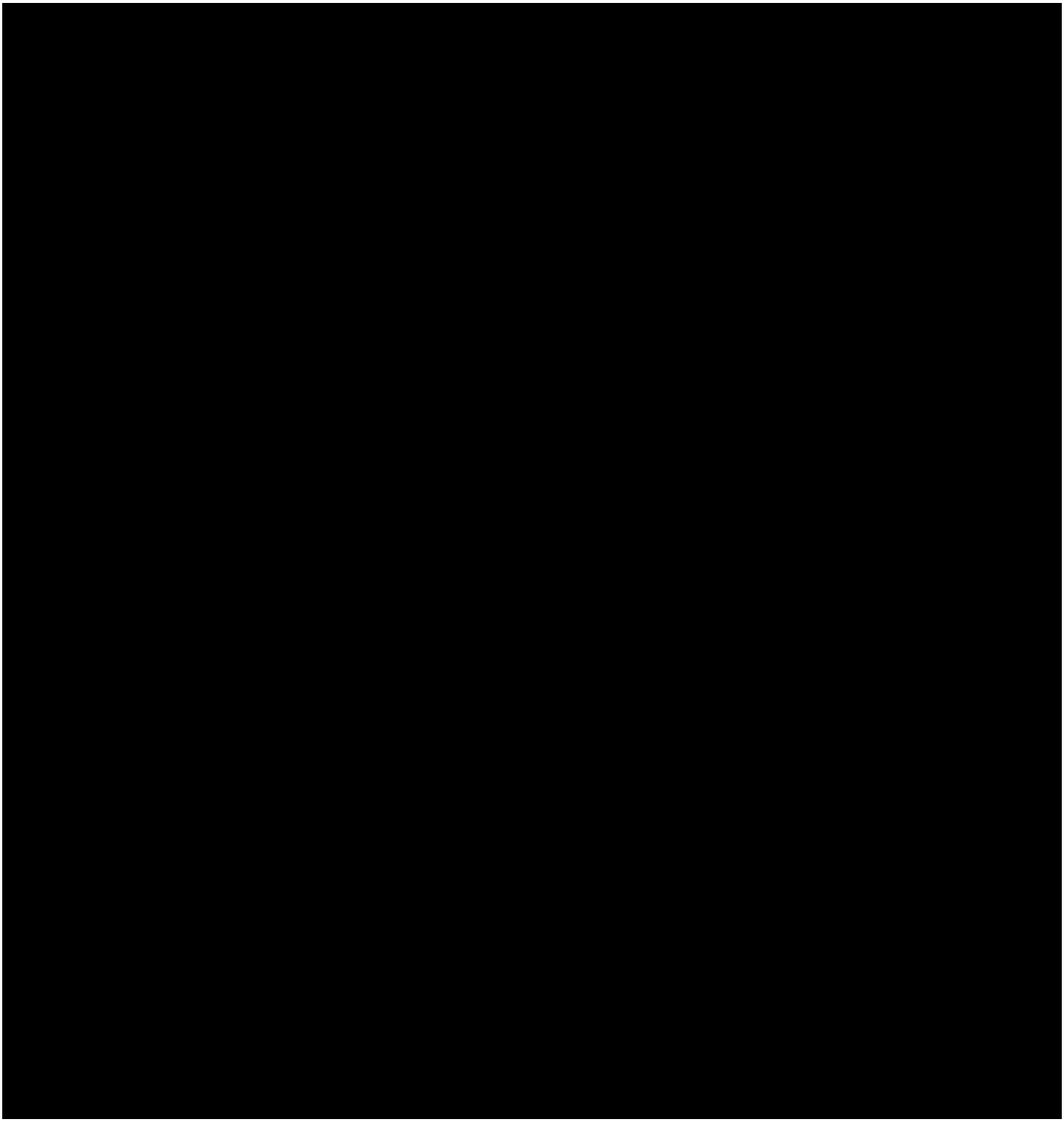












Appendix B Passive Acoustic Monitoring Plan

Passive Acoustic Monitoring Plan: Lease OCS-A 0501

Appendix B to the Pile Driving Monitoring and Mitigation Plan

2023-05-19

Version: 0.12

Prepared by:

JASCO Applied Sciences (USA) Inc.
8630 Fenton Street, Suite 218
Silver Spring, MD 20910 USA
Tel: +1.301.565.3500
http://www.jasco.com

Version History

Version	Date	Name	Change
0.1	2022-09-19	[redacted]	Initial draft for review by Vineyard Wind
0.2	2022-11-25		Revised draft addressing comments from Vineyard Wind (received 2022-11-14)
0.3	2022-12-21		Revised draft addressing comments from Vineyard Wind (received 2022-12-08)
0.4	2023-01-28		Revised draft addressing comments from Vineyard Wind (received 2023-01-25)
0.5	2023-02-02		Revised draft addressing comments from Vineyard Wind (received 2023-02-02)
0.6	2023-03-09		Revised draft addressing comments from Agencies (received 2023-03-07)
0.7	2023-04-05		Revised draft addressing comments from Agencies (received 2023-03-30)
0.8	2023-05-01		Revised draft addressing comments from Agencies (received 2023-04-28)
0.9	2023-05-08		Revised addressing NMFS comments (received 2023-05-05)
0.10	2023-05-10		Revised addressing BOEM/BSEE comments (received 2023-05-10)
0.11	2023-05-15		Revised addressing BSEE/NMFS comments (received 2023-05-12 and 2023-05-15)
0.12	2023-05-19		Revised addressing NMFS comments (received 2023-05-19)

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List of Acronyms, Symbols, and Abbreviations

AOA	Azimuth-of-arrival
3D	three-dimensional
µPa	micropascal
AMAR	Autonomous Multichannel Acoustic Recorders
BiOp	Biological Opinion
BOEM	Bureau of Ocean Energy Management
BSEE	Bureau of Safety and Environmental Enforcement
CZ	Clearance Zone
COP	Construction and Operations Plan
COP T&C	Construction and Operations Plan Approval Terms & Conditions
CPA	closest point of approach
CRB	Cramer-Rao bounds
CTD	conductivity, temperature, dissolved oxygen
dB	decibel
DM	data manager
EIS	environmental impact statement
HSE	health safety and environment
IHA	Incidental Harassment Authorization
JASCO	JASCO Applied Sciences (USA) Inc, Narragansett, RI
LF	low frequency
MZ	Monitoring Zone
MONM	marine operations noise model
NCEI	NOAA's National Centers for Environmental Information
NARW	North Atlantic Right Whale
NOTMA	notice to mariners through US Coast Guard
OCS	outer continental shelf
ONR	Office of Naval Research
PAM	passive acoustic monitoring
PAMELA	**P**assive **A**coustic **M**onitoring **E**lectronic **L**ogging and **A**cquisition System
PSO	Protected Species Observer
PSD	power spectral density
QA/QC	quality assurance/quality control
QMA	qualified marine archaeologist
rms	root-mean-square
SEL	sound exposure level
SZ	Shutdown Zone
SNR	signal to noise ratio
SPL	sound pressure level
TDOA	time difference of arrival
USV	uncrewed surface vehicle
VW1	Vineyard Wind 1 LLC
WDA	wind development area

WTG	wind turbine generator

1. Introduction

1.1. Project Overview

This plan presents the technical approach to performing real-time Passive Acoustic Monitoring (PAM) during pile driving and associated construction activities for the Vineyard Wind 1 (VW1) project in Federal waters offshore Massachusetts. Under the Bureau of Ocean Energy Management (BOEM) approved Construction and Operations Plan (COP) for Renewable Energy Lease Number OCS-A 0501 (the Project), this monitoring plan is designed to satisfy the requirements of the Incidental Harassment Authorization (IHA) and Biological Opinion (BiOp).

1.2. Compliance Requirements and Recommendations

VW1 submitted a COP to BOEM (dated December 19, 2017) and an IHA application to National Marine Fisheries Service (NMFS) (dated September 2018).

In accordance with these filings, construction, including the pile driving installation portion of the Project, is scheduled to begin in Spring 2023 and will implement monitoring and mitigation measures that include both visual and acoustic components. Specific monitoring and mitigation requirements are listed in the IHA (A.2) the COP Terms and Conditions (COP T&C) (A.3), and BiOp (Condition 3; pgs. 387 & 388). In compliance with IHA Section 5(e)(viii) and COP Section 5.7.5, a PAM plan must be submitted to NMFS and BOEM, respectively, for review and approval at least 90 days prior to the planned start of pile driving. This plan describes the equipment, procedures, protocols, and technical approaches proposed by JASCO Applied Sciences (USA) Inc (JASCO) to meet the real-time PAM permitting and compliance requirements for pile driving and related construction activities.

1.3. Overview of Technical Approach

Regulatory compliance requires clearance and monitoring of zones near the driven piles. Clearance and monitoring of the near-pile zones will be achieved using both visual and acoustic monitoring methodologies. Visual monitoring and mitigation methods for protected species sightings and detections is covered in a separate plan and work scope. The size of the clearance zones (CZs) and monitoring zones (MZs) have been established based on the expected presence of North Atlantic right whale (NARW) in relation to time of year, daily and seasonal timing restrictions, and the anticipated construction activities, and therefore, vary throughout the various stages or phases of Project installation and construction. The size of CZs and MZs are summarized in A.1.

Moored buoys will be used as the primary system for PAM during the installation of VW1's 62 monopile foundations and one jacket foundation. Once available, USVs (Uncrewed Surface Vessels) will be used in parallel as a demonstration. The technical approach for acoustically monitoring the clearance, monitoring and shutdown zones (SZs) is detailed in Section 3.

2. Passive Acoustic Monitoring Team

PAM operations including buoy support, USV piloting and acoustic monitoring, analysis and reporting will be led by a JASCO team based out of our Marine Acoustic Services Facility located at 165 Dean Knauss Drive, Suite 1, Narragansett, RI 02882 USA and supported by additional JASCO personnel as required.

JASCO's PAM Analysts are trained in the identification of marine mammal vocalizations, communicated as pitch tracks, and will be responsible for determining if an acoustic detection originated from a NARW or any other vocalizing marine mammals.

2.1. Roles and Responsibilities

The PAM team will deploy/retrieve/maintain OceanObserver Buoys and pilot/maintain the USVs, as available, and conduct PAM operations in accordance with the IHA, COP T&C and BiOp. PAM operations will be conducted concurrent to visual monitoring. Communication between the shore-based PAM Analysts and the in-situ PSO team is described in Appendix D. The PAM team will consist of:

USV Pilot

- Oversee all deployments and retrievals of the USV PAM systems
- Assign PAM sectors to the USVs
- Monitor USV operations and respond to vehicle status and navigation alerts

PAM Field Team

- Deploying, recovering, maintaining and supporting the Observer Buoys, USVs, and communication systems

Lead PAM Analyst (Located ashore)

Coordinate and oversee PAM Operations and ensure compliance with the requirements

- Acoustically monitor, detect, localize, and classify marine mammal calls
- Communicate all marine mammal PAM detections to the Lead PSO, followed by the RPS Project Manager and DOUS Project QHSE Manager
- Ensure PAM detections and validation status are input into the data collection tool
- Record and report protected species acoustic detections according to the COP T&C, IHA, and BIOP

PAM Analyst (Located ashore)

- Acoustically monitor, detect, localize, and classify marine mammal calls
- Record and report protected species acoustic detections according to the COP T&C, IHA, and BiOP

2.2. PAM Analyst Training Requirements

PAM Analysts will have completed a commercial training program for the Atlantic with an overall examination score of 80 percent or greater (Baker et. al 2013). JASCO will provide training certificates and CVs for all individual PAM Analysts to NMFS prior to the initiation of Project activities, and to BOEM upon request.

2.3. PAM Schedule

During pile driving, a minimum of one (1) acoustic PAM analyst will be on active duty (remote onshore based) from 60 minutes before, during and for 30 minutes after all pile installation activity concludes. For communication check purposes with the vessel-based PSO team and the deployed PAM platforms, the PAM Analyst will begin 3 hours prior to pile installation.

Acoustic monitoring will be conducted concurrent to real-time PSO operations at sea. A communication plan describing the *in-situ* communication between the PSO team and remote PAM Analysts, mode of communication and decision authority is described in Section 10 of the PDMP.

2.4. PAM Team Watches

The PAM Analysts, who are all located ashore, are not standing watches in the traditional sense in that they are not required to continuously monitor acoustic data as would be the case if they were operating a PAM system at sea. PAM Analysts will be assigned based on the pile driving schedule to assure that a Lead and second PAM Analyst are available to review, validate and communicate any acoustic detection alerts before, during and post pile driving, beginning 3 hours prior through 1 hour post pile driving.

PAM detection alerts received from 60 minutes pre pile driving through to 30 minutes post pile driving will be reviewed and immediately communicated to the Project Team regarding distance and bearing, species identification (if can be determined), and the degree of confidence in the determination.

Although pile driving during darkness is not permitted under the current IHA, any relevant PAM detection alerts (e.g., NARW) that occur from 30 minutes post pile driving up to the next 60-minute clearance period of active driving (i.e., overnight non-pile driving hours) would be reviewed in the morning beginning three hours prior to the scheduled start of pile driving and communicated to the PSOs to increase situational awareness prior to the start of the daily pile installation monitoring.

The Lead PAM Analyst will communicate all detections of marine mammals to the RPS Lead PSO onboard the Tier 1 contractor DEME Offshore Orion vessel (offshore pile driving installation vessel) immediately, including any determination regarding species identification, distance, and bearing and the degree of confidence in the determination (IHA 5(e)v). For more details, reference is made to the Pile Driving Monitoring Plan regarding communications.

3. PAM Procedures & Protocols

To establish the presence/absence of protected species in the area, PAM will be conducted in accordance with VW1 permit obligations. At a minimum, PAM will take place from at least 60 minutes prior to initiation of pile driving activity through to 30 minutes post-completion of pile driving activity. The deployed PAM systems will be operated to detect NARWs and other marine mammals within the PAM MZs identified in A.1 in real-time (IHA 4(g)i). The PAM system and communication protocols will be configured to ensure that the PAM Analyst is able to review acoustic detections within 30 minutes of the original detection to verify whether a NARW has been detected (IHA 4(g)iii) and communicate NARW and other marine mammal detections to the Lead PSO. The system has been designed so the buoy will transmit every 10 minutes giving the PAM Analyst 20 minutes to review and communicate detections, as technically feasible, transmission time will be reduced as close to five minutes as possible. This will ensure that the PAM Analyst is able to review acoustic detections within 30 minutes of the original detection to verify whether a NARW has been detected (IHA 4(g)iii) and communicate NARW and other marine mammal detections to the Lead PSO The Lead PSO will then use the detection alert information provided by the PAM Analyst to make informed mitigation decisions based on the timeframe and activity currently occurring, further detailed in Sections 3.1–3.3 below.

3.1. PAM Monitoring Zones (MZs)

3.1.1. Clearance Zone (CZ) PAM

Prior to initiating pile driving, PAM detections of marine mammals inside clearance Zones (CZs) (A.1.1 and A.1.3) will result in a delay. PAM operations will be conducted to establish CZs for NARWs at least 60 minutes prior to initiating pile-driving activities and 30 minutes post-completion of pile-driving activity. If the PAM Analyst has 75-percent or greater confidence that a vocalization originated from a NARW located within the relevant CZ, the detection will be treated as a NARW detection and communicated to the Lead PSO. The Lead PSO will confirm with the PAM Analyst that no actionable detections occurred during the clearance period prior to the start of pile driving, as detailed in Section 10.3 of the PDMP.

3.1.2. Monitoring Zone (MZ) PAM

Acoustic monitoring will commence 60 minutes prior to the ramp-up of pile driving activities and will be conducted continuously throughout pile driving, continuing for an additional 30 minutes after the cessation of pile driving. During pile driving, acoustic detections of NARWs and other marine mammals within the relevant MZs (A.1.1) will immediately be provided to the Lead PSO to increase situational awareness. In compliance with all permit requirements, the MZs for NARW are expanded in order to remain conservative.

3.1.3. Shutdown Zone (SZ) PAM

During pile driving, acoustic detections indicating that NARWs and other marine mammal are approaching or have entered the relevant SZs (A.1.2 and A.1.3) will be provided to the Lead PSO so that appropriate mitigation measures, including a shutdown of pile driving, when technically and safely feasible, can be implemented. Shutdown communication procedures for PAM Analysts is provided in Section 10.4 of the PDMP.

3.1.4. Seasonal PAM Zone Changes

Seasonal changes in the monopile PAM zones are shown in Figure 1. From May 1 to 14 and November 1 through December 31 the NARW CZ and MZs are 10 km and the SZ is 3.2 km. From May 15 to 31 the NARW CZ is reduced to 5 km. For the period June 1 through October 31 both the NARW CZs and MZs are reduced to 5 km. The NARW MZs are the same for the jacket pile except for the CZ, which is reduced to 3.2 km in the May 15 through October 31st period.

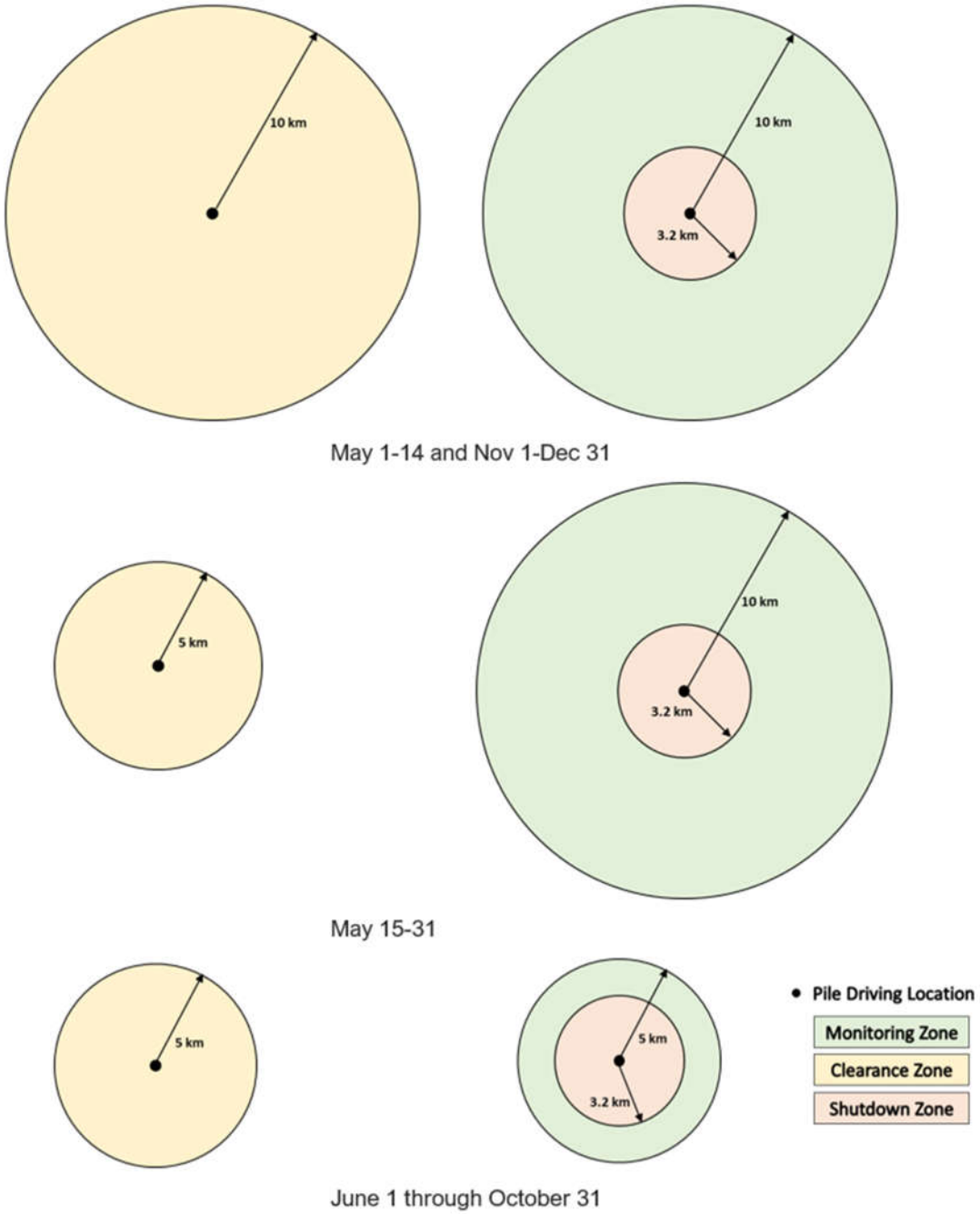


Figure 1. Monopile NARW CZs, MZs and SZs Pre & Post Pile Driving (left) and During Pile Driving (right)

3.2. PAM Procedures

According to section 1.3 of the Supplementary Information I of the *NOAA and BOEM Minimum Recommendations for Use of Passive Acoustic Listening Systems in Offshore Wind Energy Development Monitoring and Mitigation Programs* (Van Parijs et al) "NARW's call type, the upcall, which serves for inter-individual communication (e.g., Clark 1982), can be heard over an average calling *radius* of 10 km across most habitats." Initial modelling conducted by JASCO (C.3) indicates that the average detection range has a depth dependence for the region encompassing VW1's Lease OCS-A 0501. This is a result of a strong downward reflecting sound speed profile and soft bottom, which are characteristic of the region. For the purposes of this plan, JASCO will assume an average NARW detection radius of 10 km for moored buoys (hydrophones located near the bottom) and 7.5 km for USVs (hydrophones are at a depth of about 2.5 m).

Detection ranges will also be influenced by ambient noise, pile driving and project vessel noise. Ambient noise was included in JASCO's detection range modelling and therefore accounted for in the detection ranges specified above. Both pile driving and vessel noise will result in reduced acoustic detection ranges for all PAM systems. The extent of the reduction will depend on the relative distance between and, frequency content of, the additional noise source and the PAM systems.

Multiple buoys with overlapping acoustic detection ranges will be used to ensure sufficient and consistent monitoring coverage of the NARW MZs as required by VW1's permits.

3.3. OceanObserver™ 0.6-Metre Buoy (Primary PAM System)

JASCO's 0.6m ObserverBuoys (Figure 4) will serve as the PAM system. This equipment will provide real-time telemetry via Iridium of marine mammal vocalization pitch tracks and bearings for subsequent PAM analyst validation. Acquired acoustic data are automatically processed onboard the buoy in real-time by an embedded version of JASCO's PAMlab™ software (Section 3.5) running on JASCO's Observer DAQ. They will also record raw acoustic data for post deployment analysis. Candidate detections are transmitted via Iridium Certus to JASCO's PAM Team for validation. PAMlab can effectively acoustically detect many odontocetes in real time, including long-finned pilot whales (*Globicephala melas)*, short-finned pilot whales (*Globicephala macrorhynchus*), killer whales (*Orcinus orca*), short-beaked common dolphins (*Delphinus delphis*), striped dolphins (*Stenella coeruleoalba*), white-beaked dolphins (*Lagenorhynchus albirostris*), white-sided dolphins (*Lagenorhynchus acutus*), and bottlenose dolphins (*Tursiops truncatus*) (Martin et al. 2019). See B.3 (PAMlab Detector Configuration) for more details.

The buoys will be deployed and recovered from a vessel such as the R/V Discovery (Figure 3) and Appendix H. The buoy mooring being utilized use best available technology (Figure 13) designed to minimize potential entanglement risks by using appropriate cables (low bend radius) and minimizing line lengths (to avoid the risk of loops during deployment) where possible. The bottom portion of the buoy mooring will be slowly lowered and raised to minimize risk to listed species and benthic habitat. Deployment and recovery procedures will follow best management practices and are summarized in Appendix G. No gear or equipment is left behind when the buoys and associated moorings are recovered.

The ObserverBuoys and USVs will be sampling at 32 kHz. Sperm whale clicks (3-25kHz) will be detectable even without full bandwidth coverage. The ObserverBuoy can sample at as high as 512 kHz,

but that will mean much more frequent battery and memory changes. Jasco is currently conducting testing to determine the operational impacts.

The ObserverBuoys have a tetrahedral array of four hydrophones deployed on a bottom lander (Figure 15). The distance between hydrophones is 0.86m. The signals from these hydrophones may be analyzed using a TDOA-based azimuth-of-arrival (AOA) algorithm or maximum likelihood beamformer to obtain an estimate of the direction of arrival over a relatively wide band of frequencies (Urazghildiiev and Hannay 2017). A TDOA-based azimuth-of-arrival (AOA) algorithm is initially implemented for the array with pairs of N=2 hydrophones separated by d=0.86 m. There is an ambiguity in AOA estimation. Unambiguous AOA estimates can be obtained within angular sector ±90° relative to the direction perpendicular to the line connecting the hydrophones. The AOA estimation accuracy depends on the SNR, AOA of a source and TDOA estimation error. The AOA estimation error can be reduced by averaging K>1 independent AOA estimates resulting from multiple received NARW calls.
AOA estimation error can be further reduced, and the ambiguity problem can be eliminated using all 4 channels of the planar array to compute TDOAs and AOA estimates. Figure 2 shows the Cramer-Rao bounds (CRB) as a function of azimuth of the source and the number of averaged estimates, *K*, computed for a planar array with *N* = 4 hydrophones with same spacing between hydrophones.

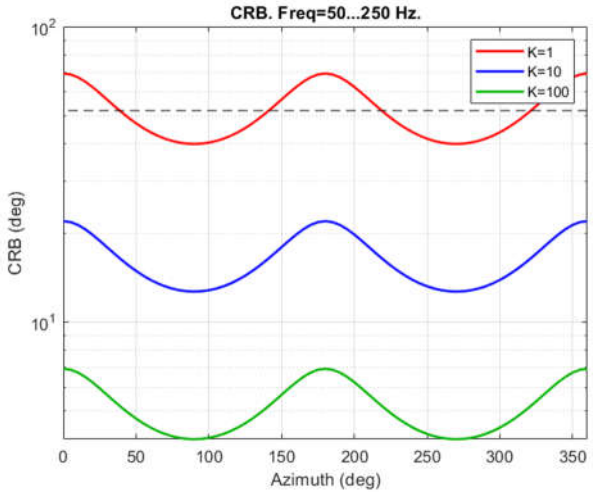


Figure 2. CRB of AOA estimates as functions of azimuth of the source and the number of averaged estimates, K. Planar array with N=4 hydrophones.

Figure 3. R/V Discovery (ryanmarineinc.com)

Figure 4. OceanObserver™ 0.6-Metre Buoy

Seven locations shown in Figure 5 have been identified for PAM buoy deployments. A minimum of 3 and maximum of 4 buoys will be deployed at any given time and will depend on the location of the active pile driving operation. An alternate buoy may replace an optimum buoy to reduce the number of times a buoy needs to be moved to minimize risk associated with buoy recovery and redeployment. Three buoys will always be operational providing the necessary coverage of the MZ, CZ and SZs.

Buoy locations are spaced on equilateral triangles with ~4 NM (~7.5 km) sides. In Figure 5 below, the colored circles represent the locations of the pile foundations. The colors represent pile installation sequence. For example, to the first sequence of 6 piles (piles 1,2,3,4,5 & 6) are colored purple. After each installation sequence, there is a break of 4-5 days while the Orion returns to Halifax to pick up six

additional piles. Approximate GPS coordinates for the buoy deployments are shown in Table 1. The actual coordinates will be recorded for each buoy deployment.

At a minimum from May 1-14 and Nov 1- Dec 31, the PAM system will operate 24/7 during times pile driving is planned. At a minimum from May 15 – Oct 31, the PAM system will operate during the pile driving operations, including the pre- and post-clearing period. Vineyard Wind will consider increasing the PAM monitoring schedule for research purposes from May 15 – October 31 to include 24/7 PAM system operations when possible, but that depends on the maintenance schedule and battery life.

Formal preclearing of the CZ will begin at least 60 minutes prior to the planned pile driving start time. On completion of the pile installation, the buoys will monitor the CZ for a minimum additional 30 minutes and then continue with 24/7 situational awareness monitoring of the area.

Table 1. PAM Buoy Deployment Locations (The indicates the location of the yellow cross of the respective theoretical radial inside the lease area as shown in Figure 5))

Buoy Identifier	Latitude	Longitude	Approximate Depth (m)
B1’	41°6'56.111" N	70°30'0.005" W	36.1
B2’	41°5'44.509" N	70°24'36.414" W	36.3
B3’	41°1'38.952" N	70°23'10.548" W	39.6
B4’	40°58'22.895" N	70°26'45.319" W	43.3
B5’	40°59'49.745" N	70°32'6.206" W	49.0
B6’	41°3'43.908" N	70°33'55.535" W	42.9
B7	41° 02' 41.3232" N	70° 28' 30.306" W	42.6

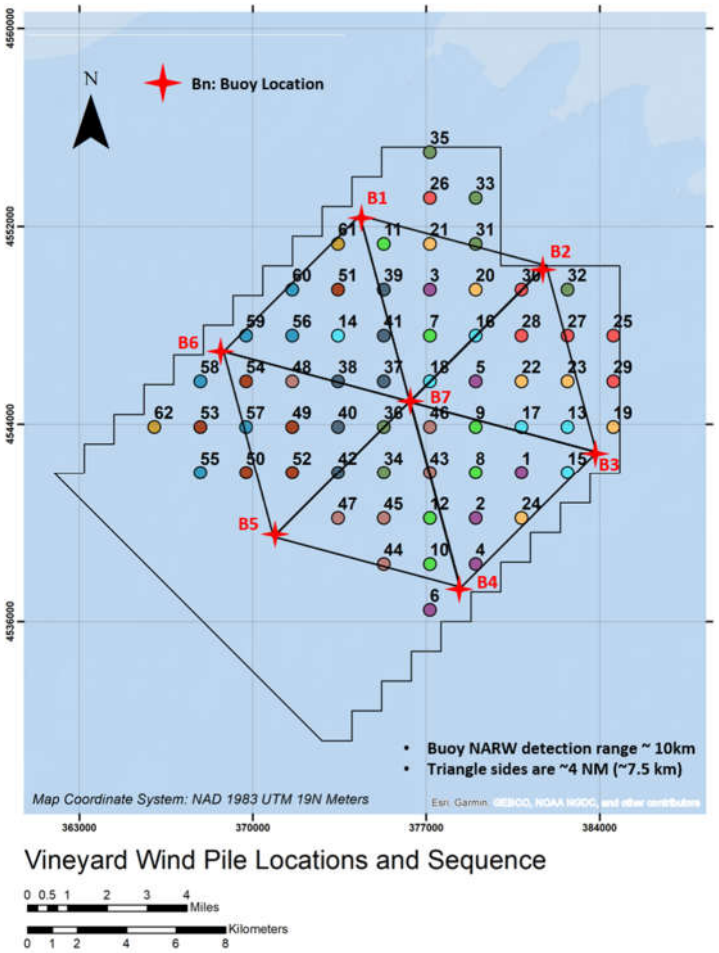


Figure 5. PAM Buoy Locations (B1 – B7) as red crosses on the radials within the lease area boundary)

Figure 6 below, shows an example deployment scenario for a pile being driven in May at the location indicated by the red dot. Buoys B1, B2 and B7 are deployed and provide full coverage of the 10 km MZ and 3.2 km SZ.

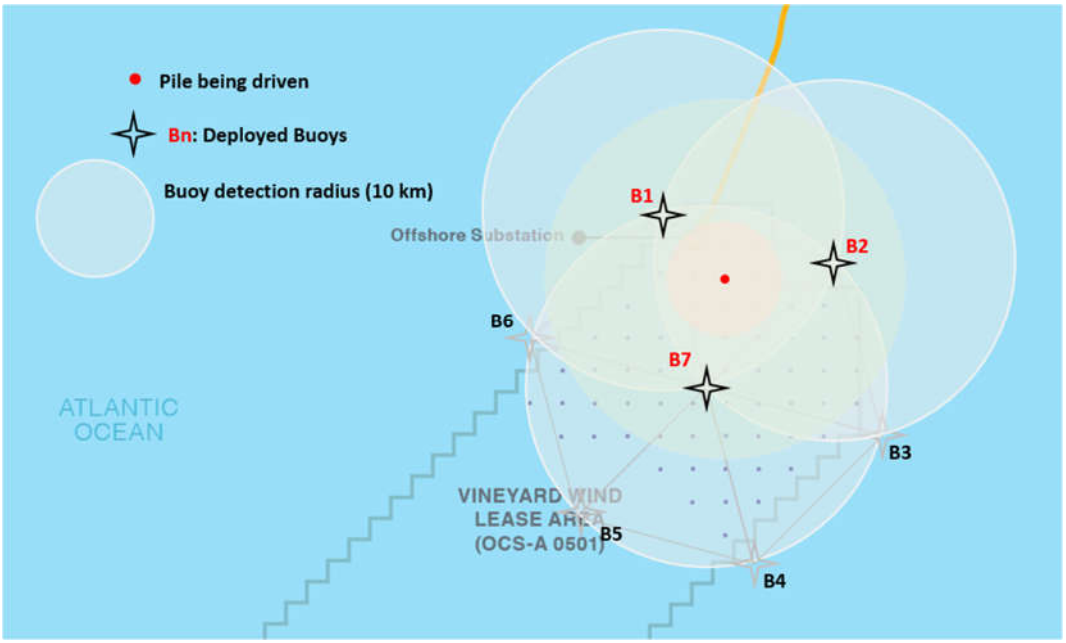


Figure 6. Example PAM Buoy Deployment Scenario with 10km MZ, 3.2 km SZ. Buoys B1, B2 and B7 deployed.

Figure 7 below, shows an example deployment scenario for a pile being driven later in the summer at another location indicated by the red dot. Buoys B5, B6 and B7 are deployed and provide full coverage of the 5 km MZ and 3.2 km SZ.

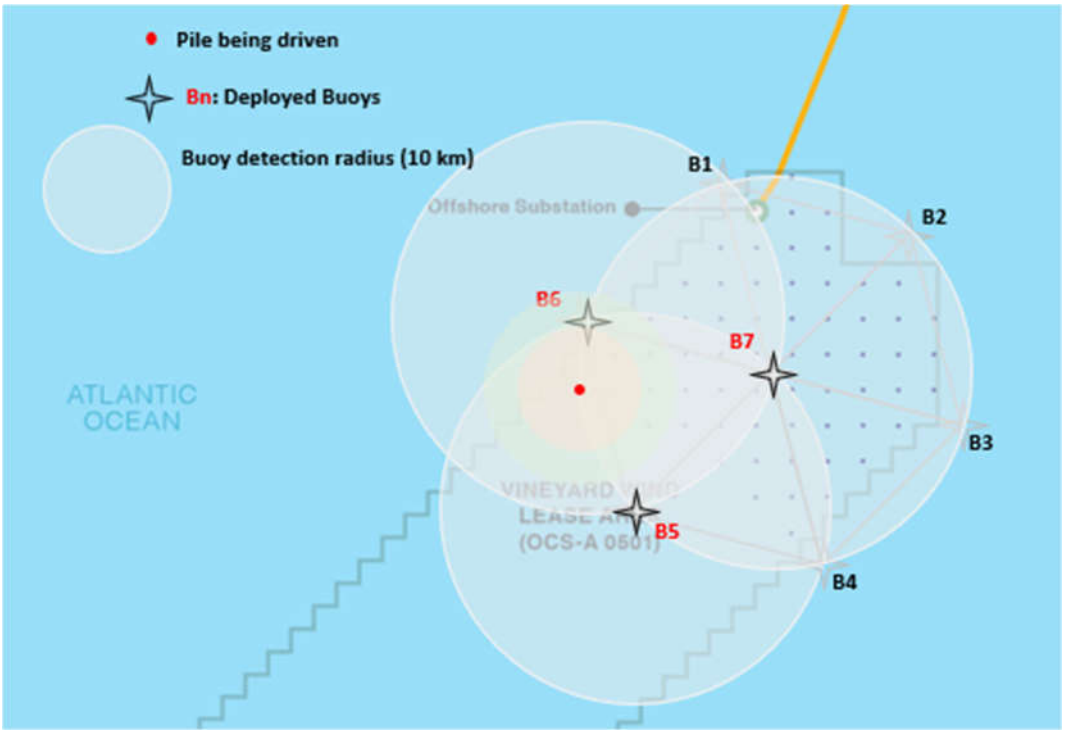


Figure 7. Example PAM Buoy Deployment Scenario with 5km MZ, 3.2 km SZ. Buoys B5, B6 and B7 deployed.

Appendix E shows the planned buoy deployments for each piling sequence.

3.4. SubSeaSail Horus USVs (Demonstration PAM System)

SubSeaSail HORUS USVs (Figure 8 & B.1) may be deployed when available as a demonstration PAM system. Figure 9 shows a scenario where 3 USVs are deployed along with 3 ObserverBuoys providing overlapping coverage of a MZ. This is an example of how the demonstration USV PAM systems could be deployed to gather data for subsequent comparison to the more traditional moored buoy PAM system. USVs will not be used as part of the mitigation. Trials will be done once they are available to demonstrate and evaluate their performance relative to that of a stationary buoy.

HORUS is an easy-to-deploy (~34 kg) monohull, semi-submersible USV with hull and keel below water propelled by an above water wing sail. HORUS also has a supplementary battery powered electric thruster Solar photovoltaic panels fitted on the USVs' wing sail and upper deck recharge batteries used for communications, sensors and the integrated thruster. The USV can be deployed and recovered by a single person from a vessel, dock or rigid-hull inflatable boat such as our Zodiac SRB (4.H.2).

The HORUS USV is fitted with Data Acquisition (DAQ) unit called PAMELA™ (Passive Acoustic Monitoring Electronic Logging and Acquisition) sampling at 32 kHz, connected to an acoustic array. The ObserverBuoys can sample at as high as 512 kHz but that would require more frequent battery and memory changes. Acquired acoustic data are automatically processed onboard the USV in real-time by an embedded version of JASCO's PAMlab™ software (Section 3.5) running on the PAMELA DAQ. Raw acoustic data is also stored on SD cards. Candidate detections are transmitted via Iridium Certus to JASCO's PAM Team for validation.

The array can be beamformed, which essentially provides acoustic listening in multiple directions. The beams that point forward toward the vehicle pick up the most system self-noise, lowering the probability of detection in that direction. The beams between the broadside and aft directions are the most sensitive, as they suppress the most self-noise. Additionally, the USV will be operated in "Acoustic Nav Mode" while performing PAM. This operational mode minimizes movement to ensure self-noise is minimized.

The HORUS USVs will transit autonomously to monitoring locations specified by the PAM Team and then station keep in a box by sailing across and/or around a specific latitude / longitude. Station keeping can be maintained autonomously without a pilot, anchor or tether for 1-3+ days (depending on sea-state conditions).

Given its small size and weight, HORUS is considered "flotsam" by the US Coast Guard. While not required, it does have a 360° white light on the mast that can be illuminated at night. As a sailing vessel, it has right-of-way over power vessels. In the unlikely event of collision, the vessel is made up primarily of foam and composite materials and should most probably be swept aside or bounce off hulls of bigger vessels. The HORUS does not currently carry AIS but will transmit its position periodically which can be broadcast as daily Notice to Mariners (NOTMAR).

Figure 8. SubSeaSail HORUS USV

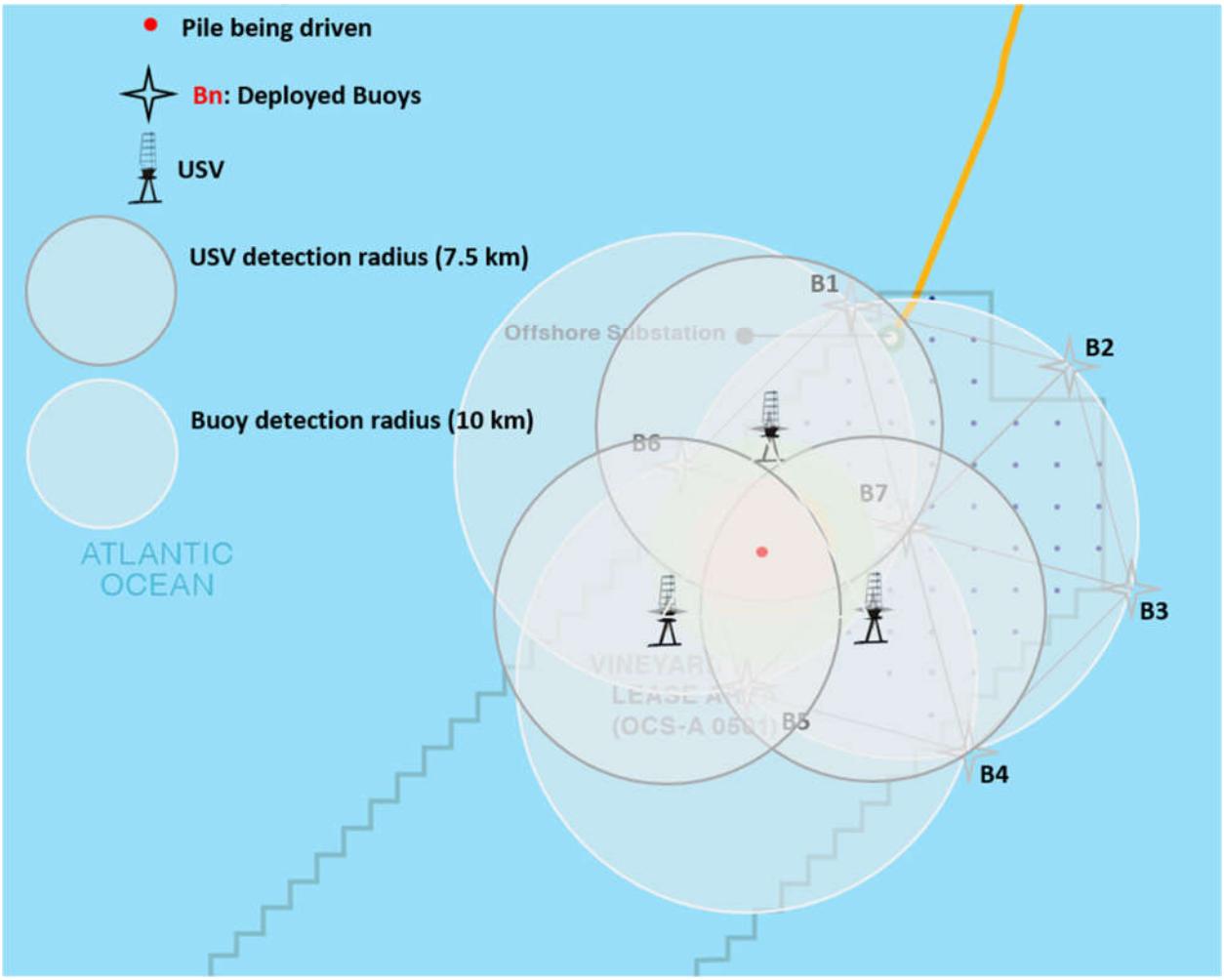


Figure 9. Scenario with 3 Observer Buoys and 3 USVs deployed with overlapping coverage.

Backups and Spare Parts

In addition to the number of moored buoys specified above there will always be a minimum of one additional buoy ready to deploy as a backup if needed. Additionally, JASCO will maintain sufficient spare parts and batteries for the buoys, USVs, PAM and communication systems at the Rhode Island facility.

3.5. Passive Acoustic Marine Mammal Detection, Validation and Communication

Raw acoustic data received on the ObserverBuoy or USV will be processed in real time, by the PAMlab embedded software. This software will be configured with detectors for automatic recognition of marine mammal calls expected in the monitoring area including NARW gunshot and upcalls (Kowarski et al. (2020)). Marine mammal candidate detections (Figure 10 - top) will be broadcast as pitch tracks (Figure 10 - bottom) along with relevant metadata in real-time via Iridium to JASCO's Back Office Service / Remote Asset Database, (Communications) where an alert will trigger a PAM analyst to validate the detection and begin the appropriate reporting sequence to the DEME Project Manager and RPS PSO Team.

Simultaneous detection from two or more PAM systems (buoys / USVs) will permit call localization using cross bearings (3.5.1). If a confirmed NARW detection cannot be localized to be within a respective zone, it will be treated as a detection within the applicable zone at the time of the detection and the applicable mitigation measures (i.e., delay or shutdown) will be taken. As well, at any time of year, a PAM detection (75% confidence) of a NARW within the PAM clearance zone must be treated as a visual detection, triggering a delay in pile driving. Pitch track validation and localization will be done using a desktop version of PAMlab combined with the Sonar Testbed (STB) by our PAM Team located in Narragansett, RI with support and backup from other offices as required. The buoy (and USV) report operational status continuously via Iridium Certus and will be monitored by the Operations team. If a buoy is lost, we can install a spare and/or reposition a USV to provide proper coverage of the area.

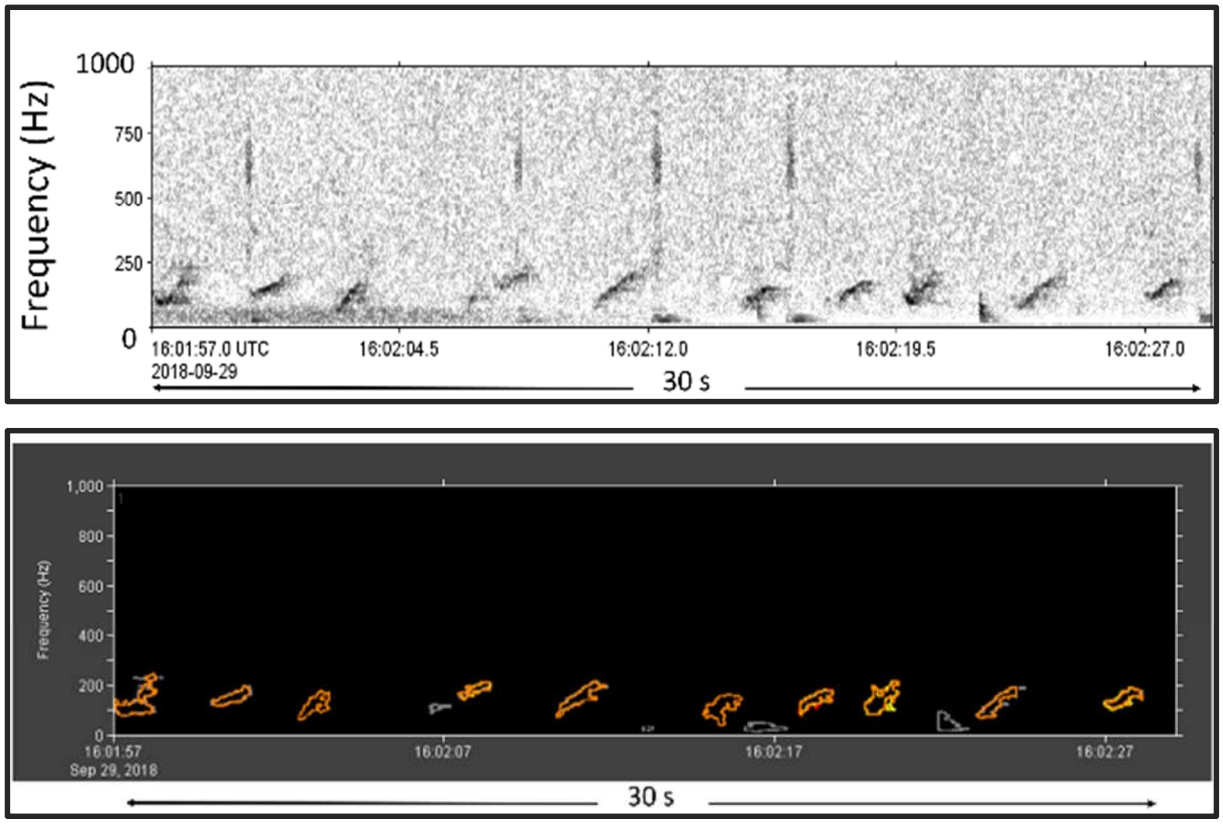
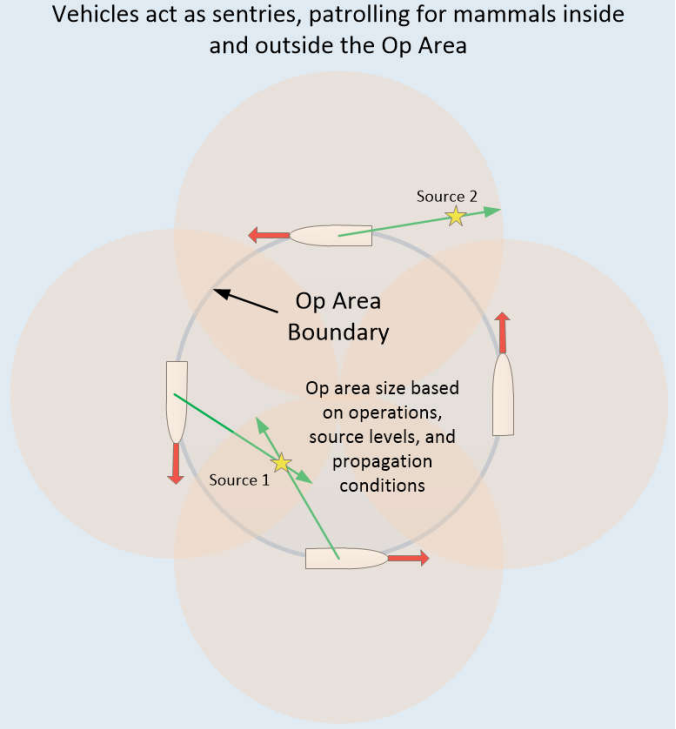


Figure 10. Example pitch tracks (bottom) of NARW calls (top) detected by PAMlab.

3.5.1. Multi-PAM System Bearing Cross-Fixing

Buoys will be deployed at fixed locations and USVs, when available, will station keep or sail slowly (~0.5 knots) within an assigned patrol area, with the bearings being used to determine whether animals are inside or outside the relevant monitoring area (Figure 11). Bearings from multiple PAM systems can be combined to estimate source locations (Figure 12).



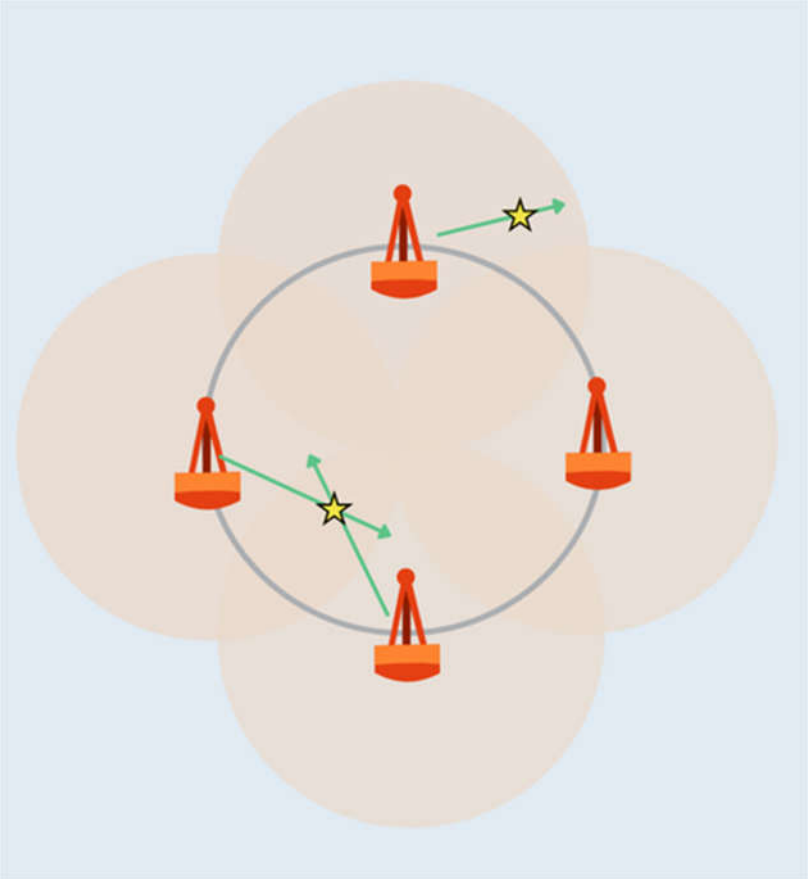


Figure 11. Buoys will be deployed conspicuously around the WDA, detecting and localizing animals that may have entered the area, or others that are outside the perimeter and moving toward it.

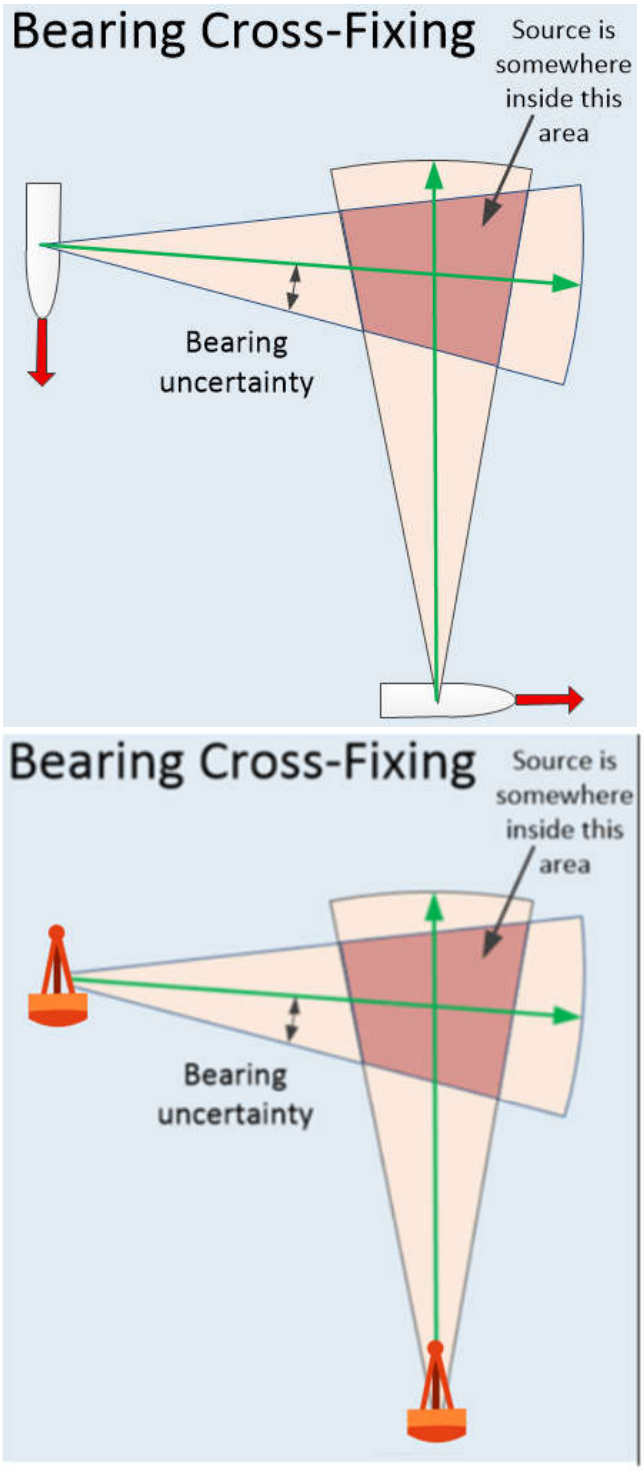


Figure 12. Intersecting bearings from multiple buoys, combined with their bearing uncertainties, define an area that contains the acoustic source.

3.6. Reporting Protocols

3.6.1. Real-time Reporting

Daily PAM reports will be generated and collated for the weekly report submission.

For all real-time monitoring deployments, the following information must be recorded:

- Location of hydrophone (latitude & longitude; in Decimal Degrees) and site name
- Bottom depth and depth of recording unit (in meters);
- Recorder (model & manufacturer) and platform type (i.e. bottom-mounted, electric glider, etc.), and instrument ID of the hydrophone and recording platform (if applicable);
- Time zone for sound files and recorded date/times in data and metadata (in relation to UTC. i.e., EST time zone is UTC-5);
- Duration of recordings (start/end dates and times; in ISO 8601 format, yyyy-mm-ddTHH:MM:SS.sssZ);
- Deployment/retrieval dates and times (in ISO 8601 format);
- Recording schedule (must be continuous);
- Hydrophone and recorder sensitivity (in dB re. 1 µPa);
- Calibration curve for each recorder;
- Bandwidth/sampling rate (in Hz);
- Sample bit-rate of recordings; and
- Detection range of equipment for relevant frequency bands (in meters).

For each detection the following information must be recorded:

- Species identification (if possible);
- Call type and number of calls (if known);
- Temporal aspects of vocalization (date, time, duration, etc., date times in ISO 8601 format);
- Confidence of detection (detected, or possibly detected);
- Comparison with any concurrent visual sightings;
- Location and/or directionality of call (if determined) relative to acoustic recorder or construction activities;
- Location of recorder and construction activities at time of call;

- Name and version of detection or sound analysis software used, with protocol reference;
- Minimum and maximum frequencies viewed/monitored/used in detection (in Hz); and
- Name of PAM Operator(s) on duty.

3.6.2. Weekly Reporting

Weekly PAM monitoring reports will be submitted to NMFS and DOI during the pile driving and construction period of the Project. Weekly reports will document the daily start and stop times of all pile-driving activities, the daily start and stop times of associated observation periods by the PAM Analysts, and a record of all detections of marine mammals. JASCO will coordinate with RPS to deliver weekly PAM reports for inclusion into their overall weekly reports. These reports will be submitted to RPS every Wednesday during construction for the previous week (Sunday through Saturday) of pile driving activity monitoring and will include:

- Date (YYYY-MM-DD)
- PAM Team name(s) (Last, First)
- Time clearance PAM monitoring began in UTC (HH:MM)
- Time PAM monitoring ended in UTC (HH:MM)
- Duration of clearance PAM
- PAM Detections - For all marine mammal acoustic detections, the following information must be recorded:
    - Identification, location and depth of recording unit
    - Time zone for sound files and recorded date/times in data and metadata
    - Duration of recording (start/end dates and times)
    - Type of recording (continuous/duty cycled)
    - Species identification (if possible)
    - Call type (if known)
    - Temporal aspects of vocalization (date, time, duration, etc.)
    - Comparison with any visual sightings
    - Name of observer/data collector/analyst
    - A record of the PAM Analyst's review of any acoustic detections.
    - Location (if geometry/density of bottom-mounted or sonobuoy array allows) or directionality (directional hydrophones and/or lateral information from towed array) of detected calls including references to location of coincident human sound-producing activities. This will include the uncertainty area and how it was estimated.

- Additional mitigation actions (if any).

The PAMlab system sends automated email and/or text alerts to the PAM team so they can initiate the appropriate verification and alerting sequence per the permit requirements. If a NARW is detected via PAM, the date, time, location (i.e., latitude and longitude of recorder that had detection) of the detection as well as the recording platform and organization (e.g., VW1 Buoy 1) will be reported immediately to the Lead PSO in real-time. Full detection data, metadata and an explanation of the imminent risk presented and animals potentially impacted will be submitted within 24 hours to the RPS Project Manager and DOUS Project QHSE Manager. This information will then be relayed to VW1 who will report to agencies as necessary.

PAM detections will be submitted via email to nmfs.pacmdata@noaa.gov using the PAM data reporting template available at https://www.fisheries.noaa.gov/resource/document/passive-acoustic-reporting-system-templates.

3.6.3. Final Report

A final draft report on all acoustic monitoring conducted under the IHA will be prepared and integrated with the visual monitoring report in coordination with RPS and submitted within 90 calendar days of the completion of monitoring. A final report will be prepared and submitted within 30 calendar days following receipt of any NMFS comments on the draft report. Additionally, JASCO will coordinate with RPS to ensure a copy of the final overall report is also submitted to BOEM. On project completion raw acoustic data will be submitted to NCEI.

4. References

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Appendix A. PAM Requirements

A.1. PAM Zones

A.1.1. NARW Clearance and Monitoring Zones

Time of Year	Pile Type	Clearance Zone (CZ)[1,2]	Monitoring Zone (MZ)
May 1 – May 14	All	10 km	10 km
May 15 – May 31	Monopile / Jacket	5 km / 3.2 km	10 km
June 1 – Oct 31	Monopile / Jacket	5 km / 3.2 km	5 km
Nov 1 – Dec 31	Monopile / Jacket	10 km	10 km

[1] At any time of year, a PAM detection (75% confidence) of a NARW within the PAM clearance zone must be treated as a visual detection, triggering a delay in pile driving.

[2] From May 1-14 and Nov 1- Dec 31, the PAM system must be operated 24/7 if pile driving will occur and must not be less than 10km.

[3] If a DMA or Slow Zone overlaps the Level B zone, the PAM system will be extended to the largest practicable detection zone to increase situational awareness, but will not be smaller than the Level B zone.

A.1.2. NARW Shutdown Zones

Pile Type	Shutdown Zone (SZ) [3,4]
Monopile / Jacket	3.2 km

[3] If a marine mammal is observed entering or within the respective shutdown zone after pile driving has commenced, a shutdown of pile driving must be implemented when technically feasible as described under Condition 4(f)(ii) of this IHA

[4] Upon receipt of an interim SSV report, NMFS may adjust the shutdown zone.

A.1.3. Non-NARW Clearance and Shutdown Zones

Species Group	Clearance and Shutdown Zones
Non-NARW mysticete whales (including humpback, sei, fin and minke) and sperm whale	500 m
Harbor porpoise	120 m
All other marine mammals (including dolphins and pinnipeds)	50 m

A.2. IHA

(e) Vineyard Wind must adhere to Passive Acoustic Monitoring protocols as follows:

(i) Acoustic monitoring must be conducted during all pile driving.

(ii) Acoustic monitoring must begin at least 60 minutes prior to initiation of pile driving, during, and 30 minutes post pile driving.

(iii) Acoustic monitoring must be conducted by at least one acoustic PSO. The acoustic PSO(s) must demonstrate that they have completed specialized training for operating PAM systems and detecting and identifying NARWs.

(iv) Acoustic PSOs may be on watch for a maximum of four consecutive hours followed by a break of at least two hours between watches.

(v) The acoustic PSO(s) must immediately communicate all detections of marine mammals to visual PSOs, including any determination regarding species identification, distance, and bearing and the degree of confidence in the determination.

(vi) The PAM system must not be located on the pile installation platform.

(vii) For all marine mammal acoustic detections, the following information must be recorded:

1. Identification, location and depth of recording unit
2. Time zone for sound files and recorded date/times in data and metadata
3. Duration of recording (start/end dates and times)
4. Type of recording (continuous/duty cycled)
5. Species identification (if possible)
6. Call type (if known)
7. Temporal aspects of vocalization (date, time, duration, etc.)
8. Comparison with any visual sightings
9. Name of observer/data collector/analyst
10. A record of the PAM operator's review of any acoustic detections.
11. Location (if geometry/density of bottom-mounted or sonobuoy array allows) or directionality (directional hydrophones and/or lateral information from towed array) of detected calls including references to location of coincident human sound-producing activities.

(viii) A Passive Acoustic Monitoring Plan must be submitted to NMFS for review and approval at least 90 days prior to the planned start of pile driving. The Plan must describe all proposed PAM equipment, procedures, and protocols.

A.3. Condition of COP Approval

5.7.5 Pile-Driving Monitoring Plan Requirements (Construction). At least 90 calendar days prior to commencing the first pile-driving activities for the Project, the Lessee must submit a Pile-Driving Monitoring (PDM) Plan to BOEM (at renewable_reporting@boem.gov), BSEE (at protectedspecies@bsee.gov), and NMFS for review. DOI will review the PDM Plan and provide comments, if any, on the plan within 30 calendar days of its submittal. The Lessee must resolve all comments on the PDM Plan to DOI's satisfaction prior to implementing the plan. If DOI provides no comments on the PDM Plan within 90 calendar days of its submittal, then the Lessee may conclusively presume DOI's concurrence with the plan.

5.7.5.1 The PDM Plan must:

5.7.5.1.1 Contain information on the visual and PAM components of monitoring, describing all equipment, procedures, and protocols;

5.7.5.1.2 Demonstrate a near-real-time capability of detection capability to 6.21 miles (10 kilometers) from the piledriving location;

5.7.5.1.3 Ensure that the full extent of the distance over which harassment may occur from piles is monitored for marine mammals (160 dB RMS) and sea turtles (175 dB RMS) to document all potential take;

5.7.5.1.4 Include a PAM Plan with a 75-percent detection confidence by the PAM operator to determine that a possible NARW vocalization originated from within the clearance and shutdown zones. Any possible NARW vocalization must be reported as a detection if it is determined by the PSO to be within the clearance and shutdown zones;

5.7.5.1.5 Include the number of NMFS-approved PSOs and/or monitors that will be employed, the platforms and/or vessels upon which they will be deployed, and contact information for the PSO provider(s);

5.7.5.1.6 Include an Alternative Monitoring Plan that includes measures for enhanced monitoring capabilities in the event that poor visibility conditions unexpectedly arise, and pile driving cannot be stopped. The Alternative Monitoring Plan must also include measures for deploying additional observers, using night vision goggles (for all marine mammals and sea turtles), or using PAM (for marine mammals) with the goal of ensuring the ability to maintain all clearance and shutdown zones in the event of unexpected poor visibility conditions; and

5.7.5.1.7 Describe a communication plan detailing the chain of command, mode of communication, and decision authority. PSOs must be previously approved by NMFS to conduct mitigation and monitoring duties for pile-driving activity. In accordance with the PDM Plan, the Lessee must use an adequate number of PSOs, as determined by NMFS and BOEM, to monitor the area of the clearance and shutdown zones. The PDM Plan must also describe seasonal and species-specific clearance and shutdown zones, including time-of-year requirements for NARWs.

5.7.5.2 A copy of the PDM Plan must be in the possession of the Lessee representative, the PSOs, impact-hammer operators, and/or any other relevant designees operating under the authority of the approved COP and carrying out the requirements of the PDM Plan on site.

Appendix B. Equipment Specifications

B.1. 0.6 m ObserverBuoy

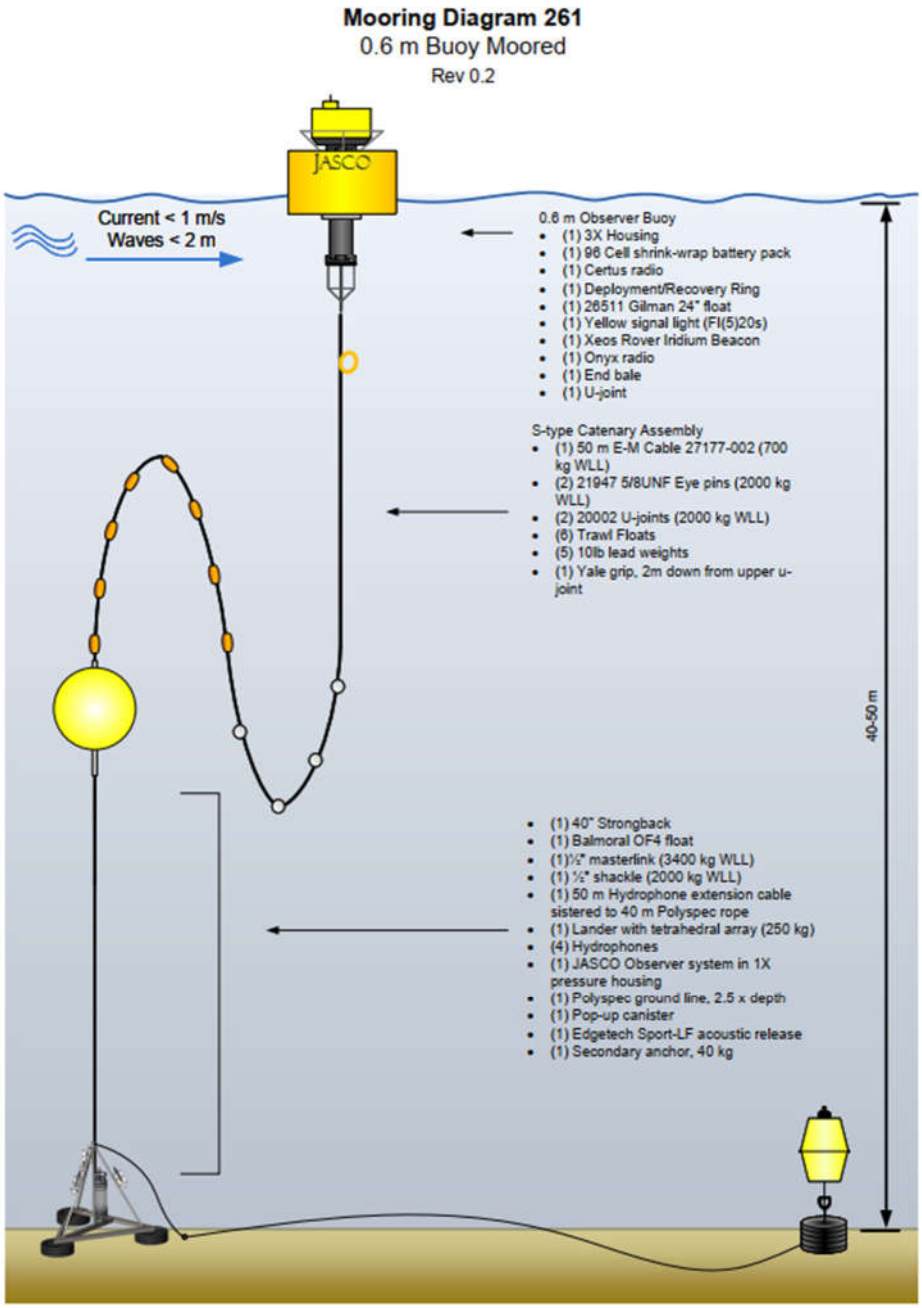


Figure 13. ObserverBuoy Mooring Diagram. The tetrahedral array has a triangular footprint with ~1.6 m sides (area ~ 1.1 square meters) and the pop-up has a circular footprint of ~.46 m diameter (area ~ 0.16 square meters). Both are only expected to sink a few centimeters into the sediment.

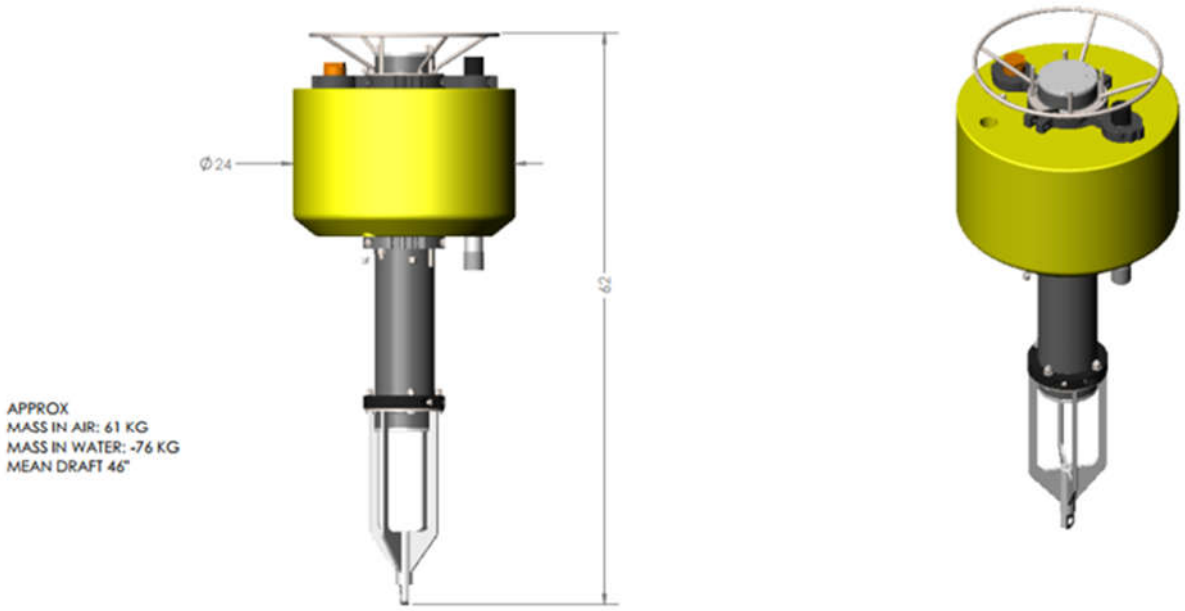


Figure 14. ObserverBuoy Surface Buoy.

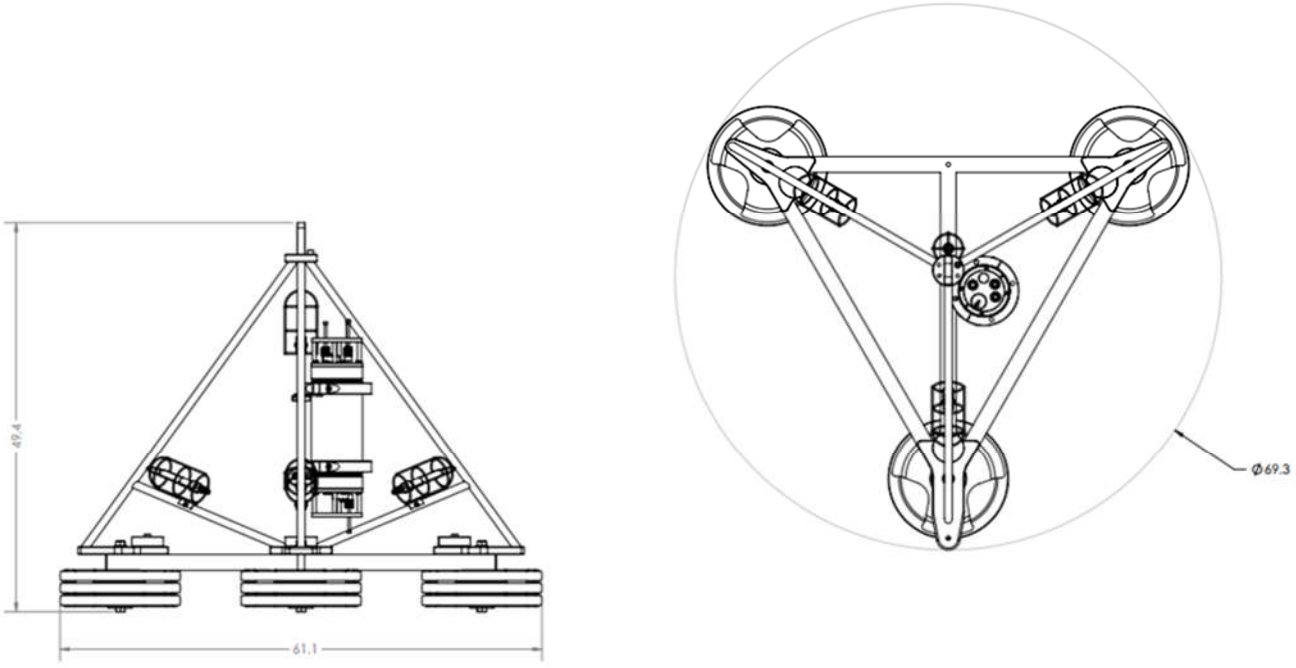
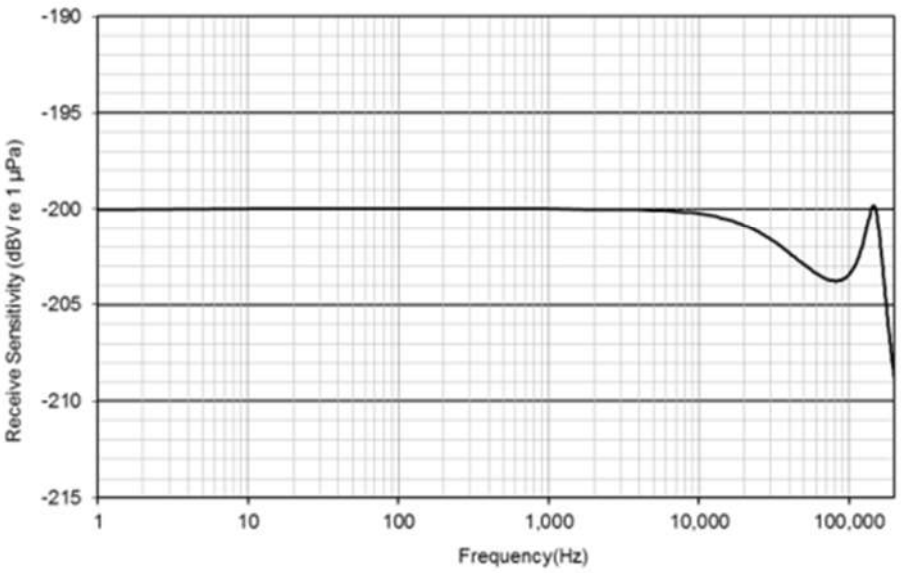


Figure 15. ObserverBuoy Bottom Lander. Its footprint is a triangle with sides of ~62”.

M36-100

The M36-100 is a wide-band omni-directional hydrophone designed for marine observation. It comes with a pre-amplified output of 0 to 35 dB (selectable on order) with current or voltage signalling.

Characteristics	
Nominal Voltage Sensitivity (without preamp)	-200 dBV re 1 µPa @ 20°C
Size	7.8" length, 1.3" max OD
Depth Rating	2500 m
Storage and Operating Temperatures	-40 to +70°C
Acceleration Sensitivity	<1.5 mbar/g, in air, any axis
Labelling	Calibration parameters, serial number, date
Connector	MCBH-8M
Pre-Amplifier	
Preamp signalling	Current, single ended voltage or, differential voltage (selectable on order)
Gain	0 – 35 dB (selectable on order)
Input Voltage	6.8 VDC nominal 4.5 – 30 VDC operating range
Band Pass	5 Hz HPF, no LPF installed (unless otherwise specified)
IRN	<140 nV/√Hz @10 Hz <4 nV/√Hz @1 kHz
Current Draw	1.3 mA (at 6.8 VDC) 4.2 mA with current signalling preamp



M36 Frequency Response (without preamp)

Figure 16. ObserverBuoy GTI M36-V35-100 Hydrophone Specification. The maximum useable frequency is 250 kHz.

B.2. Uncrewed Surface Vehicle: SubSeaSail HORUS with 4 element Array

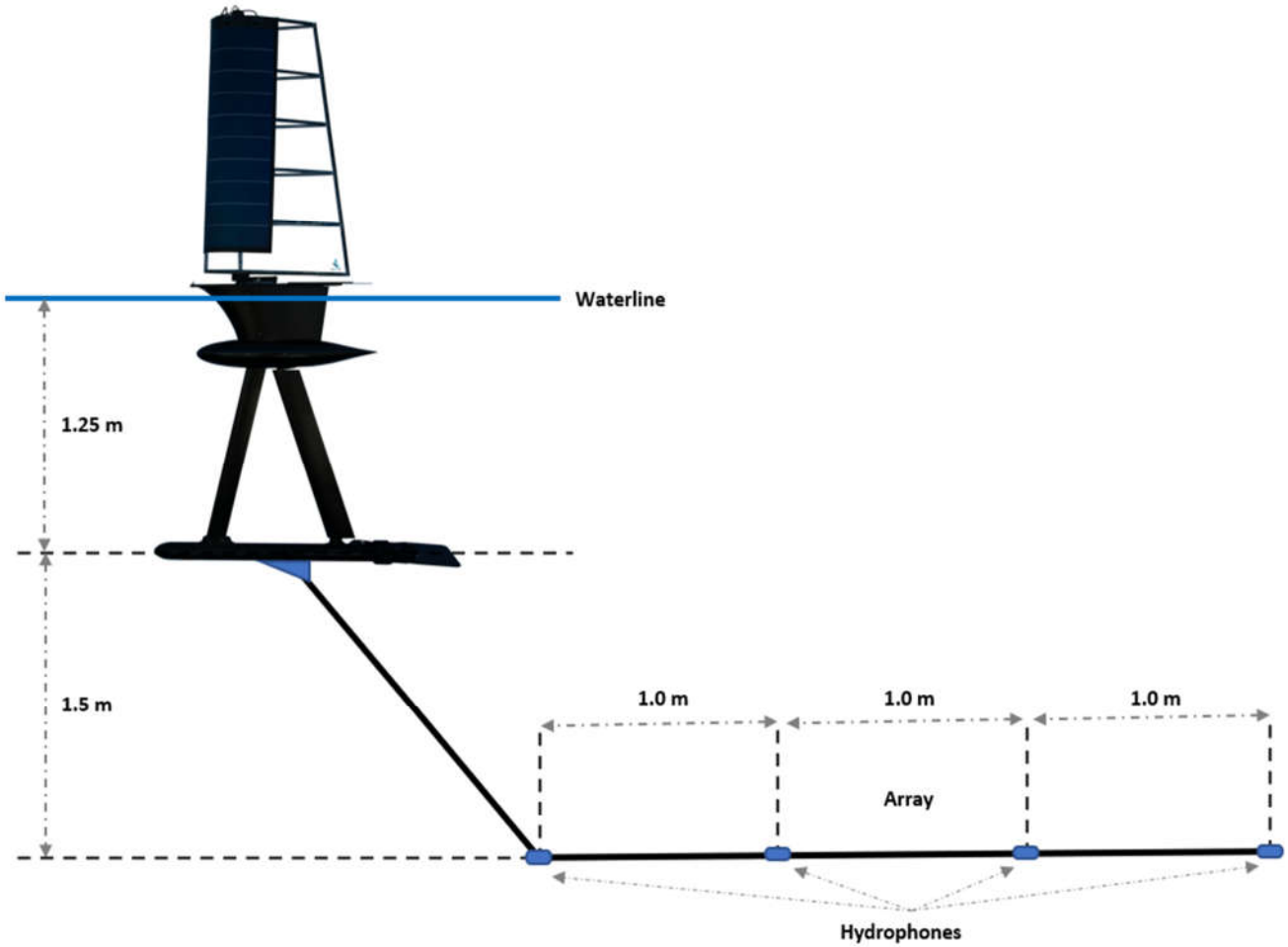
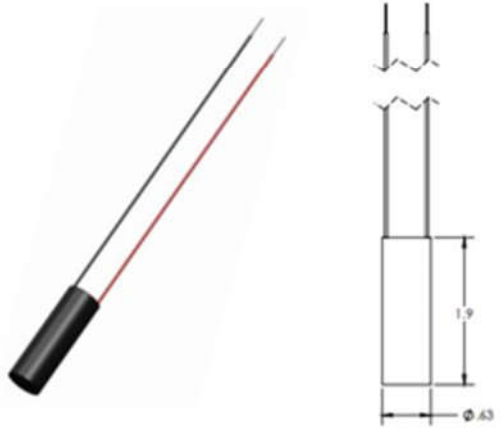


Figure 17. HORUS USV with 4-element array.

SEISMIC HYDROPHONE
SQ34-05

SENSOR TECHNOLOGY

The SQ34-05 seismic hydrophone is made with a piezoelectric ceramic cylinder. The piezo element offers a receive sensitivity of -201.5 dB over a broad working bandwidth of 1 Hz - 5,000 Hz. Seismic hydrophones provide a small form factor and are designed specifically to maintain accuracy with large changes in both temperature and pressure that are common to deep ocean applications. The SQ34-05 is a high capacitance towed array hydrophone designed to provide a high signal-to-noise ratio. Mounting points, connectors, and other parameters can all be customized. Please contact us to discuss your specific requirements.

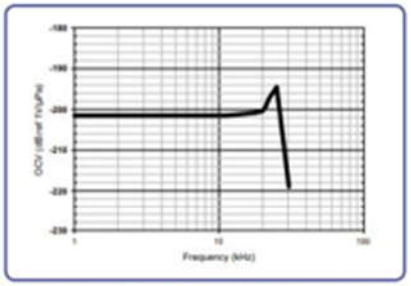


RECEIVE SENSITIVITY	-201.5 dB re 1 V/µPa @ 20°C
WORKING FREQUENCY	1 - 5000 Hz
CAPACITANCE	14.5 nF ± 15% @ 20°C
OPERATING DEPTH	2000 m

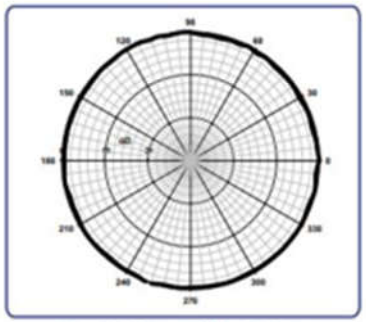
INNOVATIVE | KNOWLEDGABLE | CUSTOMIZABLE

SEISMIC HYDROPHONE
SQ34-05

SENSOR TECHNOLOGY



Receive Voltage Response



Directivity Pattern at 2 kHz, Axial Plane

Contact Us via:
info@sensortechcanada.com +1-705-444-1440
www.sensortechcanada.com

Figure 18. HORUS USV Array Hydrophone Specification. The maximum useable frequency is ~20 kHz.

B.3. PAMlab Detector Configuration

PAMlab Template		Species
Detector	**Name**	
BlueAud	Audible	Blue whale
Generic Moan	VLF Moan	Blue whale, Fin whale
Generic Moan	Short Low	Minke whale, Right whale
Generic Moan	Long Low	Right whale
Generic Moan	LF Moan	Humpback whale, Right whale, Sei Whale
Generic Moan	MF Moan-Low	Humpback whale
Generic Moan	MF Moan-High	Humpback whale
Upsweep Moan	Upcall	Right whale
Right Whale	Moan	Right whale
Fin Whale	Moan	Fin whale
Blue Whale	Moan	Blue whale
Generic Click	Click Train	Sperm whale
WhistleLow	Low Whistle	Pilot whale, Killer whale
WhistleHigh	High Whistle	Dolphins

In addition to the above, PAMlab can effectively acoustically detect many odontocetes in real time including long-finned pilot whales (*Globicephala melas)*, short-finned pilot whales (*Globicephala macrorhynchus*), killer whales (*Orcinus orca*), short-beaked common dolphins (*Delphinus delphis*), striped dolphins (*Stenella coeruleoalba*), white-beaked dolphins (*Lagenorhynchus albirostris*), white-sided dolphins (*Lagenorhynchus acutus*), and bottlenose dolphins (*Tursiops truncatus*). The tonal signals of these species can be effectively captured by the automated contour detectors run on the 32 kHz acoustic data onboard the PAM system in real-time. While the clicks of these species will not be reported in real-time, acoustic data sampling at 512 kHz will be recorded, archived, and analyzed post- equipment retrieval. These delphinid species are known to be social, travelling in groups and producing many social tonal vocalizations. PAM studies have revealed that reporting dolphin occurrence based on clicks vs tonal whistles reveals very similar results, with the tonal signals often a better representation of true species occurrence. Indeed, clicks are related to foraging, and some species click mostly at night, making clicks not ideal for real-time PAM. In contrast, tonal whistles are produced throughout the 24-h period. These patterns have been observed in many PAM programs off eastern Canada and the eastern US. For example, see below, Figure 32 and 33 from Martin et al. (2019). Figure 32 depicts hourly click occurrence, whereas Figure 33 is whistle occurrence. Dolphin acoustic occurrence could clearly be accurately represented based on whistles alone, especially at the 20km station where click behavior was largely limited to night in June through Aug.

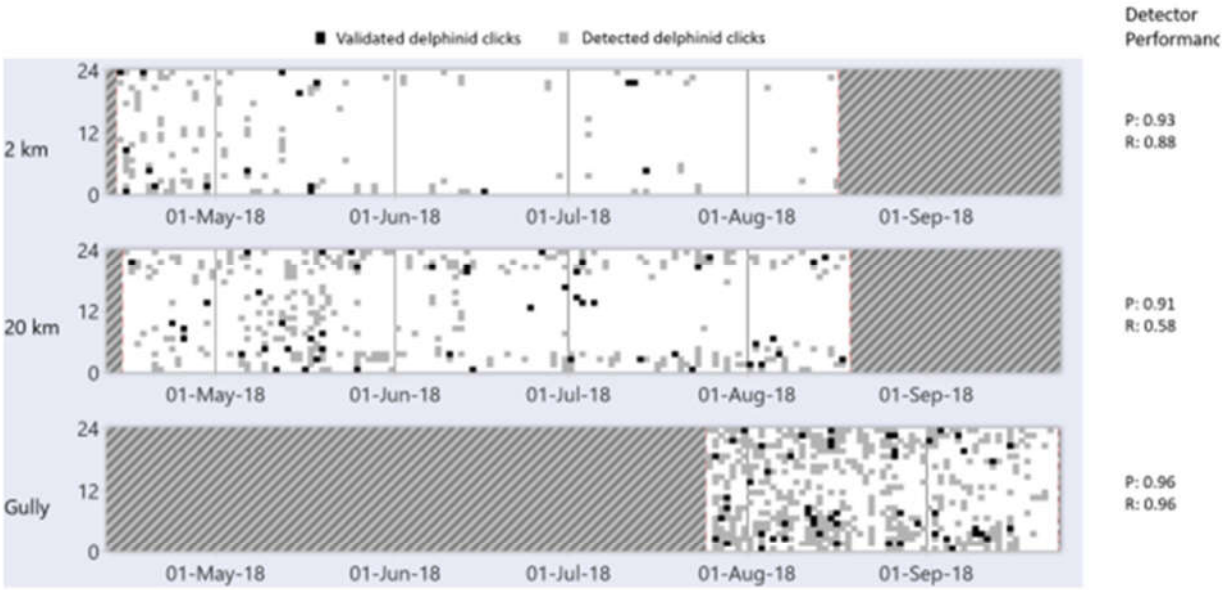


Figure 32. Dolphin clicks: Daily and hourly occurrence at 2 km, 20 km, and the Gully. Dashed lines indicate periods when AMARs were not recording.

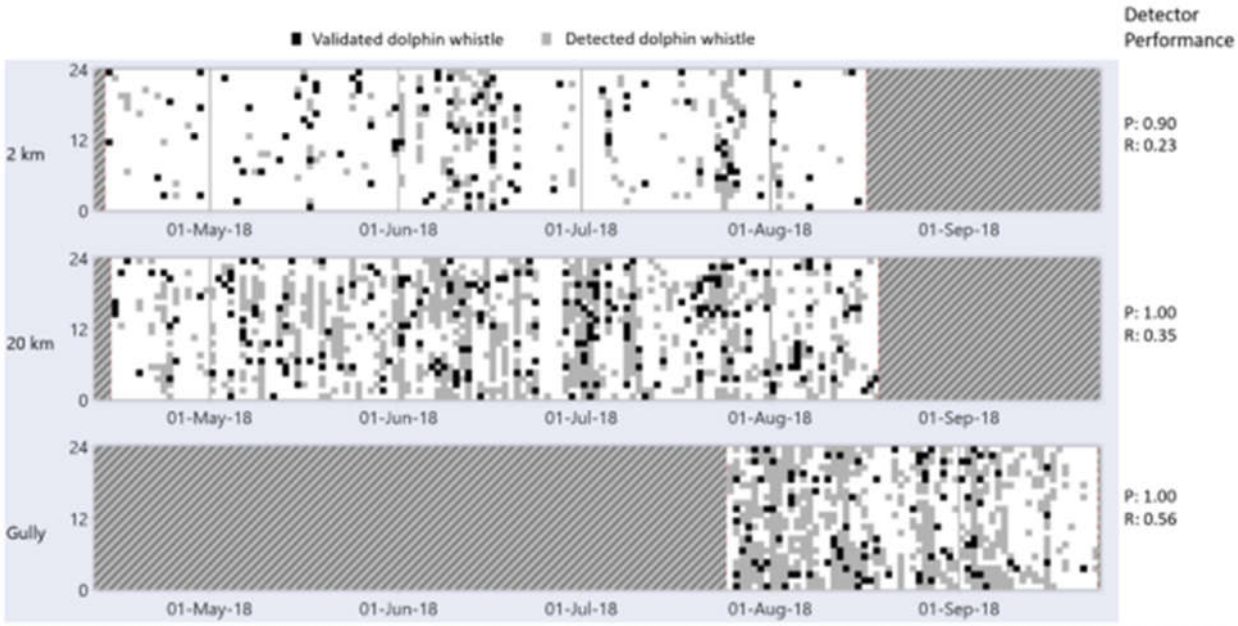


Figure 33. Dolphin whistles: Daily and hourly occurrence at 2 km, 20 km, and the Gully. Dashed lines indicate periods when AMARs were not recording.

Figure 19. Figures 32 and 33 from Martin et al. (2019)

Appendix C. Predicted PAM Performance

C.1. Distribution of Noise and NARW Upcall Source Levels

Noise estimates and NARW upcall signal models used in detection range modelling are shown below.

Table 2. Marine mammal call input parameters for the detection range modelling. The detection threshold refers to the threshold of the relevant detectors.

Species	Decidecade (Hz)	Mean source level (dB)	Source level standard deviation	Source depth range (m)	Detection threshold	References
RW upcall, Low SL	80–200	150	4	10–30	4	Parks and Tyack (2005)
RW upcall, Medium SL	80–200	165	3.5	10–30	4	Simard et al. (2019)
RW upcall, High SL	80–200	172	6.6	10–30	4	Clark et al. (2010)

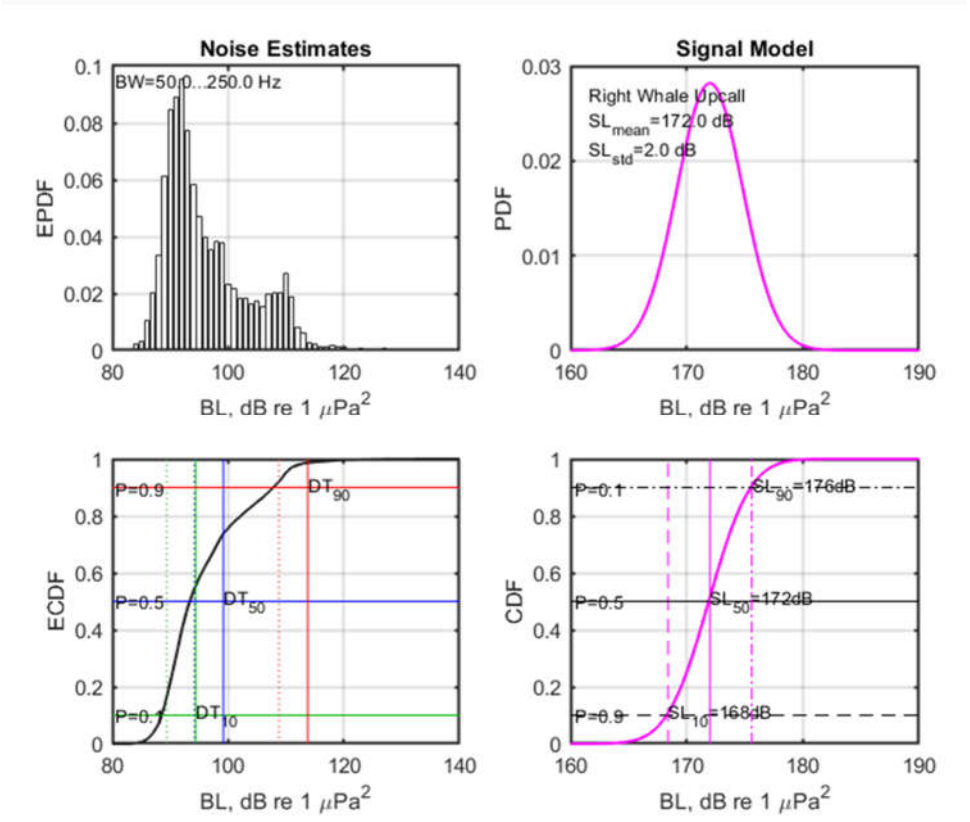


Figure 20. Noise estimate and NARW Upcall Signal Model used in Modelling. Empirical Probability Density Function (EPDF), Probability Density Function (PDF), Empirical Cumulative Distribution Function (ECDF), Cumulative Distribution Function (CDF).

C.2. Modelling Location

Upcall detection range modelling was conducted assuming the NARW was at location P1 (Figure 21) in the VW1 lease area.

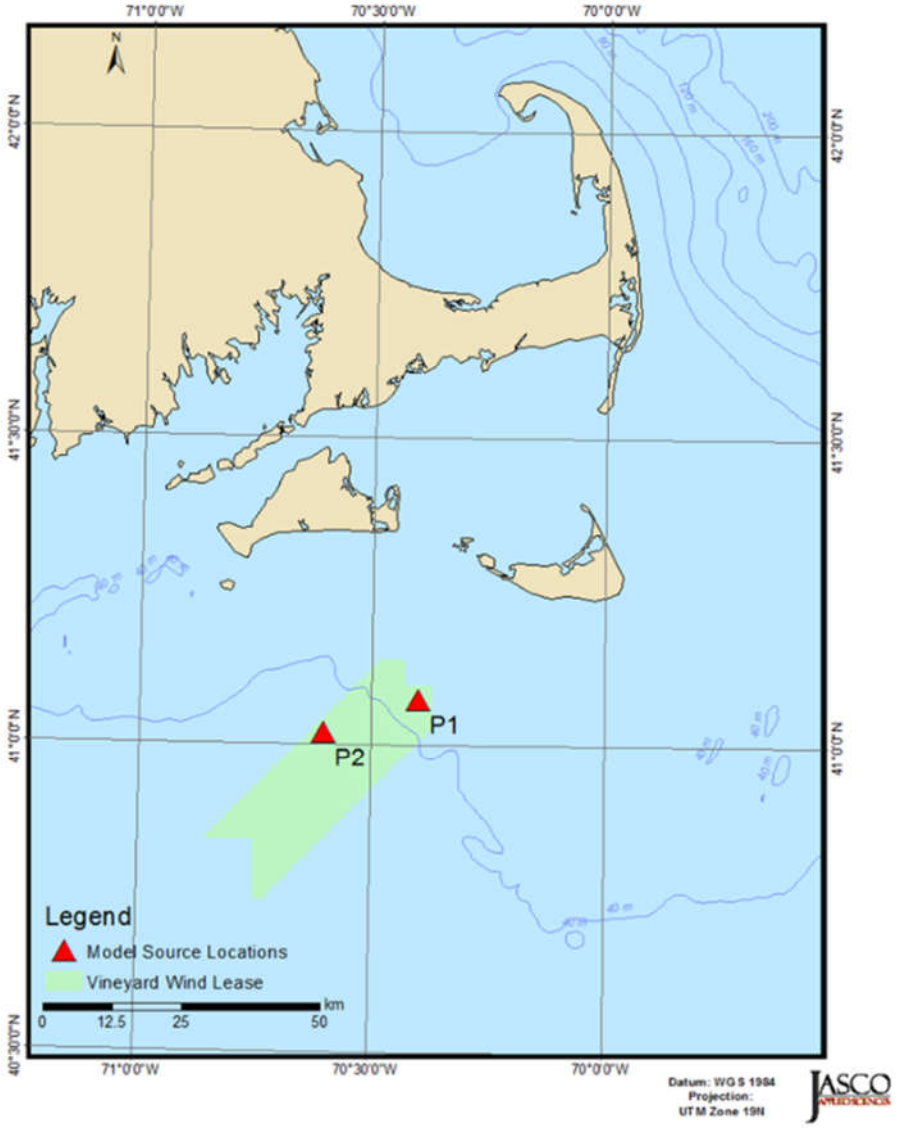


Figure 21. NARW Upcall Detection Range Modelling Location.

C.3. PAM Detection Ranges

NARW upcall detection ranges for combinations of detection probability (P_d=0.10, P_d=0.50, P_d=0.90) and noise level percentiles (NL_{10}, NL_{50} NL_{90}, see C.1 Noise Estimate) computed for the mean 172 dB source level (C.1 signal model), are shown below. The NARW was assumed to be at location Pile 1 (below) / P1 (above in C.1). The NARW (acoustic source) can be at any depth from 5 to 40 m (which is the maximum depth in the observation area). The received levels were maximized over the source depth range 5 to 40 m, such that the plots correspond to the maximum detection ranges. Figure 22 is for a hydrophone at ~35m depth (Buoy) and is for a hydrophone at <5m depth (USV).

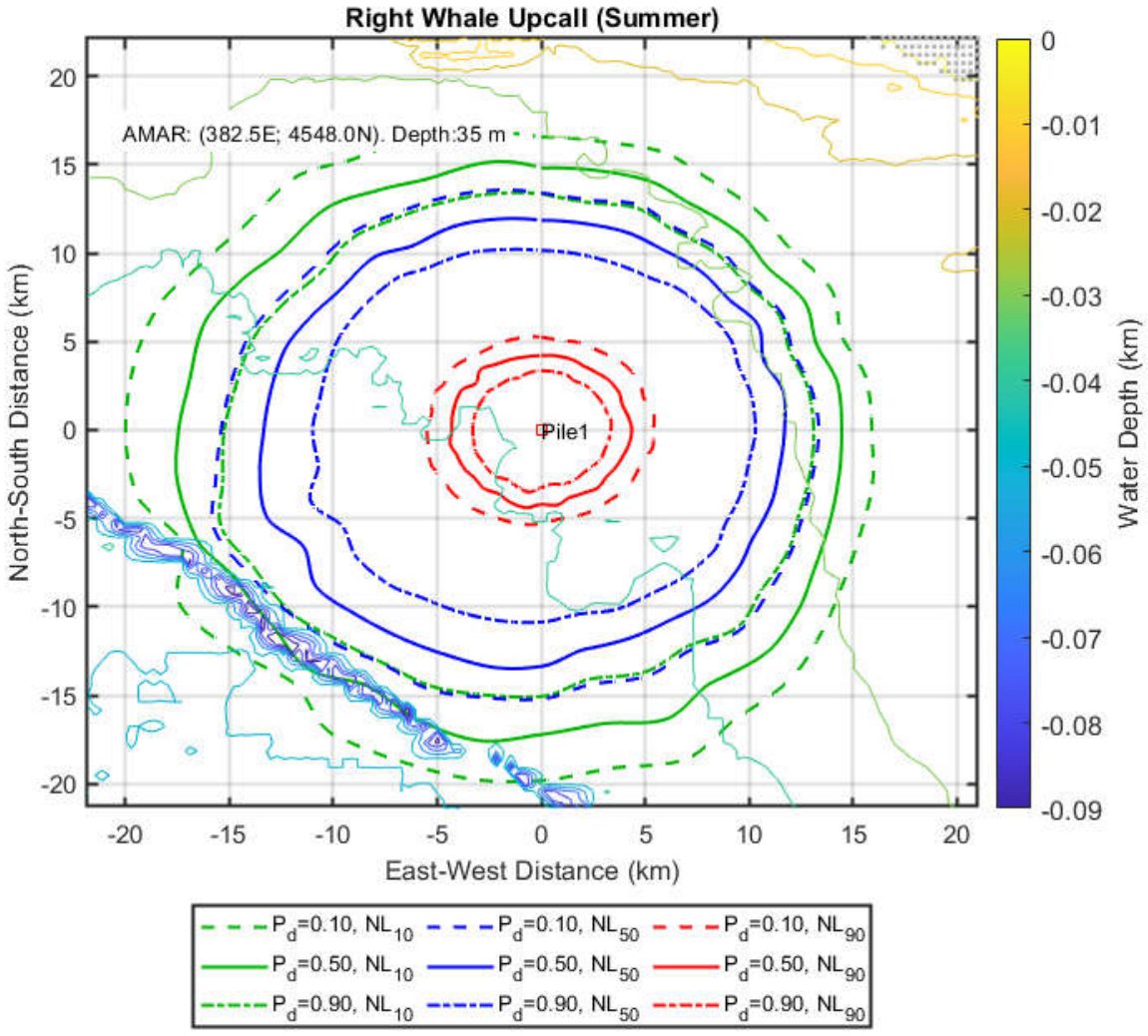


Figure 22. Predicted NARW Upcall Detection Range with Hydrophone at 35m depth.

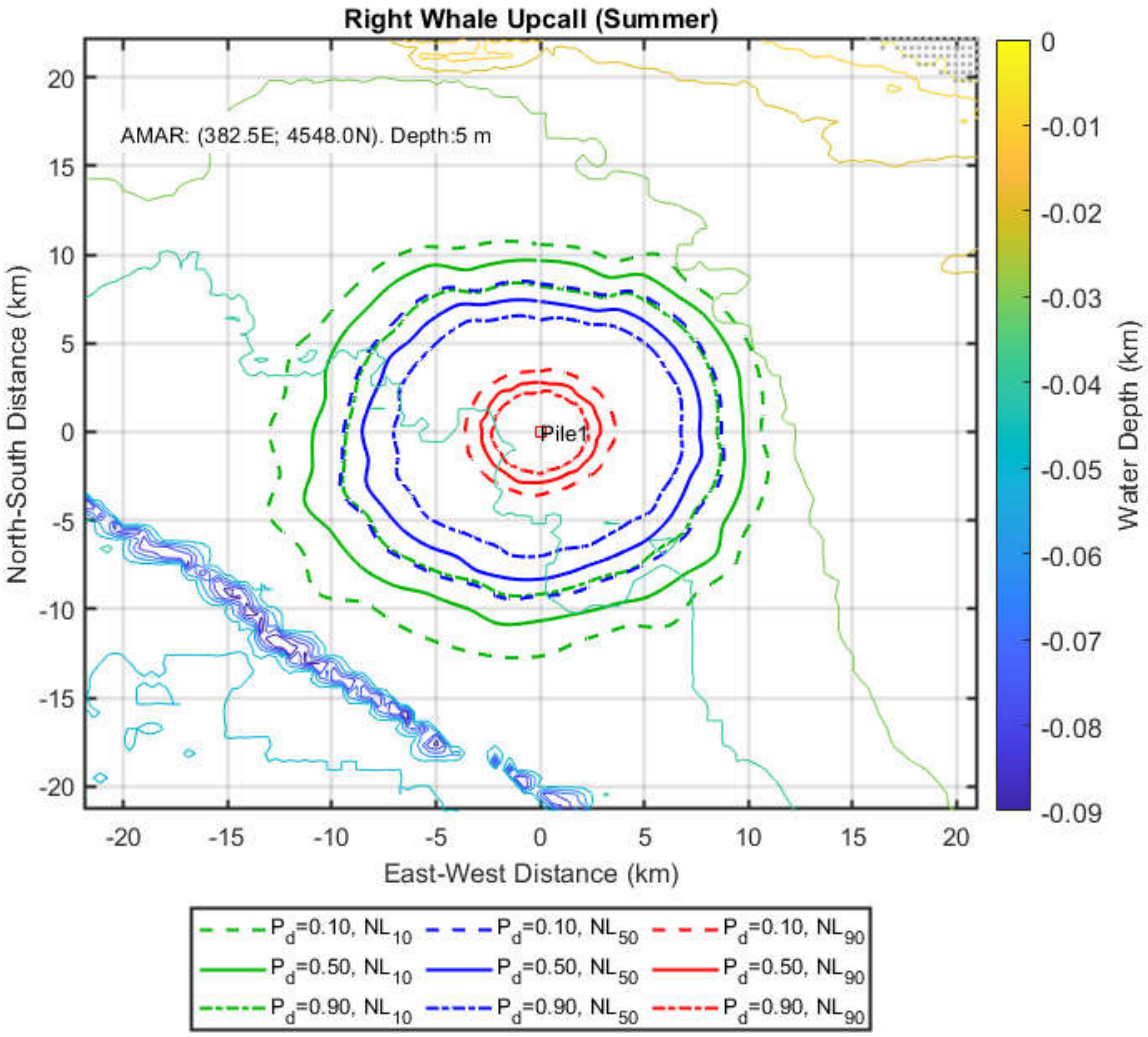
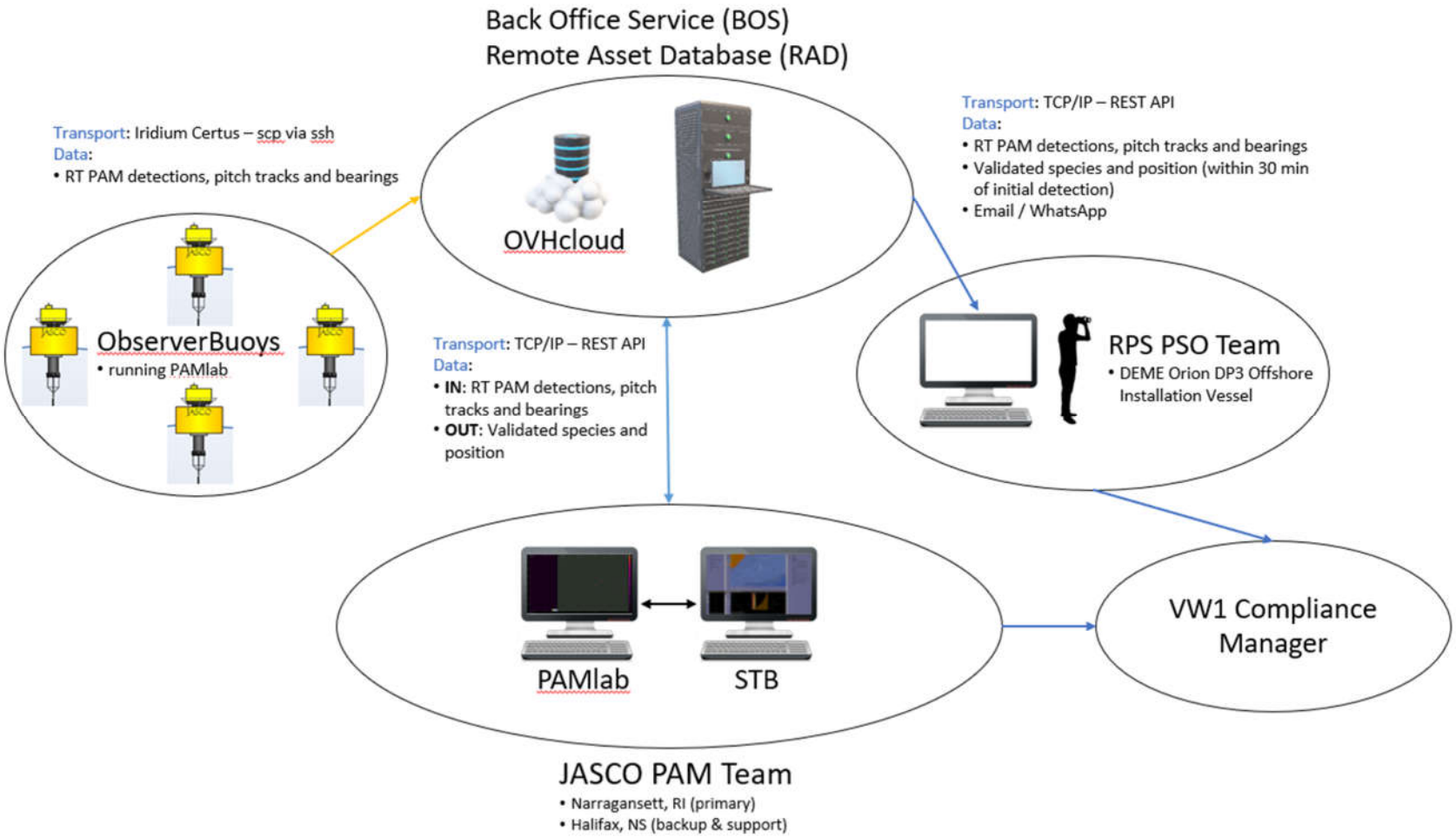


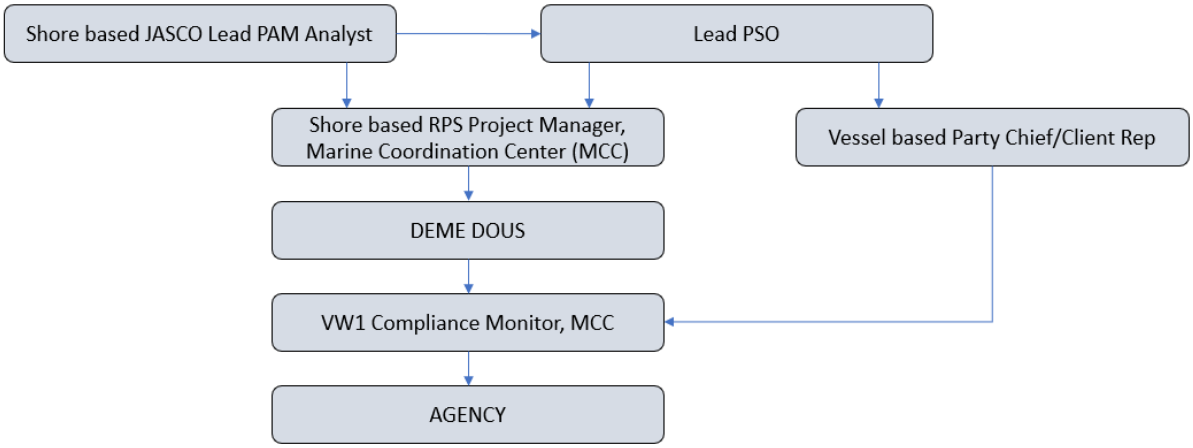
Figure 23. Predicted NARW Upcall Detection Range with Hydrophone at 5m depth.

Appendix D. Communications

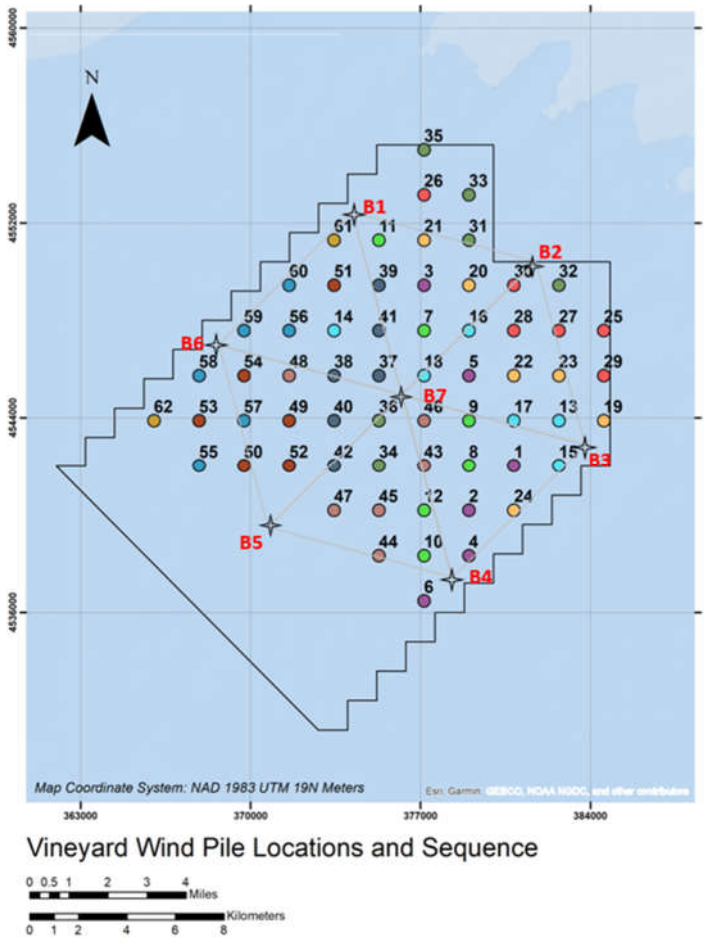
D.1. Data Flow Diagram



D.2. Reporting Flow Chart for PAM Detection



Appendix E. ObserverBuoy Deployment Plan



Piles are driven in sequences of six piles as numbered in color coded in the figure above. The table below shows the three optimum buoys (marked with an X) needed to provide coverage of the monitoring zones for the pile being driven. For example, pile 1 needs buoys B3, B4 and B7. In some cases, the optimum buoy is replaced with an alternate buoy that provides almost as good coverage as the optimum buoy. For example, pile 6 optimally requires buoys B4, B5 and B7. However, replacing buoy B5 with B3 also provides sufficient coverage and eliminates the need to deploy a buoy at B5. The shaded boxes show the actual buoys deployed for each pile. The note section for each sequence provides further information on the initial buoy deployment and any buoy relocations required during the sequence.

Pile	Buoys							Note
Sequence 1	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	• Deploy B2, B3, B4, B7
1			X	X			X	• For pile 3, move B3 to B1
2			X	X			X	• For pile 4-6, move B1 back to B3
3	X	X					X	
4			X	X			X	
5		X	X	B2			X	
6			B5	X	X		X	
Sequence 2								
7	X	X	B1				X	• Deploy B1, B2, B3, B7
8			X	X			X	• For pile 8-10, move B1 to B4
9			X	X			X	• For pile 11, move B4 back to B1
10			B5	X	X		X	• For pile 12, move B1 to B4
11	X	X					X	
12			B5	X	X		X	
Sequence 3								
13		X	X				X	• Deploy B1, B2, B3, B7
14	X	B6				X	X	
15		B4	X	X			X	
16		X	X				X	
17		X	X				X	
18		X	X				X	
Sequence 4								
19		X	X				X	• Deploy B1, B2, B3, B7
20	X	X					X	
21	X	X					X	
22		X	X				X	
23		X	X				X	
24		B4	X	X			X	
Sequence 5								
25		X	X				X	• Deploy B1, B2, B3, B7
26	X	X					X	
27		X	X				X	
28		X	X				X	
29		X	X				X	
30		X	X				X	
Sequence 6								
31	X	X					X	• Deploy B1, B2, B3, B7
32	B3	X	X				X	• For pile 34, move B2 to B4
33	X	X					X	• For pile 35, move B4 back to B2
34			B5	X	X		X	• For pile 36, move B2 to B4
35	X	X					X	
36			B5	X	X		X	

Sequence 7								
37	X					X	X	• Deploy B1, B5, B6, B7
38	X					X	X	
39	X	X				B2	X	
40					X	X	X	
42	X					X	X	
42				X	X	B4	X	
Sequence 8								
43			X	X	B3		X	• Deploy B4, B5, B6, B7
44				X	X		X	
45				X	X		X	
46			X	X	B3		X	
47				X	X		X	
48					X	X	X	
Sequence 9								
49					X	X	X	• Deploy B1, B5, B6, B7
50					X	X	X	
51	X					X	X	
52					X	X	X	
53					X	X	X	
54					X	X	X	
Sequence 10								
55					X	X	X	• Deploy B1, B5, B6, B7
56	X					X	X	
57					X	X	X	
58					X	X	X	
59	X					X	X	
60	X					X	X	
Sequence 11								
61	X					X	X	• Deploy B1, B5, B6, B7
62					X	X	X	

Jacket Foundation								
	X	X					X	• Deploy B1, B2, B7

Appendix F. Deployment & Retrieval of Observer buoy PAM

Observer buoy PAM deployment consists of preparing the equipment, lowering the bottom lander to the seabed then deploying the line and floating observer buoy. Retrieval reverses these steps.

Task: Prepare equipment for deployment

1. Tie the bottom lander over the side at a location near the A-frame but as far away as practical from the deployment area. Secure the bottom lander to a deck cleat and positioned near the water surface with passthrough tagline.
2. Attach and wind the upper 10 m wire cable onto the winch. The free end of the wire cable should be the one with the shackle (not the one with the universal joint).
3. With safety shackle, connect free end of wire cable through the A-fame to the lifting point of the bottom lander (top of the triangular structure)
4. Attach lowering line which acts as tag line to bottom lander to control movement during deployment.

Task: Deploy bottom lander

1. Lift bottom lander over the vessel stern with the A-frame and slowly lower it to the seafloor while using a tag line.
2. Release the deployment rig by pulling in the pass-through lowering line when the mooring is on bottom.

Task: Deploy S-catenary assembly line and observer buoy

1. Once the bottom lander is on the seafloor, record the geospatial position of the deployed lander, the vessel starts moving away from the deployment location, in a direction such that the bottom lander line is guided away from the vessel, against the current if possible, for S-catenary assembly line entanglement safety. Vessel speed should be 1–2 kts during this step. JASCO field team will discuss a direction with the vessel crew prior to deployment to best accommodate weather, current speed and direction, as well as any other considerations identified.
2. As the vessel moves away from the deployment location, pay out the S-catenary assembly line connecting the observer buoy
3. Observer buoy released in the water.
4. Retrieve tag line.
5. Submit the recorded position of the landers to VW1.

Task: Debriefing meeting

1. Hold debrief meeting to capture lessons learned.

Appendix G. Deployment & Retrieval of USV PAM

USV-based PAM deployment consists of preparing the equipment, placing the USVs manually overboard and taking distance. Retrieval methods reverse these steps.

Task: Prepare equipment for deployment

1. Sea fasten the USV on deck prior to departure.
2. Attach line which acts as tag line to USV to control movement during deployment and for emergency retrieval.

Task: Deploy USV

1. Final check on deck prior to launch of the USV that all systems are active and operational
2. Place USV manually overboard
3. Vessel starts moving away from the USV, in a direction such that the USV tag line is guided away from the vessel
4. In coordination with land based USV pilot do first in-water check
5. Ater green light from USV pilot, release USV
6. Retrieve tag line

Task: Debriefing meeting

1. Hold debrief meeting to capture lessons learned.

Appendix H. Vessel(s)

H.1. R/V Discovery

Ryan Marine Inc.
N41°31.48'W70°40.25'

63' R/V DISCOVERY
Click here for interior video

HULL SPECIFICATIONS

Length:	63'
Beam:	20'
Draft:	4' 6"
Builder:	Stapleton
Delivery Date:	1982

Major Refit 2020
New Deck and Framing
Expanded Cabin for increased Lab space 8'X15'

FULL ELECTRONICS PACKAGE

2 icom VHF radios
Sat Phone
Raymarine sounder
Raymarine Radar
AIS
Icom Comms
50' and 32' monitors in lab
5Kw Inverter

PROPULSION

Engine: Twin Detroit Diesel 671TI 750hp
11 Knot cruise
Twin Disc gears
22Kw Northern lights generator

ACCOMMODATIONS

5 Bunks
Full Head
Fully Galley

DECK EQUIPMENT

New DWM Marine crane (Installed 2020)
10,000lbs line pull Deck winch and Capstan

CAPACITIES

Fuel:	2800 gal
Fresh Water:	500 gal

RYAN MARINE INC. | WWW.RYANMARINEINC.COM | 508.548.6976

H.2. Zodiac H770 DJ Short Range Prosecutor

ZODIAC HURRICANE TECHNOLOGIES, INC.
Professional Division

H770 DJ Short Range Prosecutor

Length	25 ft. 7 meters
Displacement	5600 lbs.
Propulsion	Two diesel engines; Water Jet Engine for Stern Ramp Capability
Capacity	10 personnel, 150 lbs. of equipment
Speed	33 kts
Range	400 NM
Endurance	10 hours
Features	• Slam Mitigating Seats
	• Excellent Sea-Keeping
Benefits	• Decreased Fatigue for Crew
	• Increased Control
	• Rough Water Operations

Appendix I. PAM Analyst (PA) Schedules

I.1. Seasonal (summer and winter) PAM Analyst monitoring schedules describing regular pile driving operations for three PAM Analysts.

JUNE				
	Time	PA 1	PA 2	PA 3
	00:00			
	01:00			
	02:00			
	03:00			
SUNRISE 0430	04:00	ON		
	05:00	ON		
	06:00	ON		
	07:00	ON		
	08:00		ON	
	09:00		ON	
	10:00		ON	
	11:00		ON	
	12:00	ON		
	13:00	ON		
	14:00	ON		
	15:00		ON	
	16:00		ON	
	17:00		ON	
	18:00			ON
	19:00			ON
	20:00			ON
SUNSET 2030	21:00			ON
	22:00			
	23:00			
	Total	7	7	4

DECEMBER				
	Time	PA 1	PA 2	PA 3
	00:00			
	01:00			
	02:00			
	03:00			
	04:00			
	05:00			
	06:00	ON		
SUNRISE 0700	07:00	ON		
	08:00	ON		
	09:00	ON		
	10:00		ON	
	11:00		ON	
	12:00		ON	
	13:00		ON	
	14:00	ON		
	15:00	ON		
	16:00		ON	
SUNSET 1615	17:00		ON	
	18:00			
	19:00			
	20:00			
	21:00			
	22:00			
	23:00			
	Total	6	6	

I.2. PAM Analyst monitoring schedules demonstrating staffing required to cover 24-hour operations. As per the IHA from May 1-14 and Nov 1-Dec 31, the PAM system will be operated 24/7 if pile driving will occur.

JUNE					
	Time	PA 1	PA 2	PA 3	PA 4
	00:00				ON
	01:00				ON
	02:00				ON
	03:00				ON
SUNRISE 0430	04:00	ON			
	05:00	ON			
	06:00	ON			
	07:00	ON			
	08:00		ON		
	09:00		ON		
	10:00		ON		
	11:00		ON		
	12:00	ON			
	13:00	ON			
	14:00	ON			
	15:00	ON			
	16:00		ON		
	17:00		ON		
	18:00		ON		
	19:00		ON		
	20:00			ON	
SUNSET 2030	21:00			ON	
	22:00			ON	
	23:00			ON	
	Total	8	8	4	4

Appendix C NARW Strike Management Plan

Permits & Consents

Vineyard Wind 1 – Construction

Appendix C to the Pile Driving Monitoring and Mitigation Plan

North Atlantic right whale Strike Management Plan

Document Title:	**North Atlantic right whale Strike Management Plan**
Company Doc. No.	VW-PEC-VWC-GL-1008
Originator / Contractor	Vineyard Wind 1, LLC
Contractor Doc No.	
Package Code	**PEC - Permits & Consents**
Revision	**7**
Date:	2023-05-19
Doc. Status	IFU - Issued for Use
Document Type	GL - Guidelines & Procedures
Classification:	Confidential / Internal use only
Author:	Cedric Baes, Elizabeth Marsjanik, Ryan Rezendes
Checked	Michael Clayton
Approved:	Juan Levesque, Ph.D

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Revision Control

Revision	Date	Status
0	2023-02-02	IFU
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3	2023-05-09	IFU
4	2023-05-10	IFU
5	2023-05-15	IFU
6	2023-05-16	IFU
7	2023-05-19	IFU

[redacted]

Acronyms

AIS	Automatic Information System
BiOp	National Marine Fisheries Service Biological Opinion
BOEM	Bureau of Ocean Energy Management
BSEE	Bureau of Safety and Environmental Enforcement
CR	Client Representative
COP	Construction and Operations Plan
COP T&C	BOEM COP Approval Terms and Conditions
CTV	Crew Transfer Vessel
DOI	Department of Interior
DMA	Dynamic Management Area
ESA	Endangered Species Act
ft	feet
IHA	Incidental Harassment Authorization
km/hr	kilometers per hour
LPSO	Lead Protected Species Observer
m	meters
MCC	Vineyard Wind 1 Marine Coordination Center
NARW	North Atlantic right whale
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
PAM	Passive Acoustic Monitoring
PSO	Protected Species Observer
SMA	Seasonal Management Area
TL	Trained Lookout
USCG	United States Coast Guard
VHF	Very High Frequency
VO	Visual Observer
VW1	Vineyard Wind 1
WEA	Wind Energy Area
WDA	Wind Development Area

1. Introduction

The Vineyard Wind 1 (VW1) North Atlantic right whale (NARW) Strike Management Plan (Plan) was developed in accordance with the National Marine Fisheries Service (NMFS) approved Incidental Harassment Authorization (IHA), dated May 21, 2021, and the Bureau of Ocean Energy Management (BOEM) Conditions of Construction and Operations Plan Approval (COP Approval), dated July 15, 2021, and NMFS Biological Opinion (BiOp), dated October 18, 2021. The Plan establishes monitoring and mitigation measures to reduce the risk of VW1 project vessel activity potentially injuring a North Atlantic right whale (*Eubalaena glacialis*, NARW), and other marine mammals. This Plan applies to the construction phase of the VW1 Project and will be updated to comply with all applicable laws, regulations, and permits governing operations and maintenance and decommissioning.

Figure 1 illustrates the potential VW1 Project vessel transits (to & from) and within the Wind Development Area (WDA). Only one transit route, the primary transit route, will be utilized for high-speed CTV transits (i.e., greater than 10 knots) during construction. Transits along the alternative routes will not include any high-speed transits by CTVs. The primary transit route originates in New Bedford harbor to the Vineyard Wind 1 Lease Area via Quicks Hole and north of Nomans Land.

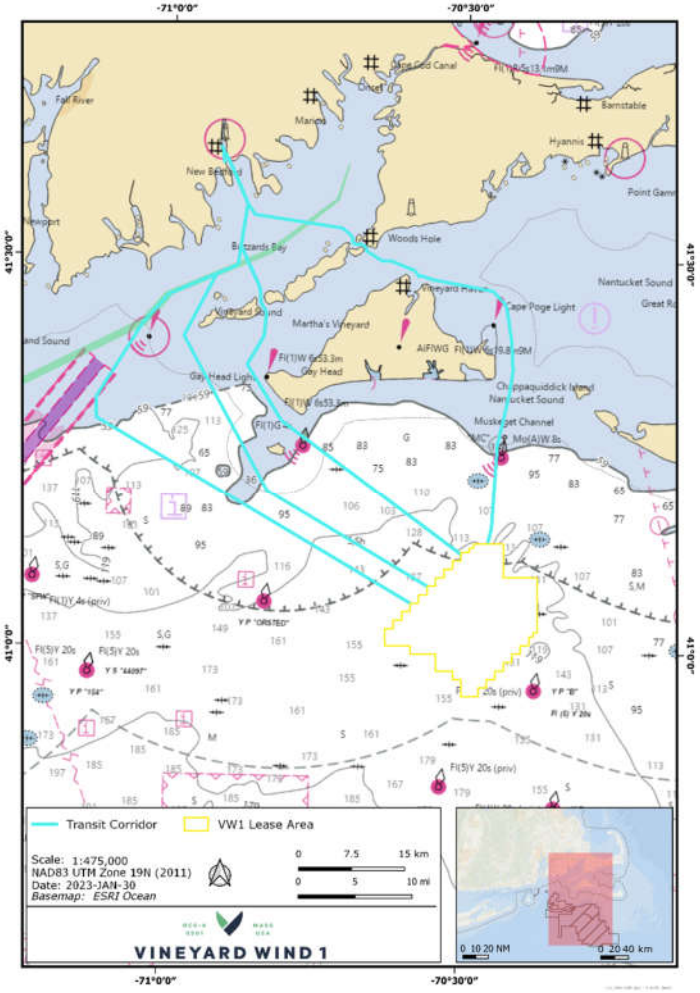


Figure 1. Vineyard Wind 1 Transit Routes.

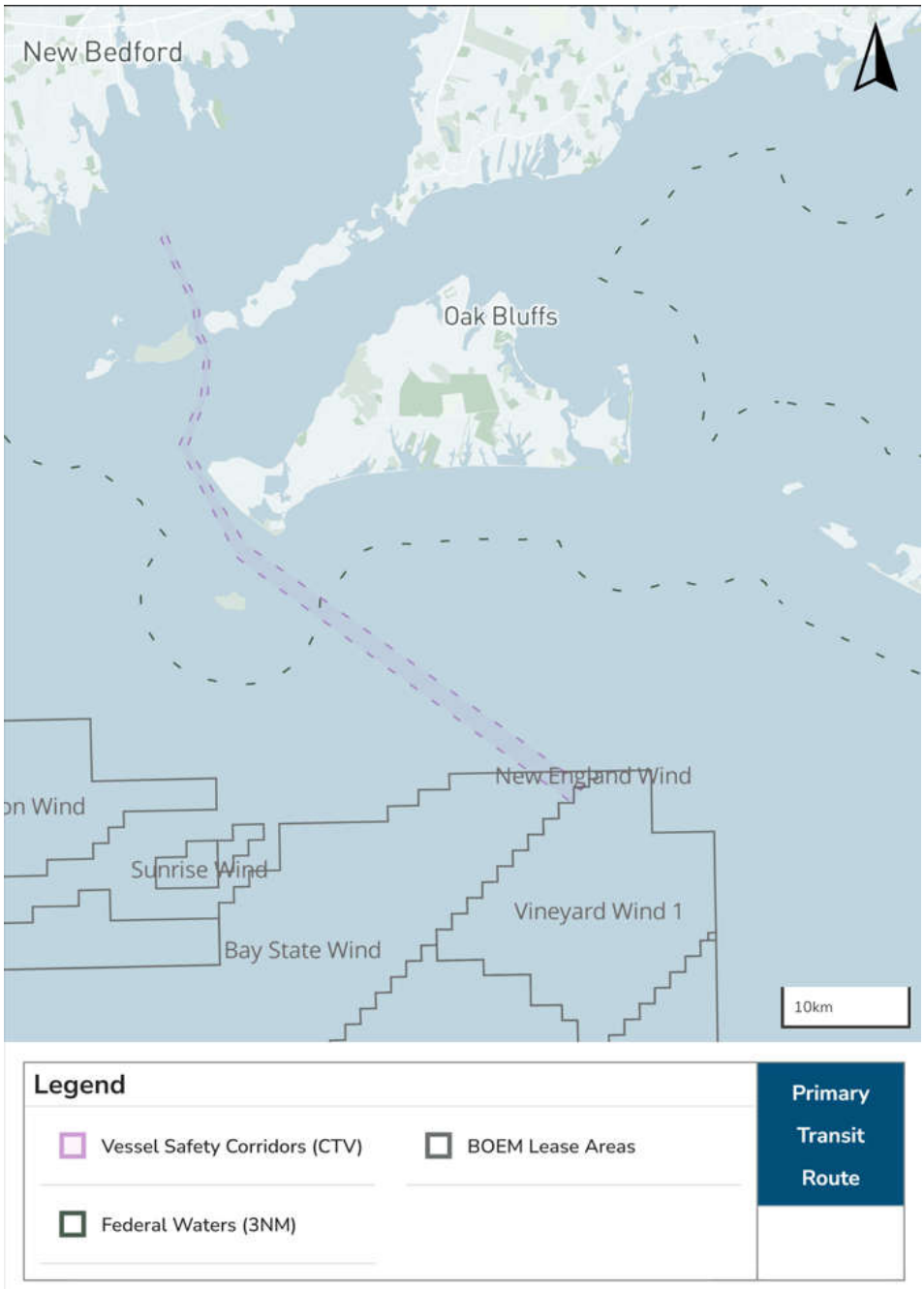


Figure 2. Primary Transit Route from New Bedford to the Vineyard Wind 1 Lease Area through Quicks Hole and north of Nomans Land

VW1 provides all contractors, vessel operators, and crew members with project-specific Site Induction Training, which includes, but is not limited to, protected species detection and identification, Federal regulations, communication protocols, reporting and recordkeeping, and vessel strike avoidance best practices. The training prepares participants to serve as Visual Observers (VO) or Trained Lookouts (TL) by including species-specific identification tips, typical marine mammal behavior, and a review of available NARW sighting resources. The training also includes the applicability and compliance requirements regarding the issuance of Dynamic Management Areas (DMAs), right whale Slow Zones, and Seasonal Management Areas (SMAs). [redacted]

[redacted]

In addition to the vessel strike avoidance measures listed below, adherence to all vessel speed and strike avoidance measures for other protected species will be monitored and audited throughout the Project. As needed, vessel operators and crew will undergo refresher training. Automatic Identification System (AIS) data will be reviewed regularly by Compliance Managers to assure adherence with the relevant speed restrictions. Also, VO Logs will be collected from all project vessels and reviewed regularly for conformance with strike avoidance protocols. Refresher training is provided when the potential, anticipated hazards change, such as a change in season resulting in an increase in certain species abundance within the project area (i.e. sea turtle season, NARW season), or when daily review of the observer data indicates there is a need for additional training, or when a compliance risk is discovered. Refresher training is also provided annually for certain portions of the training such as the Bureau of Safety and Environmental Enforcement Marine Trash and Debris training. As well, refresher training will be provided if there is a change in applicable laws, regulations, and permits governing project activities.

This Plan outlines enhanced monitoring and mitigation responsibilities to reduce risk to NARWs within the VW1 project area, including all transit routes. VW1 also maintains a project-specific vessel strike avoidance procedure and best practices for all other protected species. The procedure is not included herein but is found in the Pile Driving Monitoring Plan (PDMP) and Environmental Management Plan.

2. NARW Strike Management Plan Monitoring and Mitigation Measures[1]

2.1 Visual Observer Protocol

All vessel operators and crew members are trained to maintain a vigilant watch for marine mammals and sea turtles so they are ready to rapidly implement the relevant vessel strike avoidance protocols. In addition, all project vessels transiting to and from the WDA and those traveling over 10 knots must have a trained VO onboard who is always on duty and monitoring for NARWs (IHA 4(I)(v)). The VO is responsible for monitoring the vessel strike avoidance zone around the vessel as prescribed in the COP T&C section 5.5.2. If a vessel is carrying a Protected Species Observer (PSO) for the purposes of maintaining watch for NARWs, a VO is not required; the VO may be a third-party observer or a trained crew member..

As described in Section 1, VO training is included in the VW1 Site Induction Training and is documented on a Site Induction Acknowledgement form or training log. All vessel operators and crew members will receive the Site Induction Training prior to the start of in-water construction activities conducted by the associated vessel (IHA 4(I)(v), COP T&C 5.5.2, BiOp 3.2.6). VW1 will provide this training.

General duties of the VO, specific to NARW strike avoidance, include:

- Monitoring the NARW vessel strike avoidance zone around the vessel during transit;
- Monitoring all NARW Monitoring Notification Systems;
- Reviewing the Atlantic Reference guide;
- Reviewing relevant communications protocol for reporting any dead, injured, or entangled protected species;
- Communicating any observations of marine mammals, including NARWs, to the Captain and Client Representative (CR) and advise required strike avoidance measures immediately;
- Following all reporting and recordkeeping procedures as described in the Project permits; and

[1] In accordance with the IHA, strike avoidance measures do not apply "in cases where compliance would create an imminent and serious threat to a person or vessel or to the extent that a vessel is restricted in its ability to maneuver and, because of that maneuverability restriction, cannot comply."

- Ensuring communications with the VW1 Marine Coordination Center (MCC) and CRs (if available) are maintained for any detections of NARWs and other protected species.

2.2 Monitoring NARW Notification Systems

Year-round, all vessels will monitor available NARW reporting systems (e.g., Early Warning System app, WhaleAlert app, WhaleMap app, Sighting Advisory System, Coast Guard VHF Channel 16, Mandatory Ship Reporting System, and NOAA fisheries 24-hour Stranding Hotline number; 866-755-6622) for the presence of NARWs (IHA 4(d), BiOp 3.2.6, COP T&C 5.5.7). The NARW reporting systems will be monitored at least daily and Channel 16 will be monitored throughout the day.

- https://www.nefsc.noaa.gov/psb/surveys/MapperiframeWithText.html
- https://www.fisheries.noaa.gov/national/endangered-species-conservation/reducing-ship-strikes-north-atlantic-right-whales
- https://whalemap.org/WhaleMap/
- https://www.whalealert.org/

Additionally, VW1's MCC will facilitate transparency and situational awareness amongst all project vessels to ensure that any reports of NARW occurrence are shared with the fleet in real-time, as feasible. Whenever multiple project vessels are operating, any visual observations of a NARW will be communicated [redacted]. The vessel captain or VW1 CR is responsible for contacting the MCC, so other project vessels are notified of the NARW detection as stated above (IHA 4(I)iii, COP T&C 5.5.3, BiOp 3.2.6).

2.3 Vessel Speed Restrictions

All vessels, regardless of vessel size or speed, operators and crews must maintain a vigilant watch for all marine mammals and slow down, stop their vessel, or alter the vessel's course, as appropriate to avoid striking a marine mammal (IHA 4(I)ii, COP T&C 5.5.8).

Year-round
Vessel speeds will immediately be reduced to 10 knots or less when:

- a NARW is sighted by the onboard PSO, VO/TL, or anyone on the vessel (IHA 4(I)iv, COP T&C 5.5.8); or
- an occurrence of a NARW is confirmed, via visual and/or a passive acoustic monitoring (PAM) detection, to be approaching or within the transit route. All crew transfer vessels in those areas must travel at 10 knots or less for the remainder of that day (IHA 4(I)xii(1). COP T&C 5.5.4); or
- mother/calf pairs, pods, or large assemblages of cetaceans are observed within 100m of an underway vessel (IHA 4(I)xiii, COP T&C 5.5.8).
- when the 500-meter vessel strike avoidance zone is not fully visible (e.g., visibility is obscured due to fog, rain, darkness). However, vessels employing PSOs may utilize the DOI and NMFS approved Alternative Montioring Plan, as specified in the DOI and NMFS approved Pile Driving Monitoring and Mitigation Plan, to maintain the 500-meter vessel strike avoidance zone during limited visibility and transit above 10 knots, unless otherwise stated below. Specifically, the FLIR fixed M364 cameras should be oriented to scan the forward 180 degrees in the direction of the vessels travel to ensure the forward path of the vessel is monitored.

From November 1 to May 14, all vessels, regardless of size, must travel at 10 knots or less when traveling within the WDA. From November 1 to May 14, all vessels transiting to or from the WDA must either travel at less than 10 knots or must implement visual surveys with at least one visual observer to monitor for NARWs, with an exception for vessels transiting within Nantucket Sound, unless a DMA is in place (COP T&C 5.5.4.1, IHA 4(I)vii).

Crew transfer vessels (CTVs) may travel faster than 10 knots throughout the year, except within any Seasonal Management Area (SMA), only when the following monitoring measures are implemented:

- there is always at least one VO on duty aboard the vessel to visually monitor for whales,

AND

- simultaneous real-time PAM, discussed in Section 2.4.3, is conducted prior to and during transits to confirm the absence of NARWs within or approaching the planned transit route.

If a NARW is detected via visual survey or PAM detection (75% confidence), all CTVs must reduce speed to 10 knots or less for the remainder of that day (COP T&C 5.5.4.2, IHA 4(l)viii, BiOP 3.2.6).

Seasonal Management Area
All vessels greater than or equal to 65 ft (19.8 m) in overall length must travel 10-knots or less in any active SMA per the NOAA ship strike reduction rule (73 FR 60173; October 10, 2008) (IHA 4(l)xi). All vessels must also be provided BSEE-approved material regarding NARW SMAs, sighting information and reporting (COP T&C 5.5.2). The NOAA ship strike reduction rule states that all vessels 65 feet or longer must travel at 10 knots or less in any active SMA.

Dynamic Management Area & Right Whale Slow Zone
All project vessels, regardless of length, must transit at 10 knots (18.5 kilometers per hour) or less within any DMA and Right Whale Slow Zone. However, when a DMA is established, this requirement may be waived for CTVs if:

1. The Department of the Interior (DOI) has concurred with this Plan; and
2. The PSO or VO/TL confirm NARWs are clear of both the transit route and WDA for two consecutive calendar days, as confirmed by:
    a. Lack of visual detection of a NARW by a vessel-based monitoring survey conducted during daylight hours (see section 2.4.2) and lack of acoustic detection of a NARW sound by simultaneous real-time PAM operating concurrently with a vessel-based visual monitoring survey (see section 2.4.3); or
    b. Lack of visual detection of a NARW during an aerial monitoring survey (see section 2.4.1) conducted once the lead aerial observer determines there is adequate visibility to conduct a complete monitoring survey (COP T&C 5.5.5, IHA 4(l)viii) and lack of acoustic detection of a NARW sound by simultaneous real-time PAM operating concurrently with the aerial survey (see section 2.4.1).

If the vessel transit route and WDA are confirmed to be clear of NARWs by one of these above protective measures, CTVs may transit within a DMA at speeds greater than 10 knots, provided the following conditions are followed:

1. At least two VO/TLs and/or PSOs are onboard actively monitoring for NARWs and simultaneous real-time PAM is operating concurrently during transit; and
2. If a NARW is visually observed or acoustically detected within or approaching the transit route, CTVs must operate at 10 knots or less until clearance of the transit route for two consecutive calendar days is confirmed by the procedures described above (COP T&C 5.5.5, IHA 4(l)ix).

In a Right Whale Slow Zone, CTVs traveling over 10 knots will use an additional observer or other enhanced detection methods (e.g., thermal cameras) to monitor for North Atlantic right whales (IHA 4(l)x).

All designated PSO, VO/TL, and crew will regularly confirm the vessel speed to ensure the 10 knot restrictions are met. Additionally, VW1 MCC will track and regularly audit all project vessel speeds via AIS data review. [redacted] his AIS data is submitted to BOEM annually as a portion of the compliance certification required under 30 C.F.R. § 585.633(b).

2.4 Transit Corridor Monitoring

The following methods will be employed as noted in Section 2.3 above to clear for high-speed CTV transits through the primary transit corridor (New Bedford harbor to the Vineyard Wind 1 Lease Area

via Quicks Hole and north of Nomans Land) above 10 knots. CTV transits along the alternative routes will not exceed 10 knots.

2.4.1 Aerial Overflight Monitoring Survey

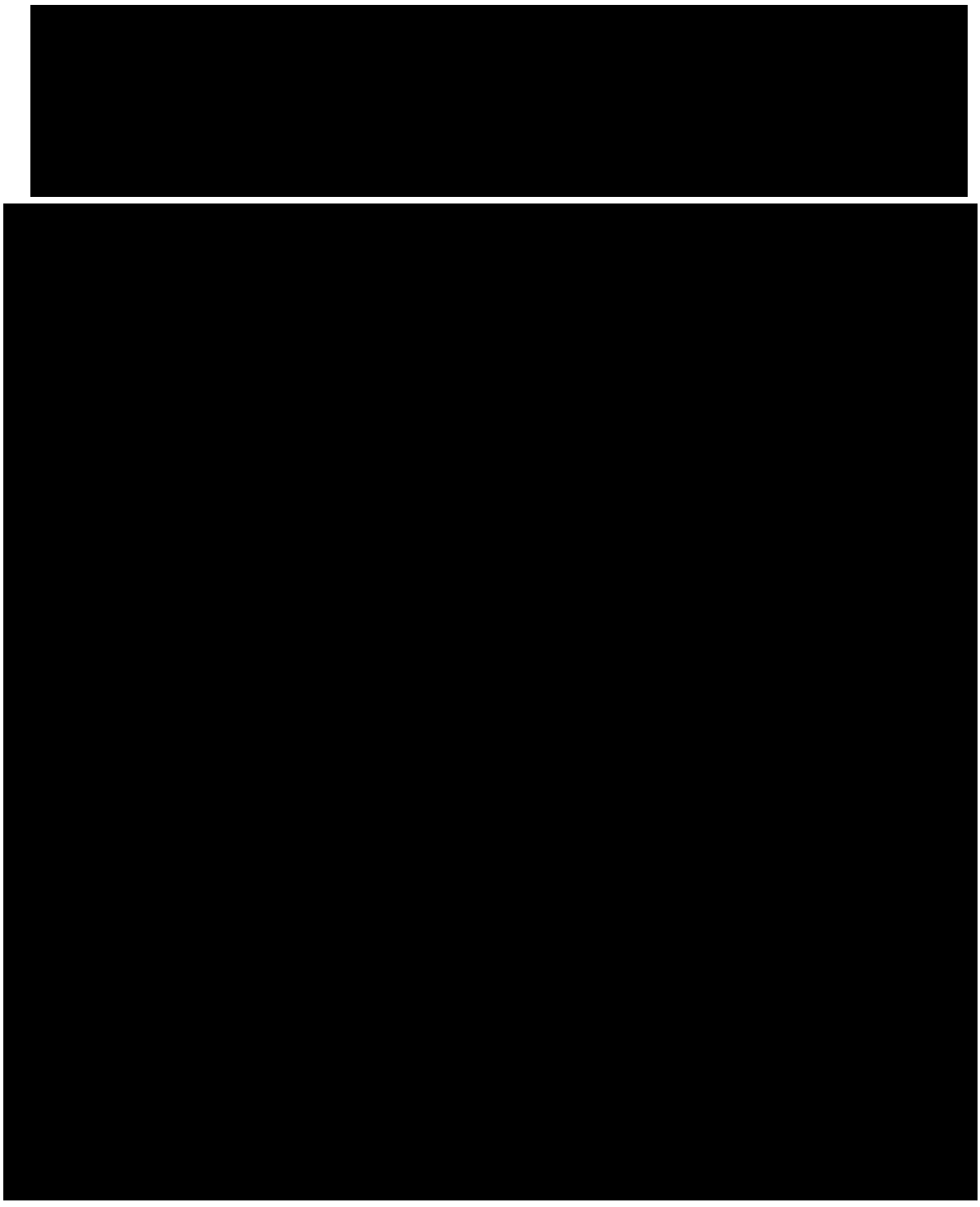
[redacted]

Figure 1 Cessna Skymaster. Photo credit Center for Coastal Studies.

[redacted]

Specifications:

- Primary transit route length: 75 km



2.4.2 Vessel-based Monitoring Survey

Vineyard Wind does not anticipate conducted vessel-based monitoring surveys to clear the transit route between New Bedford and the Wind Development Area.

2.4.3 Simultaneous Real-time PAM of Planned Transit Route

Before any visual monitoring effort begins (whether aerial or vessel-based, Section 2.4.1 and 2.4.2), continuous real-time PAM will be conducted throughout the 24 hour (48 hours if a DMA overlaps the primary transit route) day of a planned high-speed CTV transit to monitor for the possible occurrence

of a NARW vocalization within or around the primary transit corridor (New Bedford harbor to the Vineyard Wind 1 Lease Area via Quicks Hole and north of Nomans Land) . VW1 and/or its Contractors will procure the services of a regional real-time PAM network, which leverages fixed arrays, to monitor for NARW vocalization. In the unlikely event that the regional real-time PAM network (ThayerMahan) is not installed prior to the need for high-speed CTV transits, CTVs will transit at 10 knots or less. The backup methodology will be provided for review and concurrence by BOEM prior to its operation to clear transit routes for high-speed CTV transits.

[redacted]

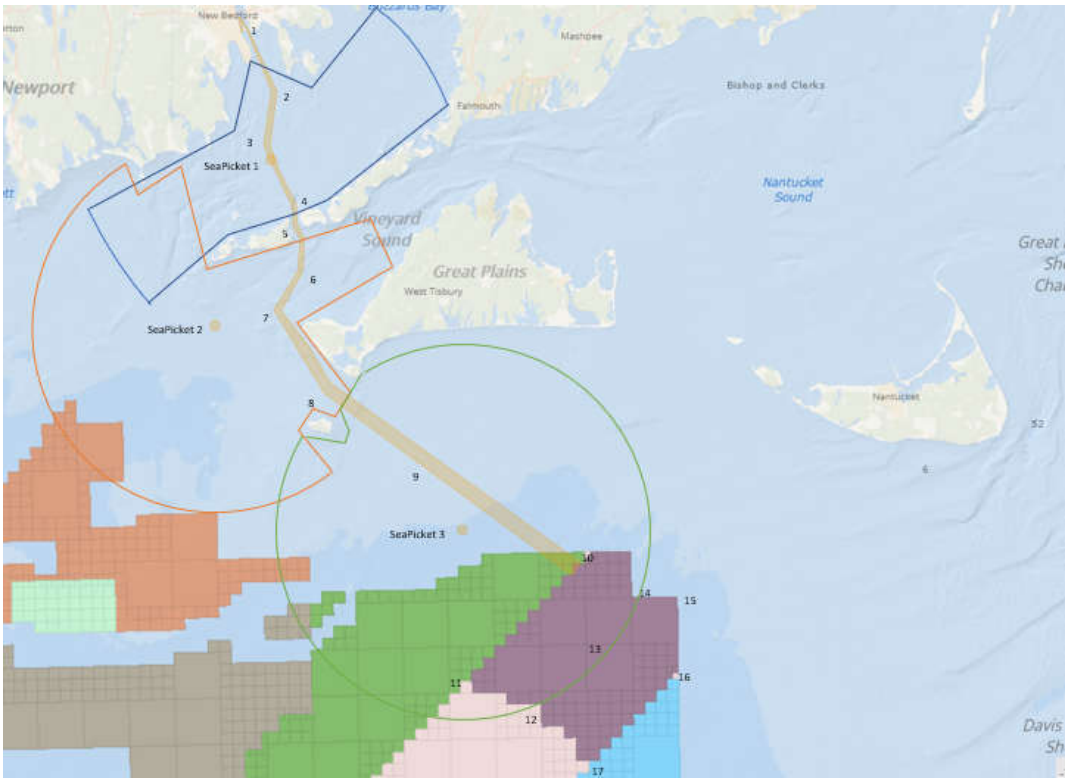


Figure 3. Deployment of three SeaPicket systems with notional detection rings monitoring the primary transit route and Wind Development Area

[redacted]

2.5 Vessel Communications

Whenever multiple project vessels are operating, any visual sighting/observation of an ESA-listed marine species (i.e., marine mammals and sea turtles) will be communicated to the MCC, which will then broadcast the sighting location and species identification to all project vessels, including PSOs, VOs, TLs and/or vessel Captains (IHA 4(I), COP T&Cs 5.5.3, BiOp 3.2.6).

[2] Van Parijs S. M., Baker K., Carduner J., Daly J., Davis G., et al. (2021). NOAA and BOEM Minimum Recommendations for Use of Passive Acoustic Listening Systems in Offshore Wind Energy Development Monitoring and Mitigation Programs. Frontiers in Marine Science, Vol., 8, doi: 10.3389/fmars.2021.760840. Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fmars.2021.760840/full.

Figure 2. Chain of Communication in the event of a NARW detection.

2.6 Vessel Strike Avoidance Separation Distances

VW1 will ensure all vessel operators and crews on vessels underway will:

- maintain a vigilant watch for all marine mammals and reduce vessel speed, stop the vessel, or alter the vessel's course, regardless of vessel size, to avoid striking any marine mammal except if taking such measures would threaten the safety of the vessel or crew (COP T&C 5.5.8, BiOp 3.2.6);
- maintain a minimum separation distance of 500 meters (m) [1640 ft] from a NARW. Trained PSO, VO or TL must notify the vessel captain of any NARW visually observed within the designated separation distance. If a large whale is sighted but its species cannot be confirmed as a NARW, the vessel operator must assume that it is a NARW and take appropriate action (IHA 4(I)xiv, COP T&C 5.5.8.1),
- if underway, steer a course away from any sighted NARW at 10 knots (18.5 km/hr.) or less ensuring the 500 m (1640 ft) minimum separation distance is not violated. If a NARW is sighted at or within 500 m (1640 ft) of an underway vessel, that vessel must shift the engine(s) to neutral and its engines must not be engage until the NARW has moved outside of the vessel's path and beyond 500 m (IHA 4(I)xv),
- not divert or alter course to approach any marine mammal. Any vessel underway will avoid excessive speed or abrupt changes in direction (IHA 4(I)xix)
- take action as necessary to avoid violating the relevant separation distances, (e.g., attempt to remain parallel to the animal's course, avoid excessive speed or abrupt changes in direction until the animal has left the area). If marine mammals are sighted within the relevant separation distance, the vessel must reduce speed and shift the engine to neutral, not engaging the engines until animals are clear of the area. It should be noted, this requirement does not apply

when taking such a measure would threaten the safety of the vessel or crew (e.g., a vessel towing gear, any vessel that is navigationally constrained) (IHA 4(I)xviii, COP T&C 5.5.8).

2.7 NARW Sighting Reporting

NARW sighting reporting is required for every project vessel during any project-related activity. As described above, any confirmed visual sighting or acoustic detection of a NARW will be reported immediately by the PSO/VO/TL or vessel personnel to the onboard CR and Contractor's HSE Manager, i.e. DOUS (DEME) Project QHSE Manager, if applicable. The CR will notify the MCC and Contractor's HSE Manager who will then notify VW 1 (IHA 6(a)). The report will include time of sighting, location, and number of animals (IHA 6(a), COP T&C 5.5.7).

Any visual sighting of a NARW will be reported immediately using the designated form, Appendix 1. The report will immediately be sent to the Contractor's HSE Manager who will then report to the VW1 Compliance Manager. The PSO/VO/TL will attempt to photograph and document all relevant information associated with the NARW sighting. The vessel Captain will then notify the USCG on channel 16 to report the detection as soon as feasible, but no longer than 24 hours after the sighting (COP T&C 5.5.7, IHA 6(a), BiOp 16a).

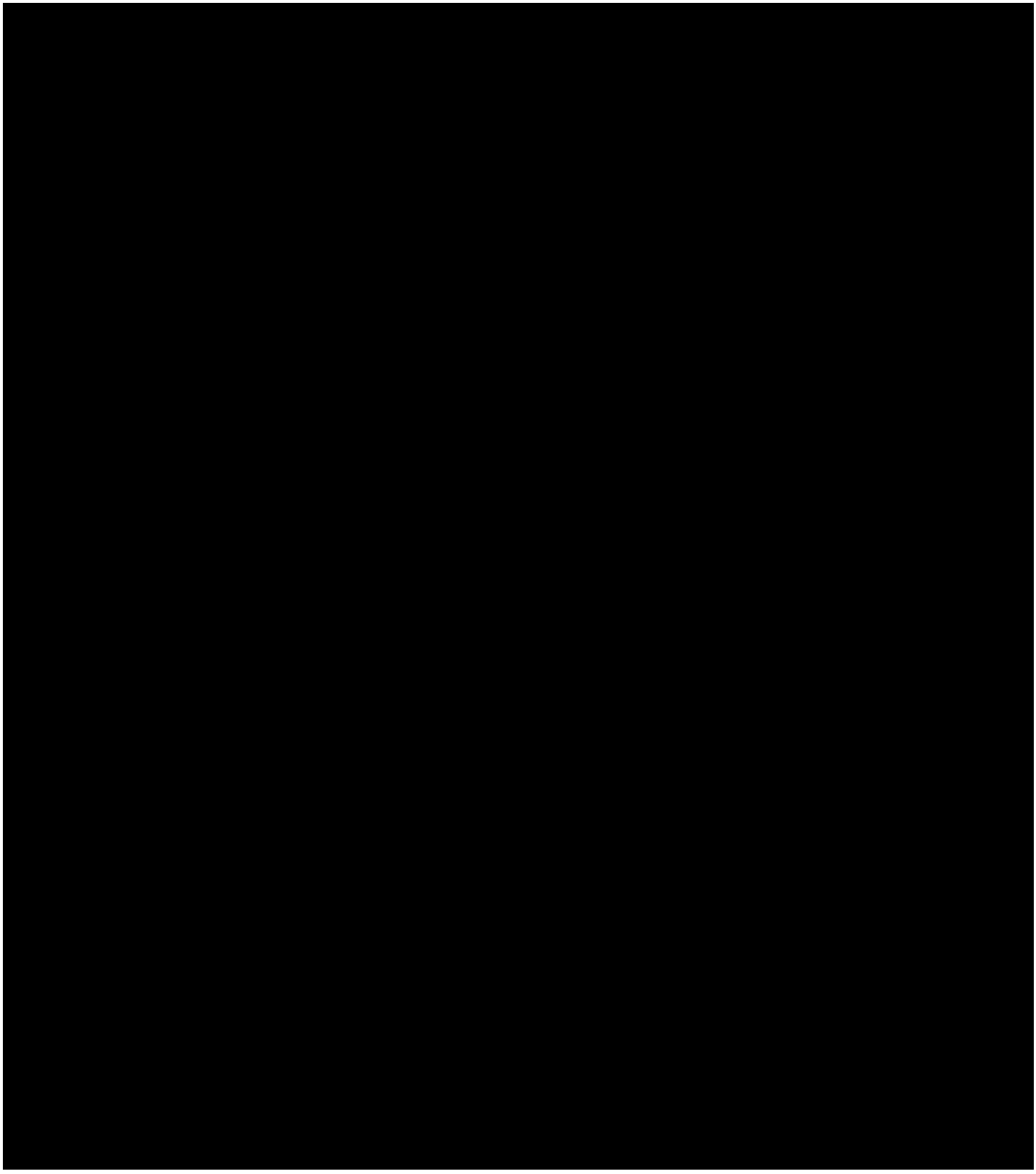
Any visual sighting of a NARW by VW1 personnel or by personnel contracted by VW1 (including vessel crews and construction personnel) will be reported immediately to the LPSO, VO or TL (IHA 4(f)ix). VW1 will also report NARW sightings to BOEM and to NMFS North Atlantic right whale Sighting Advisory System: (866) 755-6622, and WhaleAlert - as soon as feasible, but no longer than 24 hours after the sighting was reported (COP T&C 5.5.7, IHA 6(a), BiOp 11.3.16b).

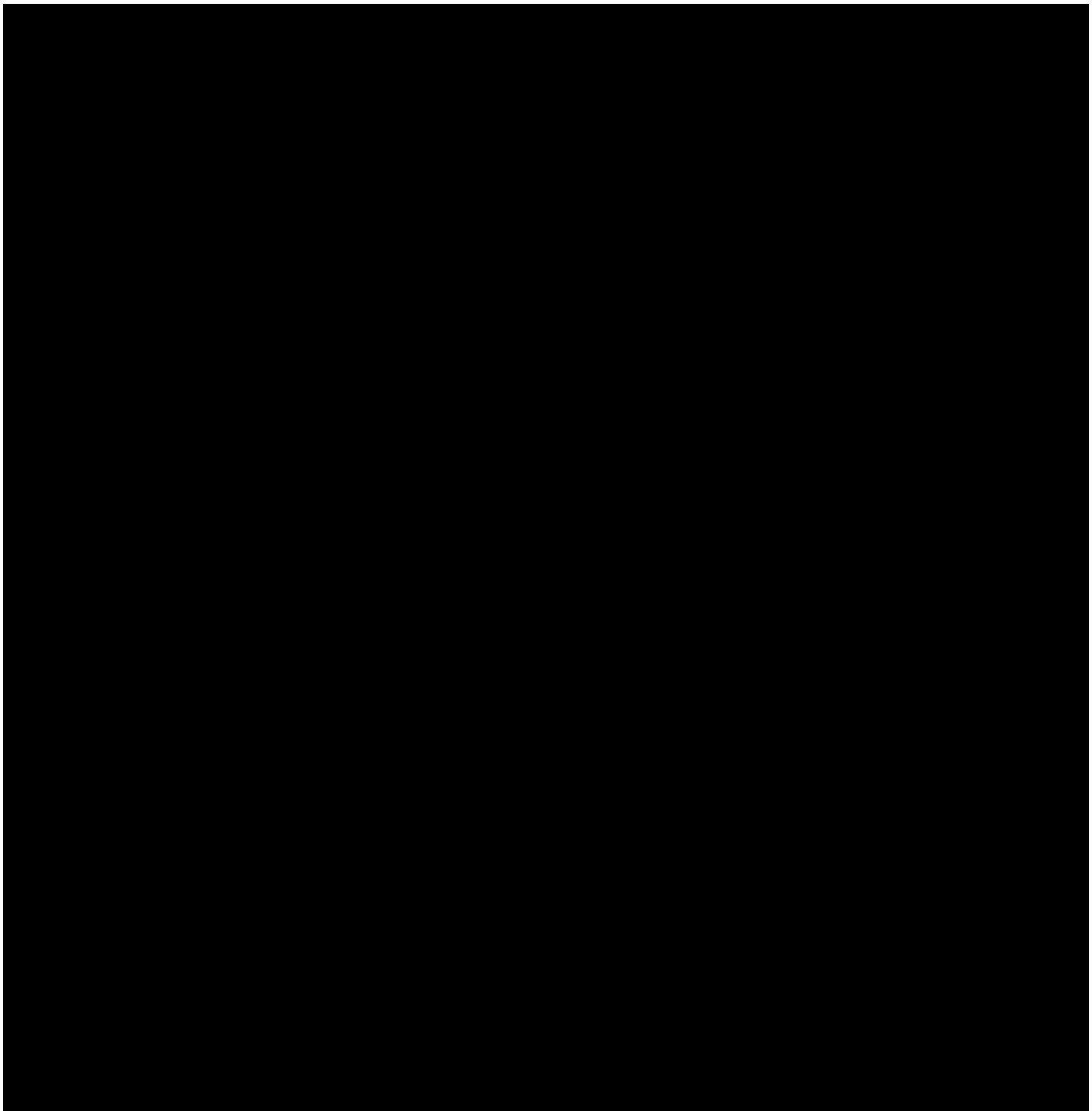
Acoustic detections of a NARW will be reported immediately by VW1 to BOEM via renewable_reporting@boem.gov), , and WhaleAlert (http://www.whalealert.org/). As soon as feasible, but no longer than 24-hours after the detection, VW1 will report the detection to nmfs.pacmdata@noaa.gov. Within 48-hours, VW1 will report the detection to the NMFS North Atlantic right whale Passive Acoustic Reporting System website (www.fisheries.noaa.gov/new-england-mid-atlantic/endangered-species-conservation/passive-acoustic-research-atlantic-ocean).

Appendix 1 NARW Sighting Report

***Notify the Vineyard Wind Marine Coordination Center at (888) 516–5926, extension #5, immediately. Submit form to Vineyard Wind immediately.**

PROTECTED SPECIES DETAILS





Appendix 2 Crew Transfer Vessel Speed Requirements Guide

Crew Transfer Vessel
Vessel Speed Restrictions

<table>
<tr><th colspan="2">COP & BiOp Effective
(Prior to May 1, 2023 and after April 30, 2024)</th><th colspan="2">IHA effective
(May 1, 2023 to April 30, 2024)</th></tr>
<tr><td colspan="4">Spatial Speed Restrictions</td></tr>
<tr><td colspan="4">Seasonal Management Areas</td></tr>
<tr><td colspan="4">All vessels greater than or equal to 65 ft (19.8 m) in overall length must travel 10 knots or less [1]</td></tr>
<tr><td colspan="4">Dynamic Management Areas</td></tr>
<tr><td colspan="2">10 knots or less within any DMA unless NARW Strike Management Plan is approved by DOI and a lead PSO confirms NARWs are clear of the transit route and WDA for two consecutive days, as confirmed by the lack of detections of NARW vocalizations by PAM and by vessel-based surveys conducted during daylight hours or by aerial survey conducted in accordance with the NARW Strike Management Plan once lead aerial observer determines adequate visibility to complete the survey

If transit route is confirmed clear of NARW by methods listed above, CTVs may transit within a DMA over 10 knots if they have at least two TLs and/or PSOs on duty to monitor for NARWs

If a NARW is observed within or approaching the transit route, CTVs must operate at 10 knots or less until clearance of the transit route for two consecutive days is confirmed by the procedures listed above [2]</td><td colspan="2">10 knots or less within any DMA unless NARW Strike Management Plan is approved by DOI and NARWs are clear of the transit route and WDA for two consecutive days, as confirmed by vessel-based surveys conducted during daylight hours and real-time PAM of the transit corridors, or, by an aerial survey if the lead aerial observer determines adequate visibility

If transit route is confirmed clear of NARW in accordance with the NARW Strike Management Plan, CTVs may transit within a DMA over 10 knots if they have at least two visual observers on duty to monitor for NARWs

If a NARW is observed within or approaching the transit route, CTVs must operate less than 10 knots until clearance of the transit route for two consecutive days is confirmed by the procedures listed above [5]</td></tr>
<tr><td colspan="4">North Atlantic Right Whale Slow Zones</td></tr>
<tr><td colspan="2">10 knots or less [2]</td><td colspan="2">10 knots or less unless an additional observer (at least two visual observers) is employed or other enhanced detection methods are used to monitor for NARW in addition to PAM in the transit corridor [6]</td></tr>
<tr><td colspan="4">Time of Year Speed Restrictions</td></tr>
<tr><td>May 15 - October 31</td><td>November 1 - May 14</td><td>May 15 - October 31</td><td>November 1 - May 14</td></tr>
<tr><td rowspan="3">Use one visual observer during transit or travel 10 knots or less [4]

(except when traveling within an active DMA, SZ or SMA)</td><td rowspan="3">Use one visual observer and conduct simultaneous real-time PAM during transit or travel 10 knots or less

If a NARW is detected via visual observation or PAM within or approaching the transit route, CTVs must travel at 10 knots or less for the remainder of that day [3]

(except when traveling within an active DMA, SZ or SMA)</td><td colspan="2">Transiting outside of the Wind Development Area</td></tr>
<tr><td colspan="2">Use one visual observer and conduct simultaneous real-time PAM prior to and during transit or travel 10 knots or less

If a NARW is detected via visual observation or PAM within or approaching the transit route, CTVs must operate at 10 knots or less for the remainder of that day [7]

(except when traveling within an active DMA, SZ or SMA)</td></tr>
<tr><td colspan="2">Transiting within the Wind Development Area</td></tr>
<tr><td>Use one visual observer and conduct simultaneous real-time PAM prior to and during transit or travel 10 knots or less

If a NARW is detected via visual observation or PAM within or approaching the transit route, CTV must operate at 10 knots or less for the remainder of that day [7]

(except when traveling within an active DMA, SZ or SMA)</td><td>Less than 10 knots [8]</td></tr>
<tr><td colspan="4">Note: All vessels traveling at any speed are required to have a trained lookout for sea turtles if a VO/PSO is not in use from June 1 - November 30</td></tr>
</table>

CTV = Crew Transfer Vessel; DMA = Dynamic Management Area; NARW = North Atlantic right whale; SZ = NARW Slow Zone; SMA = Seasonal Management Area; WDA = Wind Development Area; VO = Visual Observer; PSO = Protected Species Observer; TL = Trained Lookout; PAM = Passive Acoustic Monitoring

[1] BOEM – COP Approval Terms and Conditions, Condition 5.5.6; NMFS – BiOp, Section 3.2.6; NMFS – Construction IHA, Measure 4.l.xi

[2] BOEM – COP Approval Terms and Conditions, Condition 5.5.5; NMFS – BiOp, Section 3.2.6

[3] BOEM – COP Approval Terms and Conditions, Condition 5.5.4.2; NMFS – BiOp, Section 3.2.6

[4] BOEM – COP Approval Terms and Conditions, Condition 5.5.2; NMFS – BiOp, Section 3.2.6

[5] NMFS – Construction IHA, Measure 4.l.ix [6]

NMFS – Construction IHA, Measure 4.l.x [7]

NMFS – Construction IHA, Measure 4.l.xii [8]

NMFS – Construction IHA, Measure 4.l.vi

Appendix D List of Protected Species Reference Guides

- Guide to Marine Mammals & Turtles of the U.S. Atlantic & Gulf of Mexico— Alaska Sea Grant, University of Alaska Fairbanks; First edition
- Guide to Marine Mammals of the World—National Audubon Society, Knopf; 1st edition
- Whales, dolphins, and Other Marine Mammals of the World—Princeton Field Guide, Princeton University Press
- Whales, Dolphins, and Seals: A field Guide to the Marine Mammals of the World – Brett Jarrett & Hadoram Shirihai, A & C Black Publishers Ltd; 1st edition

Appendix E Visual Monitoring Schedules

E2. Seasonal (summer and winter) PSO monitoring schedules describing pile driving during DMA with additional monitoring conditions, for five PSO

DECEMBER

E3. PSO monitoring schedules demonstrating staffing required to cover 24-hour operations

Appendix F Night Vision Devices and Infra-Red Equipment Specifications

Night Monitoring Equipment Specifications

Night monitoring watches were conducted with infrared LED handheld spotlights and night vision goggles with head mounts and thermal clip-ons. Regular night vision binoculars work by enhancing the disponible light to allow a brighter image with the use of phosphor screen. The PVS-7D night vision goggles (Figure 1) withstand water immersion and runs on two AA batteries for more than 40 hours. Also provided were three pairs of batteries and a batteries charger with the equipment.

Figure 1: Night vision goggles with thermal clip.

The thermal clip on the night vision binocular enabled the capture of infrared light, which provided thermal imaging. The handheld forward-looking infrared (FLIR) system may also be provided (Figure 2). This allows a bit more flexibility with the IR detached from the headpiece.

Figure 2: Handheld thermal FLIR

Night Monitoring Equipment Specifications

Night Vision Goggle Technical Specifications

- Generation: 3 U.S.
- Resolution: 64 lp/mm (Min)
- Film: Thin-fimed
- Magnification: 1x
- Field of View: 40°
- Objective Lens: 25mm f/1.2
- Eyepiece Lens EFL: 26 mm
- Diopter Adjustment: +2 to -6
- Interpupillary Adjustment: 55 to 71 mm
- Range of Focus: 20cm to infinity
- Battery Type: Two (2) AA batteries
- Weight w/batteries: 24 oz / 680 grams
- Dimensions: 6 3/8"(L) x 6"(W) x 3"(H)
- Operating Temperature: -51°C to +52° C
- Weather Resistant: Yes
- IR Illuminator: Yes (built in)

Thermal Acquisition Clip-On Technical Specifications

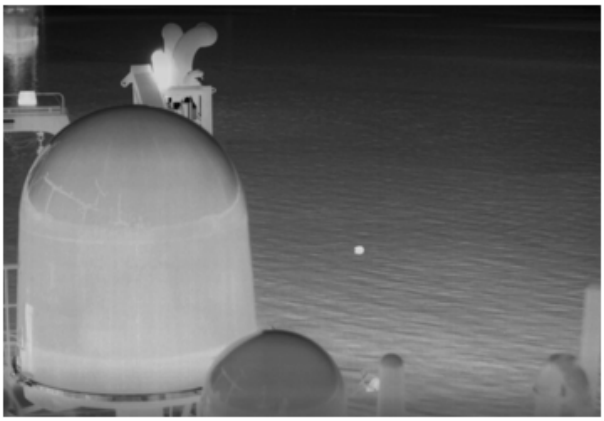
- Field of View: 20° circular (centered)
- Magnification: 1X, optical unity
- Sensor: 320 x 240 Vox uncooled LWIR microbolometer
- Display Brightness: Adjustable
- Polarity: White hot/black hot
- Calibration: Manual
- Range: Detection – 300m, Recognition – 260m
- Compatibility: PVS-7
- Interface: Standard quick connect
- Battery Type: CR123, 3V lithium
- Battery Life: >3.0 hours (23°C), 2.5 hours (0°C)
- Dimensions: 38 x 64 x 89 mm (W x H x L)
- Weight: 166g with battery

Forward–looking Infrared (FLIR) Monocular Technical Specifications

- Dimensions: 5.5"(L) x 2.7"(W) x 1.9"(H)
- Weight: 0.46 pounds
- Detector Type: 320 x 256 V0x Microbolometer
- FOV: 24° x 19° (NTSC)
- Refresh Rate: 60 Hz
- Video Output: Digital Video
- Optical Magnification: 1x
- Display: Quad-VGA (1280 x 960) FLCOS
- Battery Type: One CR123A 3V Lithium Battery
- USB Power: 5 VDC

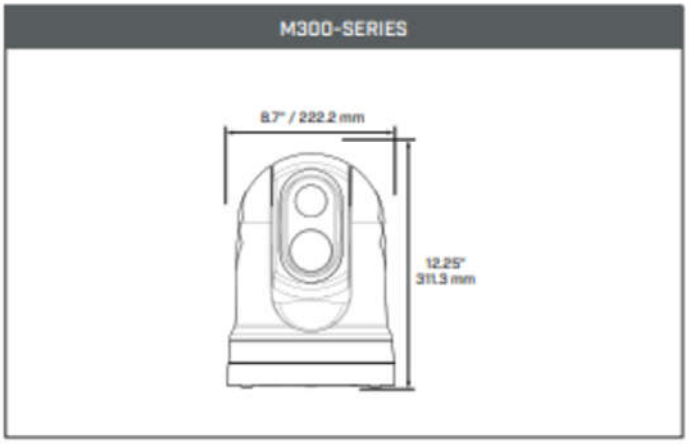
Forward-looking Infrared (FLIR) M300 Series Fixed Camera

Two fixed FLIR thermal cameras will be utilized in addition to the handheld alternative monitoring equipment. The cameras will be mounted on pedestals on the starboard and port bridge wings of the Orion, where watch camera has a 360-degree field of view.



1 M300 SERIES GENERAL SPECIFICATIONS

General M300 Series Camera Specifications as listed on the manufacture specifications sheet.



Every M300 Camera System includes:

- Camera unit
- Camera base-seal
- Camera gasket
- RayNet-to-RJ45 adaptor cable 120 mm (4.72 in)
- Right-angled RayNet-to-RayNet cable 3 m (9.8 ft)
- Right-angled BNC-to-BNC cable 3 m (9.8 ft)
- Right-angled 3-pin power cable 3 m (9.8 ft)
- Mounting riser
- 3 x camera fixings: nuts, dome nuts, spring and flat washers, threaded studs
- 2 x self-adhesive decals (for ball-down mounting only)
- Documentation pack

2 M364 CAMERA SPECIFICATIONS

RPS owns the M364 Camera from the M300 series. Below are the manufacture specifications for the specific model of camera.

2.1 Main Thermal Camera

- Video Refresh Rate: 30 Hz of <9 Hz
- Field of View: 24° x 18°
- Focal Length: 18 mm
- Focus: Fixed 12 ft (3m) to infinity
- E-Zoom: 8x Continuous
- Image Processing: FLIR Proprietary Digital Detail Enhancement
- Detector Type: 640 x 512 V0x Microbolometer

2.2 System Specifications

- Gyro Stabilized: Yes
- ClearCruise Analytics: Yes
- Color Thermal Vision (CTV): No
- Multispectral Imaging (MSX): No
- Video Tracking: No
- Firefighter Mode: No
- Pan / Tilt Adjustment Range: 360° Continuous Pan, +/- 90° Tilt
- Analog Video Output: NTSC / PAL User Settable
- Analog Video Connector Types: BNC
- Network Video Output: Single H.264 Network Video Stream
- HD-SDI Lossless Video Output: Yes
- Power Requirements: 12 to 24vDC (24vDC Recommended)
- Power Consumption: 41 W typical, 56 W typical (with heaters on.) Note: FLIR recommends using a 75 W power supply

2.3 Environmental

- Operating Temperature Range: -13°F to +131°F (-25°C to +55°C)
- Storage Temperature Range: -30°F to +158°F (-30°C to +70°C)
- Automatic Window Defrost: Standard at Power-Up
- Sand / Dust Ingress: Mil-Std-810E or IP6X
- Water Ingress: IPX6 (heavy seas, power jets of water)
- Shock: 15g vertical, 9g horizontal
- Vibration: IEC60945
- Lightning Protection: Standard
- Salt Mist: IEC60945
- Wind: 100 knots (115.2 mph)
- EMI: IEC 60945

2.4 Physical

- Weight: 6.3 kg (13.9 lb) without mounting riser; 6.75 kg (14.9 lb) with mounting riser
- Size: Camera: Base diameter: 222.2 mm (8.7 in) Height: 328.3 mm (12.9 in). Camera attached to mounting riser: Base diameter (with seal): 254.0 mm (10.0 in) Height: 365.5 mm (14.4 in)

2.5 Range Performance

- Clear Weather Range Performance Distance in meters and nautical miles
  - Detect a 30-foot Vessel: 3150.0 m; 1.7 nm
  - NATO Target 2.3m x 2.3m @50%: 1691.0 m; 0.9 nm
  - Detect Human Sized Target: 926.0 m; 0.5 nm

	M364
MAIN THERMAL CAMERA	
Video Refresh Rate	
Field of View	24 ° x 18 °
Focal Length	18 mm
Focus	Fixed 12 ft (3m) to infinity
Optical Zoom	N/A
E-Zoom	8x Continuous
Image Processing	FLIR Proprietary Digital Detail Enhancement
Detector Type	640 x 512 VOx Microbolometer
MAIN VISIBLE CAMERA	
Detector Type	N/A
Resolution	N/A
Minimum Illumination	N/A
Zoom	N/A
E-Zoom	N/A
Focal Length	N/A
Field of View	N/A

ENVIRONMENTAL	
Operating Temperature Range	-13°F to +131°F (-25°C to +55°C)
Storage Temperature Range	-30°F to +158°F (-30°C to +70°C)
Automatic Window Defrost	Standard at Power-Up
Sand/Dust Ingress	Mil-Std-810E or IP6X
Water Ingress	IPX6 (heavy seas, power jets of water)
Shock	15g vertical, 9g horizontal
Vibration	IEC60945
Lightning Protection	Standard
Salt Mist	IEC60945
Wind	100 knots (115.2 MPH)
EMI	IEC60945

PHYSICAL	
Weight	6.3 kg (13.9 lb) without mounting riser; 6.75 kg (14.9 lb) with mounting riser.
Size	Camera: Base diameter: 222.2 mm (8.7 in.) Height: 328.3 mm (12.9 in.) Camera attached to mounting riser: Base diameter (with seal): 254.0 mm (10.0 in.) Height: 365.5 mm (14.4 in.)

RANGE PERFORMANCE		
Clear Weather Range Performance	**metres**	**nm**
Detect a 30-foot vessel	3150.0	1.7
NATO Target 2.3m x 2.3m @50%	1691.0	0.9
Detect Human Sized Target	926.0	0.5

Appendix G Monopile Installation Overview and Sequence

Foundation installation and construction is expected to begin on or around May 10, 2023 and end on or around November 30, 2023.

Appendix H Weather Assessment Method Statement

Appendix I Protected Species Observer and Passive Acoustic Monitoring Species Detection Data Form

Appendix I.1 Project Information

Project Information

Project Name	Lease Number	State Coastal Zones	Contractor	PSO Contractor(s)	PAM Contractor(s)	Vessel Name	Reporting Start Date (YYYY-MM-DD)	Reporting End Date (YYYY-MM-DD)	Visual Monitoring Equipment Used (e.g., binoculars, magnification, IR cameras, etc.)	Distance Finding Method Used	PSO/PAM Information						Observation Height Above Sea Surface (m)
											PSO/PAM Names (Last, First)	Position (e.g., Lead PSO, PAM, etc.)	PSO Training (Type)	PSO Training (Date; YYYY-MM-DD)	PAM Training, if Applicable (Date; YYYY-MM-DD)	PSO/PAM Affiliation	

Appendix I Protected Species Observer and Passive Acoustic Monitoring Species Detection Data Form

Appendix I.2 PSO Effort

PSO Effort

New effort line and enviornmental data must be entered each time a pile segment changes or weather conditions change, or at the START AND END of each survey line, at any PSO shift change, and at leaset once an hour as a minimum

Date (YYYY-MM-DD)	**Vessel Name**	**Vessel Type** (Pile Driving Vessel, PSO Support Vessel, PSO Support Aerial)	**Visual, PAM or Both** (RPS Please note that the data will need to be reconciled once received from JASCO to fill in the "both")	**Observer's Name(s)** (Last, First; If Lead PSO or PAM, designate with an *)	**Number of PSOs on Watch**	**PSO Affiliation**	**Start of Watch** (UTC; HH:MM)	**End of Watch** (UTC; HH:MM) [UTC midnight, enter 00:00]	**Did the watch occur during the daylight or night-time?** (Daylight / Night-time)	**Duration of Visual Observations** (HH:MM)	**Survey Start Position** (Decimal Degrees)		**Survey End Position** (Decimal Degrees)		**Water Depth** (Meters)	**Wind**		**Sea Conditions**		**Visibility** (≤0.49, 0.5-0.99, 1-1.99, 2-4.99, 5-9.99, ≥10 Kilometers)	**Precipitation** ([Light, Medium, Heavy] Rain, Fog, Snow, Sleet; None)	**Glare Strength** (None, Slight, Moderate, Severe)	**Cloud Cover** (Percent)	**Vessel Info**				**Did a shutdown occur?** (Yes/No)	**Time Shutdown Called For** (UTC; HH:MM) If no shutdown please leave blank	**Time Equipment was Shutdown** (UTC; HH:MM) If no shutdown please leave blank	**Habitat or Prey Observations** (Decimal Degrees)			**Marine Debris** (Decimal Degrees)			**Vantage Point allows for 360-degree visual coverage around vessel?** (Yes/No, provide photo)
											Latitude	**Longitude**	**Latitude**	**Longitude**		**Speed** (Knots)	**Direction** (Degrees)	**Swell Height** (<2, 2-4, >4 Meters)	**Beaufort**					**Speed** (Knots)	**Heading** (Degrees)	**Vessel activity** (Transit, Neautral, Soft-start, Piling, Piling (Mitigation Energy), Deploying/Retrieving)	**Noise Source** (ON=Hammer On; OFF = Hammer Off)				**Habitat or Prey Type**	**Latitude**	**Longitude**	**Marine Debris Observed**	**Latitude**	**Longitude**	
										24:00																										

Appendix I Protected Species Observer and Passive Acoustic Monitoring Species Detection Data Form

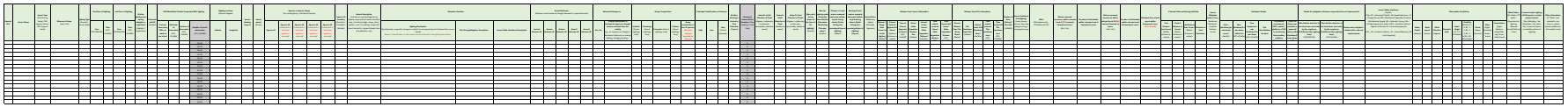
Appendix I.3 Operations

Operations

Date (YYYY-MM-DD)	**Hammer Type Used** (Make and Model)	**Greatest Hammer Power Used for Each Pile** (kj)	**Pile Identifier and Pile Number for Day** (i.e., AL 39)	**Pile Diameter** (Meters)	**Pile Length** (Meters)	**Pile Location** (Latitude, Decimal Degrees)	**Pile Location** (Longitude, Decimal Degrees)	**Time Pre-clearance visual monitoring began** (UTC; HH:MM)	**Time Pre-clearance visual monitoring ended** (UTC; HH:MM)	**Time Pre-clearance PAM monitoring began** (UTC; HH:MM)	**Time Pre-clearance PAM monitoring ended** (UTC; HH:MM)	**Duration of pre-clearance visual monitoring** (HH:MM)	**Duration of pre-clearance PAM monitoring** (HH:MM)	**Time power-up/ramp-up began** (UTC; HH:MM)	**Time equipment full power was reached** (UTC; HH:MM)	**Duration of power-up/ramp-up** (HH:MM)	**Time pile driving began (Hammer on, per pile)** (UTC; HH:MM) Should not include soft start time	**Time pile driving ended (Hammer off, per pile)** (UTC; HH:MM)	**Did pile driving end on the same UTC day?** (Yes/No)	**Duration of Pile Driving** (Per pile, not including soft start, HH:MM)	**Duration of Activity** (Per pile; HH:MM)	**Notes** (e.g. soft start aborted, pile driving continues to next UTC day etc.)

Appendix I Protected Species Observer and Passive Acoustic Monitoring Species Detection Data Form

Appendix I.4 Visual Sightings



Appendix I Protected Species Observer and Passive Acoustic Monitoring Species Detection Data Form

Appendix I.5 Acoustic Detections

Precipitation (Light, Medium, Heavy) Rain; Fog; Snow; Sleet; None)	**Watch Status:** (On Watch, Off watch - Opportunistic Sighting, Alternate Vessel/Platform/ Crew)	**Communicated sighting of ESA species to other project vessels** (Yes; WhatsApp, Yes; Mysticetus, Yes; radio, No; Communications unavailable at time of sighting)	**Other Information** (If "Other" was selected in any column, please provide additional information here)
Sleet	On Watch	Yes; Mysticetus	

Appendix I Protected Species Observer and Passive Acoustic Monitoring Species Detection Data Form

Appendix I.6 NMFS Passive Acoustic Reporting System

PACM_TEMPLATE_DETECTIONDATA

UNIQUE_ID	ANALYSIS_PERIOD_START_DATETIME	ANALYSIS_PERIOD_END_DATETIME	ANALYSIS_PERIOD_EFFORT_SECONDS	ANALYSIS_TIME_ZONE	SPECIES_CODE	ACOUSTIC_PRESENCE	N_VALIDATED_DETECTIONS	CALL_TYPE_CODE	DETECTION_METHOD	PROTOCOL_REFERENCE	DETECTION_SOFTWARE_NAME	DETECTION_SOFTWARE_VERSION	MIN_ANALYSIS_FREQUENCY_RANGE_HZ	MAX_ANALYSIS_FREQUENCY_RANGE_HZ	ANALYSIS_SAMPLING_RATE_HZ	QC_PROCESSING	LOCALIZED_LATITUDE	LOCALIZED_LONGITUDE	DETECTION_DISTANCE_M	LOCALIZATION_DISTANCE_METHOD	LOCALIZATION_DISTANCE_PROTOCOL

Detection_Data_Template

PACM_TEMPLATE_DETECTIONDATA

In order for the data to be read correctly in our database, please do not use any commas (",") in any fields. If there is a need for multiple values (cases explained in field definitions), use a semicolon (";"). If a comma is necessary, enclose the entire field entry in quotations ("example entry").

COLUMN_NAME	DEFINITION	ENTRY OPTIONS	EXAMPLE
UNIQUE_ID*	A unique ID for the recorder on	Text string	NEFSC_SBNMS_200601_CH3_3
ANALYSIS_PERIOD_START_DATETIME	Start date time of validated dat	DATETIME in ISO8601 format (YYYY-MM-	2021-01-01T00:00:00-05:00
ANALYSIS_PERIOD_END_DATETIME	End date time of validated data	DATETIME in ISO8601 format (YYYY-MM-	2021-01-02T00:00:00-05:00
ANALYSIS_PERIOD_EFFORT_SECONDS	The amount of time, in seconds	Numeric	86400
ANALYSIS_TIME_ZONE	The time-zone that the analysis	Text string	UTC-5
SPECIES_CODE*	The species for which analysis w	see SPECIES_CODE field on Species_Code	RIWH
ACOUSTIC_PRESENCE	Whether the species was detec	"D"; "P"; "N"; "M"	D
N_VALIDATED_DETECTIONS	The number of detections valid	Numeric or NA	1
CALL_TYPE_CODE*	The call type used for the analy	see CALL_TYPE_CODE field on Call_Type_	UPCALL
DETECTION_METHOD*	How the data was reviewed for	Text string	LFDCS
PROTOCOL_REFERENCE*	Published reference, DOI, or link	Text string	Baumgartner & Mussoline 2011 (doi:10.1121/1.3562166); Davis et al. 2017 (doi:10.1038/s41598-017-13359-3)
DETECTION_SOFTWARE_NAME	The software used for the detec	Text string	Matlab
DETECTION_SOFTWARE_VERSION	The version number of the softv	Text string	2014b
MIN_ANALYSIS_FREQUENCY_RANGE_HZ	The minimum frequency (Hz) us	Numeric	0
MAX_ANALYSIS_FREQUENCY_RANGE_HZ	The maximum frequency (Hz) u	Numeric	1000
ANALYSIS_SAMPLING_RATE_HZ	The sample rate used for the an	Numeric	2000
QC_PROCESSING	Was the analysis conducted in r	"Real-time" or "Archival"	Archival
LOCALIZED_LATITUDE	The estimated latitude (in DD) c	Numeric in DD	42.4697
LOCALIZED_LONGITUDE	The estimated latitude (in DD) c	Numeric in DD	-70.2403
DETECTION_DISTANCE_M	The estimated distance (in mete	Numeric	8500
LOCALIZATION_DISTANCE_METHOD	The method used to localize and	Text string	Cross-correlation Stafford et al. 1998 (doi.org:10.1121/1.423944)
LOCALIZATION_DISTANCE_PROTOCOL	Published reference, DOI, or link	Text string	

should have the same

PACM_TEMPLATE_DETECTIONDATA

Please save and send your data sheet as a CSV (comma delimited, *.csv) file with the following file name structure: [OrganizationCode]_[Date-of-submission as YYYYMMDD]_DETECTIONDATA. You can look up your organization code in the table below. If your organization is not currently listed below, please email nmfs.nec.pacmdata@noaa.gov to request a code for your organization.

Example: NEFSC_20210731_DETECTIONDATA.csv

Organization	Organization_Code
College of the Atlantic	COATL
Cornell University	UCORN
Dalhousie University	UDALH
DFO Canada (Fisheries and Oceans Canada)	DFOCA
Duke University	UDUKE
Florida Fish and Wildlife Conservation Commission	FWCON
Flower Garden Banks National Marine Sanctuary	FGBNM
HDR Environmental	HDREN
James Cook University College of Science and Engineering	UJCSE
JASCO Applied Sciences	JASCO
Maine Department of Marine Resources (MEDMR)	MEDMR
Naval Facilities Engineering Systems Command (NAVFAC)	NAVFA
New England Aquarium	NEAQU
New England Whale Center	NENWC
New Jersey Department of Environmental Protection (NJDEP)	NJDEP
NOAA Florida Keys National Marine Sanctuary	FKNMS
NOAA Gray's Reef National Marine Sanctuary	GRNMS
NOAA National Centers for Coastal Ocean Science	NCCOS
NOAA National Marine Mammal Laboratory, Alaska Fisheries Science Center	AKFSC
NOAA Northeast Fisheries Science Center	NEFSC
NOAA ONS, Hawaiian Islands Humpback Whale National Marine Sanctuary	HIHWS
NOAA Pacific Islands Fisheries Science Center	PIFSC
NOAA Pacific Marine Environmental Laboratory	PMELA
NOAA Science & Technology (S&T), Ocean Acoustics Program	OACOU
NOAA Southeast Fisheries Science Center	SEFSC
NOAA Southwest Fisheries Science Center	SWFSC
NOAA Stellwagen Bank National Marine Sanctuary	SBNMS
Norwegian University of Science and Technology	UNSTE
Oregon State Universtiy	UORES
Parks Australia	AMPAR
SEA Ltd.	SEALT
Southeast Asia Marine Mammal Research Hong Kong	SEAMA
Stanford University	USTAN
Syracuse University	USYRA
UCSD/Scripps	SCRIP
Univerisity of Texas, Galveston	UTGAL
University of Maine	UMAIN
University of Maryland Center for Environmental Science	UMCES
University of New Brunswick	UNBRU
University of Puerto Rico	UPRIC
Universtiy of Washington	UWASH
Woods Hole Oceanographic Institution	WHOIN

PACM_TEMPLATE_DETECTIONDATA

COMMON_NAME	SCIENTIFIC_NAME	SPECIES_CODE
Atlantic spotted dolphin	*Stenella frontalis*	ASDO
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	WSDO
Beluga whale	*Delphinapterus leucas*	BELU
Blainville's beaked whale	*Mesoplodon densirostris*	BLBW
Blue whale	*Balaenoptera musculus*	BLWH
Bottlenose dolphin	*Tursiops truncatus*	BODO
Bowhead whale	*Balaena mysticetus*	BOWH
Bryde's whale (includes Eden's whale)	*Balaenoptera edeni*	BRWH
Clymene dolphin	*Stenella clymene*	CLDO
Cuvier's beaked whale	*Ziphius cavirostris*	GOBW
Dwarf sperm whale	*Kogia sima*	DSWH
False killer whale	*Pseudorca crassidens*	FKWH
Fin whale	*Balaenoptera physalus*	FIWH
Fraser's dolphin	*Lagenodelphis hosei*	FRDO
Gervais' beaked whale	*Mesoplodon europaeus*	GEBW
Gray whale	*Eschrichtius robustus*	GRWH
Gulf of Mexico beaked whale (BWG)	*Ziphiidae sp.*	BWGM
Harbor porpoise	*Phocoena phocoena*	HAPO
Humpback whale	*Megaptera novaeangliae*	HUWH
Killer whale	*Orcinus orca*	KIWH
Melon-headed whale	*Peponocephala electra*	MEWH
Minke whale (common)	*Balaenoptera acutorostrata*	MIWH
North Atlantic right whale	*Eubalaena glacialis*	RIWH
Northern bottlenose whale	*Hyperoodon ampullatus*	NBWH
Offshore bottlenose dolphin	*Tursiops truncatus*	OBDO
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*	PWDO
Pantropical spotted dolphin	*Stenella attenuata*	PSDO
Pilot whale (long-finned)	*Globicephala melas*	LFPW
Pilot whale (short-finned)	*Globicephala macrorhynchus*	SFPW
Pygmy killer whale	*Feresa attenuata*	PYKW
Pygmy sperm whale	*Kogia breviceps*	PSWH
Rice's whale	*Balaenoptera ricei*	RCWH
Risso's dolphin	*Grampus griseus*	GRAM
Rough-toothed dolphin	*Steno bredanensis*	RTDO
Sei whale	*Balaenoptera borealis*	SEWH
Short-beaked common dolphin	*Delphinus delphis*	SADO
Southern right whale	*Eubalaena australis*	SRWH
Sowerby's beaked whale	*Mesoplodon bidens*	SOBW
Sperm whale	*Physeter macrocephalus*	SPWH
Spinner dolphin	*Stenella longirostris*	SNDO
Striped dolphin	*Stenella coeruleoalba*	STDO
True's beaked whale	*Mesoplodon mirus*	TRBW
Unid True's/Gervais beaked whale	*Mesoplodon mirus/europaeus*	MEME
Unid dolphin	*Delphinidae sp.*	UNDO
Unid common dolphin	*Delphinus sp.*	DESP
Unid ziphiidae	*Ziphiidae sp.*	UNBW
Unid mesoplodont	*Mesoplodon sp.*	UNME
Unid pilot whale	*Globicephala sp.*	PIWH
Unid Pygmy/Dwarf sperm whale	*Kogia sp.*	UNKO
White beaked dolphin	*Lagenorhynchus albirostris*	WBDO

PACM_TEMPLATE_DETECTIONDATA

CALL_TYPE_CODE	CALL_TYPE_NAME	CALL_TYPE_DESCRIPTION
FMUS	Beaked whale frequency modulated upsweep	Beaked whale foraging clicks
BWCLICK	Beaked whale surface click	Beaked whale communication, does not contain frequency-modulation
BLSONG	Blue whale A/B/AB song	North Atlantic blue whale song; includes all three call types (A, B, and AB)
BLARCH	Blue whale Arch/D call	North Atlantic blue whale Arch calls, or D calls
BLMIX	Blue whale mix of A/B/AB song, arch, and D calls	North Atlantic blue whale mix of calls including A/B/AB song, Arch calls, and D calls.
FWNOTE	Fin whale 130-Hz note	Fin whale 130-Hz note
FWPLS	Fin whale 20-Hz pulse	Fin whale 20-Hz pulses (song and non-song)
FWDS	Fin whale downsweep/40-Hz call	Fin whale downsweep (termed "higher frequency sounds", "HF downsweep", or "40-Hz" call); spanning ~75-40 Hz
FWMIX	Fin whale mixed call types	Mix of North Atlantic fin whale call types: 20-Hz calls, 130-Hz note, and the higher-frequency downsweeps (~75-40 Hz), also referred to as “40-Hz” calls
HWSOC	Humpback whale social	Humpback whale social calls only
HWSONG	Humpback whale song	Humpback whale song only
HWMIX	Humpback whale song and social	When there is a mix of humpback whale song and social calls
MWPT	Minke whale pulse train	Minke whale pulse trains; currently includes all pulse train types: constant/slow-down/speed-up
NBHF	Narrow band high frequency click	Narrow band high frequency clicks used by Kogia and porpoises
NONBIO	non-biological	Anthropogenic, Environmental and other non-biological sounds
ODBZ	Odonotcete buzz	Dolphin buzzes (either delphinid or blackfish)
ODCLICK	Odontocete impulsive click	Dolphin clicks (either delphinid or blackfish)
ODMIX	Odontocete mixed calls	When there's a mix of whistles, clicks, burst pulses, etc. for dolphins
ODWHIS	Odontocete whistle	Dolphin whistles (either delphinid or blackfish)
ODBP	Odontoete burst pulse	Dolphin burst pulses (either delphinid or blackfish)
OTHER	Other	Other Call type which is not listed (check with PACM group first to add call type to list, if applicable).
ACLICKT	Pacific white-sided dolphin A click	Pacific white-sided dolphin A click type
BCLICKT	Pacific white-sided dolphin B click	Pacific white-sided dolphin B click type
POBZ	Porpoise buzz	Buzzes used by porpoise species, can be either social or foraging
RCDS	Rice's whale downsweep	Rice's whale downsweep
RCMOAN	Rice's whale moan	Rice's whale moan
GUNSHOT	Right whale gunshot	Right whale gunshot: broadband signal
RWMOAN	Right whale moan	Right whale moan: typically 100-200Hz
UPCALL	Right whale upcall	Contact-call produced by right whales; typically 100-300Hz upsweep
SWDS	Sei whale 30-80Hz downsweep	Sei whale downsweep spanning 80-30Hz, occurs as single downsweeps or repeated 3-5 seconds apart as doublets, triplets, or more. If different distinguishable downsweep types are used, please notify PACM group to add call type
SPCODA	Sperm whale coda	Sperm whale social: codas
SPCREAK	Sperm whale creak	Sperm whale foraging terminal buzz
SPFORG	Sperm whale foraging mix	When there's a mix of sperm whale foraging call types (i.e. usual clicks and buzzes)
SPSLC	Sperm whale slow click	Sperm whale social: slow clicks
SPSOCBZ	Sperm whale social buzz	Sperm whale social: social buzz
SPMIX	Sperm whale social mix	When there's a mix of sperm whale social call types (i.e. codas & social buzzes)
SPUSC	Sperm whale usual click	Sperm whale foraging click

Call_Type_Codes

PACM_TEMPLATE_GPSDATA

Instructions: Please save and send your data sheet as a CSV (comma delimited, *.csv) file with the following file name structure: [OrganizationCode]_[Date-of-submission(format: YYYYMMDD)]_GPSDATA. You can look up your organization code in the table below. If your organization is not currently listed below, please email nmfs.nec.pacmdata@noaa.gov to request a code for your organization.

Example: NEFSC_20210731_GPSDATA.csv

Organization	Organization_Code
College of the Atlantic	COATL
Cornell University	UCORN
Dalhousie University	UDALH
DFO Canada (Fisheries and Oceans Canada)	DFOCA
Duke University	UDUKE
Florida Fish and Wildlife Conservation Commission	FWCON
Flower Garden Banks National Marine Sanctuary	FGBNM
HDR Environmental	HDREN
James Cook University College of Science and Engineering	UJCSE
JASCO Applied Sciences	JASCO
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Naval Facilities Engineering Systems Command (NAVFAC)	NAVFA
New England Aquarium	NEAQU
New England Whale Center	NENWC
New Jersey Department of Environmental Protection (NJDEP)	NJDEP
NOAA Florida Keys National Marine Sanctuary	FKNMS
NOAA Gray's Reef National Marine Sanctuary	GRNMS
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NOAA National Marine Mammal Laboratory, Alaska Fisheries Science Center	AKFSC
NOAA Northeast Fisheries Science Center	NEFSC
NOAA ONS, Hawaiian Islands Humpback Whale National Marine Sanctuary	HIHWS
NOAA Pacific Islands Fisheries Science Center	PIFSC
NOAA Pacific Marine Environmental Laboratory	PMELA
NOAA Science & Technology (S&T), Ocean Acoustics Program	OACOU
NOAA Southeast Fisheries Science Center	SEFSC
NOAA Southwest Fisheries Science Center	SWFSC
NOAA Stellwagen Bank National Marine Sanctuary	SBNMS
Norwegian University of Science and Technology	UNSTE
Oregon State Universtiy	UORES
Parks Australia	AMPAR
SEA Ltd.	SEALT
Southeast Asia Marine Mammal Research Hong Kong	SEAMA
Stanford University	USTAN
Syracuse University	USYRA
UCSD/Scripps	SCRIP
Univerisity of Texas, Galveston	UTGAL
University of Maine	UMAIN
University of Maryland Center for Environmental Science	UMCES
University of New Brunswick	UNBRU
University of Puerto Rico	UPRIC
Universtiy of Washington	UWASH
Woods Hole Oceanographic Institution	WHOIN

PACM_TEMPLATE_GPSDATA

UNIQUE_ID	DATETIME	LATITUDE	LONGITUDE

In order for the data to be read correctly in our database, please do not use any commas (",") in any fields.

COLUMN_NAME	DEFINITION	ENTRY OPTIONS	EXAMPLE
UNIQUE_ID	A unique ID f	Text string	NEFSC_GU1803
DATETIME	The date and	DATETIME in ISO8	2018-07-21T19:00:00Z
LATITUDE	Latitude posi	Numeric in DD	39.88628
LONGITUDE	Longitude po	Numeric in DD	-69.7674575

UNIQUE_ID	PROJECT	DATA_POC_NAI	DATA_POC_AFF	DATA_POC_EM	STATIONARY_OI	PLATFORM_TYP	PLATFORM_NO	SITE_ID	INSTRUMENT_T	INSTRUMENT_IE	CHANNEL	MONITORING_START_DATETIME	MONITORING_END_DATETIME	SOUNDFILES_TI	LATITUDE	LONGITUDE	WATER_DEPTH_	RECORDER_DEP	SAMPLING_RAT	RECORDING_DU	RECORDING_IN	SAMPLE_BITS	SUBMITTER_NA	SUBMITTER_AFI	SUBMITTER_EM	SUBMISSION_DATE

In order for the data to be read correctly in our database, please do not use any commas (",") in any fields. If there is a need for multiple values (cases explained in field definitions), use a semicolon (";"). If a comma is necessary, enclose the entire field entry in quotations ("example entry").

COLUMN_NAME	DEFINITION	ENTRY OPTIONS	EXAMPLE
UNIQUE_ID	A unique ID for th	Text string	NEFSC_SBNMS_200601_CH3_3
PROJECT	The name of the p	Text string	NEFSC_SBNMS_200601_CH3
DATA_POC_NAME	The name of the p	Text string	Sofie Van Parijs
DATA_POC_AFFILIATION	The data POC's pr	Text string	NOAA NEFSC
DATA_POC_EMAIL	The data POC's en	Text string	sofie.vanparijs@noaa.gov
STATIONARY_OR_MOBILE	Is the recorder mo	"Stationary" or "Mobile"	Stationary
PLATFORM_TYPE	The type of platfo	"Bottom-Mounted"; "Surface-I	Bottom-Mounted
PLATFORM_NO	ID or number of th	Text string	we04
SITE_ID	The site or station	Text string	H3
INSTRUMENT_TYPE	Recording instrum	Text string	MARU
INSTRUMENT_ID	Serial or unit ID nu	Text string	82
CHANNEL	The recording cha	Numeric	3
MONITORING_START_DATETIME	The start date tim	DATETIME in ISO8601 format (	2006-01-06T00:00:00+05:00
MONITORING_END_DATETIME	The end date time	DATETIME in ISO8601 format (	2006-03-29T00:00:00+00:00
SOUNDFILES_TIMEZONE	The time zone the	Text string	UTC-5
LATITUDE	Latitude of record	Numeric in DD	42.4697
LONGITUDE	Longitude of reco	Numeric in DD	-70.2403
WATER_DEPTH_METERS	Water depth (met	Numeric	66.4
RECORDER_DEPTH_METERS	Depth of the reco	Numeric	64.4
SAMPLING_RATE_HZ	Sampling rate of r	Numeric	2000
RECORDING_DURATION_SECONDS	Recording schedu	Numeric	600
RECORDING_INTERVAL_SECONDS	Recording schedu	Numeric	0
SAMPLE_BITS	The sample bit rat	Numeric	16
SUBMITTER_NAME	Name of who is su	Text string	Genevieve Davis
SUBMITTER_AFFILIATION	Primary affiliation	Text string	NOAA NEFSC
SUBMITTER_EMAIL	Email of who is su	Text string	genevieve.davis@noaa.gov
SUBMISSION_DATE	The date the data	DATETIME in ISO8601 format (	2021-08-02T04:01:00-05:00

PACM_TEMPLATE_METADATA

Please save and send your data sheet as a CSV (comma delimited, *.csv) file with the following file name structure: [OrganizationCode]_[Date-of-submission as YYYYMMDD]_METADATA. You can look up your organization code in the table below. If your organization is not currently listed below, please email nmfs.nec.pacmdata@noaa.gov to request a code for your organization.

Example: NEFSC_20210731_METADATA.csv

Organization	Organization_Code
College of the Atlantic	COATL
Cornell University	UCORN
Dalhousie University	UDALH
DFO Canada (Fisheries and Oceans Canada)	DFOCA
Duke University	UDUKE
Florida Fish and Wildlife Conservation Commission	FWCON
Flower Garden Banks National Marine Sanctuary	FGBNM
HDR Environmental	HDREN
James Cook University College of Science and Engineering	UJCSE
JASCO Applied Sciences	JASCO
Maine Department of Marine Resources (MEDMR)	MEDMR
Naval Facilities Engineering Systems Command (NAVFAC)	NAVFA
New England Aquarium	NEAQU
New England Whale Center	NENWC
New Jersey Department of Environmental Protection (NJDEP)	NJDEP
NOAA Florida Keys National Marine Sanctuary	FKNMS
NOAA Gray's Reef National Marine Sanctuary	GRNMS
NOAA National Centers for Coastal Ocean Science	NCCOS
NOAA National Marine Mammal Laboratory, Alaska Fisheries Science Ce	AKFSC
NOAA Northeast Fisheries Science Center	NEFSC
NOAA ONS, Hawaiian Islands Humpback Whale National Marine Sanctua	HIHWS
NOAA Pacific Islands Fisheries Science Center	PIFSC
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NOAA Science & Technology (S&T), Ocean Acoustics Program	OACOU
NOAA Southeast Fisheries Science Center	SEFSC
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Syracuse University	USYRA
UCSD/Scripps	SCRIP
Univerisity of Texas, Galveston	UTGAL
University of Maine	UMAIN
University of Maryland Center for Environmental Science	UMCES
University of New Brunswick	UNBRU
University of Puerto Rico	UPRIC
Universtiy of Washington	UWASH
Woods Hole Oceanographic Institution	WHOIN

UNIQUE_ID	ANALYSIS_PERIOD_START_DATETIME	ANALYSIS_PERIOD_END_DATETIME	SPECIES_CO	ACOUSTIC_	CALL_TYPE_	LOCALIZED_	LOCALIZED_	DETECTION_	PLATFORM_	REPORTING_COMPANY

In order for the data to be read correctly in our database, please do not use any commas (",") in any fields. If there is a need for multiple values (cases explained in field definitions), use a semicolon (";"). If a comma is necessary, enclose the entire field entry in quotations ("example entry").

COLUMN_NAME	DEFINITION	ENTRY OPTIONS	EXAMPLE
UNIQUE_ID	A unique ID for the re	Text string	WHOI_SBNMS_20 2003_sbnms0320 _we04
ANALYSIS_PERIOD_START_DATETIME	Start date time of vali	DATETIME in ISO8601	2021-01- 01T00:00:00- 05:00
ANALYSIS_PERIOD_END_DATETIME	End date time of valid	DATETIME in ISO8601	2021-01- 02T00:00:00- 05:00
SPECIES_CODE	Currently, for the shor	RIWH	RIWH
ACOUSTIC_PRESENCE	Whether the species v	"D"; "P"; "N"; "M"	D
CALL_TYPE_CODE	Currently, for the shor	UPCALL	UPCALL
LOCALIZED_LATITUDE	The estimated latitude	Numeric in DD	42.4697
LOCALIZED_LONGITUDE	The estimated latitude	Numeric in DD	-70.2403
DETECTION_DISTANCE_M	The estimated distanc	Numeric	8500
LOCALIZATION_DISTANCE_METHOD	The method used to lo	Text string	Cross-correlation
LOCALIZATION_DISTANCE_PROTOCOL	Published reference, D	Text string	Stafford et al. 1998 (doi.org:10.1121/ 1.423944)
PLATFORM_ID	The name or referenc	Text string	MAMV glider
REPORTING_COMPANY	The company respons	Text string	Northeast Wind

24-HOUR_NARW_REPORTING_SYSTEM_TEMPLATE_2023-03-24

Please save and send your data sheet as a CSV (comma delimited, *.csv) file with the following file name structure: [OrganizationCode]_[Date-of-submission as YYYYMMDD]_NARW24HOURDETECTION. You can look up your organization code in the table below. If your organization is not currently listed below, please email nmfs.nec.pacmdata@noaa.gov to request a code for your organization.

Example: NEFSC_20210731_NARW24HOURDETECTION.csv

Organization	Organization_Code
College of the Atlantic	COATL
Cornell University	UCORN
Dalhousie University	UDALH
DFO Canada (Fisheries and Oceans Canada)	DFOCA
Duke University	UDUKE
Florida Fish and Wildlife Conservation Commission	FWCON
Flower Garden Banks National Marine Sanctuary	FGBNM
HDR Environmental	HDREN
James Cook University College of Science and Engineering	UJCSE
JASCO Applied Sciences	JASCO
Maine Department of Marine Resources (MEDMR)	MEDMR
Naval Facilities Engineering Systems Command (NAVFAC)	NAVFA
New England Aquarium	NEAQU
New England Whale Center	NENWC
New Jersey Department of Environmental Protection (NJDEP)	NJDEP
NOAA Florida Keys National Marine Sanctuary	FKNMS
NOAA Gray's Reef National Marine Sanctuary	GRNMS
NOAA National Centers for Coastal Ocean Science	NCCOS
NOAA National Marine Mammal Laboratory, Alaska Fisheries Science Center	AKFSC
NOAA Northeast Fisheries Science Center	NEFSC
NOAA ONS, Hawaiian Islands Humpback Whale National Marine Sanctuary	HIHWS
NOAA Pacific Islands Fisheries Science Center	PIFSC
NOAA Pacific Marine Environmental Laboratory	PMELA
NOAA Science & Technology (S&T), Ocean Acoustics Program	OACOU
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NOAA Stellwagen Bank National Marine Sanctuary	SBNMS
Norwegian University of Science and Technology	UNSTE
Oregon State Universtiy	UORES
Parks Australia	AMPAR
SEA Ltd.	SEALT
Southeast Asia Marine Mammal Research Hong Kong	SEAMA
Stanford University	USTAN
Syracuse University	USYRA
UCSD/Scripps	SCRIP
Univerisity of Texas, Galveston	UTGAL
University of Maine	UMAIN
University of Maryland Center for Environmental Science	UMCES
University of New Brunswick	UNBRU
University of Puerto Rico	UPRIC
Universtiy of Washington	UWASH
Woods Hole Oceanographic Institution	WHOIN

Filename_Instructions

Appendix I Protected Species Observer and Passive Acoustic Monitoring Species Detection Data Form

Appendix I.7 BOEM Standard Field Codes and UnitsTemplates

ATTACHMENT A. STANDARD FIELD CODES AND UNITS

BEAUFORT SCALE

BEAUFORT	DESCRIPTION OF SEA STATE
0	Windless: Glassy sea surface, 0 knot winds, 0-meter swell
1	Calm, light air: Ripples, no white caps, 1-3 knot winds, 0.1-meter swells
2	Light breeze: Short, small wavelets that don't break, 4-6 knot winds, 0.2-0.3-meter swells
3	Gentle breeze: Large wavelets that begin to break, 7-10 knot winds, 0.6-1-meter swells
4	Moderate breeze: Small waves with frequent white caps, 11-16 knot winds, 1-1.5-meter swells
5	Fresh breeze: Long, moderate waves with many white caps, 17-21 knot winds, 2-2.5-meter swells
6	Strong breeze: Large waves with extensive foaming and some spray, 22-27 knot winds, 3-4-meter swells
7	Near gale: Sea heaps up, waves breaking, streaks forming, 28-33 knot winds, 4-4.5-meter swells
8	Gale: Moderately high waves of great length, well-marked streaks, 34-40 knot winds, 5.5-7.5-meter swells
9	Severe gale: High waves, dense streaking, spray may affect visibility, 41-47 knot winds, 7-10-meter swells
10	Storm: Very high waves with long over-hanging crests, sea becoming white with streaks, 48-55 knot winds, 9-12.5-meter swells
11	Violent storm: Exceptionally high waves, sea completely covered with foam, 56-63 knot winds, 11.5-12.5-meter swells
12	Hurricane: Air filled with foam and spray, sea completely white, no visibility, 63+ knot winds, 16+ meter swells

UNITS

Date	YYYY-MM-DD
Durations (e.g., start and end times) (Coordinated Universal Time, UTC)	YY-MM-DDT HH:MM
Wind Speed	Knots (kt)
Distance, height, and depth	Meters (m) or kilometers (km)
Position in Latitude and longitude	Decimal degrees (North American Datum of 1983 (NAD83)); e.g., dd.ddddd, dd.ddddd
Bearing or direction of travel	Ship heading + clock face to animal

CLOUD COVER CODE	Percent (%) of sky covered with clouds:
1	<10%
2	10–50%
3	50–90%
4	>90%

MONITORING EQUIPMENT

CODE	EQUIPMENT	CODE	EQUIPMENT
HB	Hand-held Binoculars	IG	Infrared Goggles
BE	Big Eyes	CR	Crew Reported (any method)
NE	Naked Eye	PT	Passive Acoustic Towed Array
IC	Infrared Camera	PA	Passive Acoustic Moored/Stationary

DISTANCE FINDING

CODE	DISTANCE FINDING METHOD
EST	Eye estimation
RET	Reticle
LAS	Laser range-finder
RFS	Range-finding stick or calipers

SPECIES IDENTIFICATION

CODE	ITIS	WoRMS APHIA	COMMON NAME	SCIENTIFIC NAME
Marine Mammals				
ASDO	552460	137108	Atlantic spotted dolphin	*Stenella frontalis*
WSDO	180443	137100	Atlantic white-sided dolphin	*Lagenorhynchus acutus*
BLBW	180517	137122	Blainville's beaked whale	*Mesoplodon densirostris*
BLWH	180528	137090	Blue whale	*Balaenoptera musculus*
BODO	180426	137111	Bottlenose dolphin	*Tursiops truncatus*
BRWH	180525	242603	Bryde’s whale	*Balaenoptera edeni*
GOBW	180498	137127	Cuvier's beaked whale	*Ziphius cavirostris*
DSWH	180492	159025	Dwarf sperm whale	*Kogia sima*
FKWH	180463	137104	False killer whale	*Pseudorca crassidens*
FIWH	180527	137091	Fin whale	*Balaenoptera physalus*
BEBW	180509	137123	Gervais' beaked whale	*Mesoplodon europaeus*
HAPO	180473	137117	Harbor Porpoise	*Phocoena phocoena*
HUWH	180530	137092	Humpback whale	*Megaptera novaeangliae*
KIWH	180469	137102	Killer whale	*Orcinus orca*
MANA	180684	159504	Manatee	*Trichechus manatus*
MHWH	180459	137103	Melon-headed whale	*Peponocephala electra*

CODE	ITIS	WoRMS APHIA	COMMON NAME	SCIENTIFIC NAME
MIWH	180524	137087	Minke whale	*Balaenoptera acutorostrata*
RIWH	180537	159023	North Atlantic right whale	*Eubalaena glacialis*
NBWH	180504	343899	Northern bottlenose whale	*Hyperoodon ampullatus*
SPDO	180430	137105	Pantropical spotted dolphin	*Stenella attenuata*
SFPW	552461	137097	Pilot whale (shortfinned)	*Globicephala macrorhynchus*
LFPW	180466	137096	Pilot whale (longfinned)	Globicephala melas
PYKW	180461	137095	Pygmy killer whale	*Feresa attenuata*
PSWH	180491	137113	Pygmy sperm whale	*Kogia breviceps*
GRAM	180457	137098	Risso's dolphin	*Grampus griseus*
RTDO	180417	137110	Rough-toothed dolphin	*Steno bredanensis*
SEWH	180526	137088	Sei whale	*Balaenoptera borealis*
SADO	180438	137094	Short-beaked common dolphin	*Delphinus delphis*
SOBW	180515	137121	Sowerby's beaked whale	*Mesoplodon bidens*
SPWH	180488	137119	Sperm whale	*Physeter macrocephalus*
STDO	180434	137107	Striped dolphin	*Stenella coeruleoalba*
TRBW	180508	137126	True's beaked whale	*Mesoplodon mirus*
WBDO	180442	137101	White-beaked dolphin	*Lagenorhynchus albirostris*
Seals				
GRSE	180653	137080	Gray seal	*Halichoerus grypus*
HASE	180649	137084	Harbor seal	*Phoca vitulina*
HGSE	622022	159019	Harp seal	*Pagophilus groenlandicus*
HOSE	180657	137078	Hooded seal	*Cystophora cristata*
			Sea Turtles	
LHST	173833	137206	Loggerhead sea turtle	*Caretta caretta*
LBST	173836	137207	Leatherback sea turtle	*Dermochelys coriacea*
KRST	551770	137208	Kemp's ridley sea turtle	*Lepidochelys kempii*
HBST	173843	137209	Hawksbill sea turtle	*Eretmochelys imbricata*
GRST	173830	137205	Green sea turtle	*Chelonia mydas*
			Fish	
MARA	—	1026118	Giant manta ray	*Manta birostris*
STUR	—	—	Atlantic sturgeon	*Acipenser oxyrinchus oxyrinchus*
Unidentified Species				
UNID	—	—	Unidentified animal	—
UNBA	180403	2688	Unidentified baleen whale	—
UNBW	180493	136986	Unidentified beaked whale	—
UNTU	173828	136999	Unidentified turtle	—
UNLW	180403	2688	Unidentified large whale	—
UNTW	180404	148723	Unidentified odontocete	—
UNSE	—	—	Unidentified seal	—

CODE	ITIS	WoRMS APHIA	COMMON NAME	SCIENTIFIC NAME
KOGI	180490	159024	Unidentified Kogia spp.	—
PIWH	180464	137017	Unidentified pilot whale	—

BEHAVIORAL/STATE

CODE	BEHAVIOR/STATE	CODE	BEHAVIOR/STATE
14	acrobatic	78	milling
25	blowing	22	motionless at surface
12	bow riding	11	porpoising
13	breaching	90	SAG
05	injured (e.g., visible wound)	21	spy hopping
00	dead	19	surfacing
03	dead in fishing gear	17	swimming at surface (non-travel)
23	diving (mammal)	18	swimming below surface
69	diving (turtle)	20	tail slapping (lobtailing)
07	diving fluke up	16	travel (slow < 1 kt)
92	entangled in lines, ropes, gear	07	travel (moderate 1-10 kt)
54	feeding	06	fast travel >10 kt
22	logging	94	undetermined

Appendix J Representative Sound Level Meter(s) for in-air MPIT tool Monitoring

REED INSTRUMENTS

Data Logging Sound Level Meter

Model **R8070SD**

TECHNICAL DATA

Features

- High accuracy of ±1.4dB meets Type 2 standards
- Triple range measurement (50dB dynamic range)
- A & C frequency weighting
- Fast & Slow time weighting
- Real time data logger with integrated SD memory card
- User selectable sampling rate from 1 to 3600 seconds
- Easy-to-read backlit LCD display
- Peak hold, Data hold and Min/Max hold
- Tripod mount for long-term monitoring
- Low battery indicator and auto shut off
- The single AC output jack (3.5mm stereo mini-plug) provides analog signals to frequency analysers, level recorders, FFT analysers, graphic recorders, etc.
- Includes windshield ball, soft carrying case & batteries

Specifications

Measuring Ranges:	30 to 130dB Low: 30 to 80dB Med: 50 to 100dB High: 80 to 130dB Full: 30 to 130dB
Dynamic Range:	50dB (in each range)
Accuracy:	31.5Hz ±3.0dB, 63Hz ±2.0dB, 125Hz ±1.5dB, 250Hz ±1.5dB, 500Hz ±1.5dB, 1kHz ±1.0dB, 2kHz ±2.0dB, 4kHz ±3.0dB, 8kHz ±5.0dB
Resolution:	0.1dB
Response Time:	500ms
Frequency Range:	31.5Hz to 8kHz
Frequency Weighting:	A, C
Time Weighting:	Fast/Slow (125ms and 1s)
Microphone:	0.5" (12.7mm) electret condenser
Display:	4-digit LCD
Backlit Display:	Yes
Data Hold:	Yes
Min:	Yes
Max:	Yes
Alarm Indicators:	Under and Over (visual on screen)
Datalogging Capabilities:	Yes
Real-Time Clock and Date Stamp:	Yes
Selectable Sampling Rate:	Yes (1, 2, 5, 10, 30, 60, 120, 300, 600, 1800, 3600 seconds)

Continued...

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REED INSTRUMENTS

Data Logging Sound Level Meter

Model **R8070SD**

TECHNICAL DATA

External Memory:	Yes, expandable up to 16GB with SD card (optional)
Auto Shut-Off:	Yes (after 10 minutes/off)
Kick Stand:	Yes
Tripod Mountable:	Yes
Low Battery Indicator:	Yes
Power Supply:	6 x AA batteries or AC Adapter (optional)
Data Output:	Yes (RS-232)
AC Output Signal:	0.5Vrms (full scale of selected range)
AC Output Impedance:	600 ohms
AC Output Terminal:	3.5mm Stereo Jack
Battery Life:	Sampling Time Dependent
Product Certifications:	CE, IEC 61672-1-2013, Class 2
Operating Temperature:	32 to 122°F (0 to 50°C)
Storage Temperature:	14 to 140°F (-10 to 60°C)
Operating Humidity Range:	Less than 85% RH
Dimensions:	9.7 x 2.7 x 1.8" (245 x 68 x 45mm)
Weight:	0.7lbs (320g)

R8070SD-KIT

Data Logging Sound Level Meter with Adapter and SD Card Kit

Includes:
R8070SD Data Logging Sound Level Meter, RSD-16GB 16GB Micro SD Memory Card with adapter and RSD-ADP-NA AC Power Adapter

R8070SD-KIT2

Data Logging Sound Meter with Tripod, SD Card and Power Adapter

Includes:
R8070SD Data Logging Sound Level Meter, R1500 Tripod, RSD-16GB 16GB Micro SD Memory Card with adapter and RSD-ADP-NA AC Power Adapter

Model	Description
R8070SD	Data Logging Sound Level Meter
R8090	Sound Calibrator
REED-WB	Windshield Ball
RSD-ADP-NA	Power Supply, 110V
RSD-ADP-EU	Power Supply, 220V
R1500	Tripod
CA-05A	Soft Carrying Case
R8888	Hard Carrying Case
SD-4GB	4GB Class 4 SDHC Memory Card
RSD-16GB	16GB Micro SD memory Card w/Adapter
R8070SD-KIT	Data Logging Sound Level Meter with Adapter and SD Card Kit
R8070SD-KIT2	Data Logging Sound Meter with Tripod, SD Card and Power Adapter
R8070SD-NIST	Data Logging Sound Level Meter with NIST

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23. Technical Data XL2

All specifications are according to the IEC61672 standard. Other standards are listed the corresponding specifications.

Sound Level Meter	
Certified Product Configurations Class 1	• XL2 with TA-Option, M2230 Microphone and Shroud MXA01 form an integrating sound level meter with type approval in accordance with class 1 requirements of IEC 61672 and ANSI S1.4
Product Configurations Class 1	The XL2 is identical to the certified configuration, just using the latest firmware. • XL2 with M2230 microphone Class 1 in accordance with IEC 61672 and ANSI S1.4 • XL2 with M2340 microphone Class 1 in accordance with IEC 61672 and ANSI S1.4 • XL2 with M2211, M2215 microphone Class 1 frequency response in accordance with IEC 61672 and ANSI S1.4 These specifications apply for operation with the microphone attached using the Shroud MXA01 or the microphone detached using the ASD cable.
Product Configurations Class 1	This prevents possible acoustic reflections from the XL2 housing and ensures a high measurement accuracy in accordance with the standards IEC 61672 and ANSI S1.4.
Product Configurations Class 2	• XL2 with M4261 microphone Class 2 in accordance with IEC 61672 and ANSI S1.4
Conforms with Standards	• IEC 61672:2013, IEC 61672:2003, IEC 61260:2014, IEC 61260:2003, IEC 60651, IEC 60804, IEC 61183 • SMPTE ST 202:2010, ISO 2969:2015 • China: GB/T 3785:2010, GB/T 3241, GB 3096-2008, GB 50526, GB-T 4959 • Germany: » DIN 15905-5, DIN 45657:2014, DIN 45657:2005, DIN 45645-2 » DIN 45645-1 (optional with Extended Acoustic Pack) • Japan: JIS C1509-1:2005, JIS C 1513 class 1, JIS C 1514 class 0 • Switzerland: V-NISSG • UK: BS 4142:2014, BS 5969, BS 6698 • US: ANSI S1.4:2014, ANSI S1.43, ANSI S1.11:2014, ANSI/ASA S12.60 • International IEC standards are adopted as European standards and the letters IEC are replaced by EN. XL2 conforms to these EN standards. • WELL Buildings, LEED Green Building • FGI Facility Guidelines Institute
Weighting	• Frequency weighting: A, C, Z (simultaneous) • Time weighting: (simultaneous) » Fast, Slow » Impulse (optional with Extended Acoustic Pack)

Level Details	• Measurement bandwidth (-3dB): 4.4 Hz - 23.0 kHz • Level resolution: 0.1 dB • Internal noise: 1.3 µV A-Weighted
Audio Recording	• Default » Recording of compressed wav-files (ADPCM - 4 bit, 24 kHz) » a new wav-file starts every 12 hours (max. wav-file size 512 MB) » Bandwidth: 2.0 Hz - 10.2 kHz • Optional: Extended Acoustic Pack » Recording of linear wav-files (24 bit, 48 kHz) » a new wav-file starts every 1 hours (max. wav-file size 512 MB) » Bandwidth: 2.0 Hz - 23.6 kHz • Optional: NoiseScout - Managed Mode » Recording of compressed wav-files (4 bit, 12 kHz) » Bandwidth: 2.0 Hz - 5.1 kHz » requires activated “NoiseScout 365” or “Data Day Credits” • Audio files include meta data (scaling, time, ...) in Broadcast Wave Format BWF according to EBU TECH 3285
Measurement Ranges with different microphones	• XL2+M2230: 17 dB(A) - 137 dB • XL2+M2340: 18 dB(A) - 138 dB • XL2+M2215: 25 dB(A) - 153 dB • XL2+M2211: 21 dB(A) - 144 dB • XL2+M4261: 27 dB(A) - 146 dB @ typical microphone sensitivity

Linear Measurement Range acc. IEC61672 / ANSI S1.4	• XL2+M2230: 24 dB(A) - 137 dB, 27 dB(C) - 137 dB • XL2+M2340: 25 dB(A) - 138 dB, 28 dB(C) - 138 dB • XL2+M2215: 33 dB(A) - 153 dB • XL2+M2211: 29 dB(A) - 144 dB • XL2+M4261: 33 dB(A) - 146 dB @ typical microphone sensitivity
Stabilization Time	< 10 seconds
Integration Time	• Minimum: 1 second • Maximum: 100 hours minus 1 second
Display Measurement Ranges	Three level ranges depending on the microphone sensitivity with manual setting. For example: • M2230, M2340 @ sensitivity = 42 mV/Pa » LOW, lower level range: 0 - 100 dBSPL » MID, mid-level range: 20 - 120 dBSPL » HIGH, upper level range: 40 - 140 dBSPL • M2215 @ sensitivity = 8 mV/Pa » LOW, lower level range: 20 - 120 dBSPL » MID, mid-level range: 40 - 140 dBSPL » HIGH, upper level range: 60 - 160 dBSPL • M2211 @ sensitivity = 20 mV/Pa » LOW, lower level range: 10 - 110 dBSPL » MID, mid-level range: 30 - 130 dBSPL » HIGH, upper level range: 50 - 150 dBSPL • M4261 @ sensitivity = 16 mV/Pa » LOW, lower level range: 10 - 110 dBSPL » MID, mid-level range: 30 - 130 dBSPL » HIGH, upper level range: 50 - 150 dBSPL

Residual noise in [dB] @ S = 42 mV/Pa of XL2 without measurement microphone

- Frequency weighting A

Level range	L_{eq}	L_{peak}
LOW	4	17
MID	18	31
HIGH	43	55

- Frequency weighting C

Level range	L_{eq}	L_{peak}
LOW	3	16
MID	17	30
HIGH	41	55

- Frequency weighting Z

Level range	L_{eq}	L_{peak}
LOW	7	20
MID	21	34
HIGH	46	58

Measurements

- SPL actual, Lmin, Lmax, Lpeak, Leq, Lp
- Gliding LAeq and LCeq with selectable time window from one second to one hour (=running Lxeq or sliding Lxeq with x= A or C)
- All measurement results simultaneously available
- Correction value measurement wizard based on LAeq, LCeq and LCpeak
- Noise exposure level LEX with post-processing
- Logging all data or subsets in selectable intervals
- Recording of voice notes
- Monitoring of sound levels that exceed limits
- Digital I/O interface for external peripherals control

Real-Time Analyzer RTA

- Conforms with class 1 of IEC 61260:2014 and ANSI S1.11-2014
- 1/1 octave band display: 8 Hz - 16 kHz
  sub ranges 8 Hz - 4 kHz or 31.5 Hz - 16 kHz
  displayed with A/Z broadband levels at one glance
- 1/3 octave band display: 6.3 Hz - 20 kHz
  sub ranges 6.3 Hz - 8 kHz or 20 Hz - 20 kHz
  displayed with A/Z broadband levels at a glance
- Level resolution: 0.1 dB
- Measurement Units: Volt, dBu, dBV and dBSPL
- Band pass filters (base 10) conform with class 1 of IEC 61260:2014 and ANSI S1.11-2014
  » 1/1 octave spectrum: > 16 Hz band
  » 1/3 octave spectrum: > 16 Hz band
- Wide band levels simultaneously
- Frequency weighting: X-Curve @ 500 seats in accordance with SMPTE ST 202:2010 and ISO 2969:2015 (not available for XL2-TA)
- Capturing of a single reading into the internal memory for comparative measurements
- Leq logging

Remote Measurement (optional)	• Querying measurement data online via the USB interface of the following functions: » Sound level meter and spectrum analyzer SLMeter/RTA » FFT analyzer » RT60 reverberation time » Audio analyzer RMS/THD+N » High-resolution spectral analyzer 1/12 Oct + Tol • Typical response time: 10 ms @ querying the frequency spectrum in SLMeter

Functions of Extended Acoustic Pack (optional)	• SLMeter/RTA function » Recording of linear wav-files (24 bit, 48 kHz) a new wav-file starts every 1 hour (max. wav-file size 512 MB) » Percentiles for wide band, 1/1 and 1/3 octave spectrum - Flexible setting from 0.1% to 99.9% - Sampling: every 1.3 ms - Wide band: in 0.1 dB wide classes, based on sampling Lxy (x= A, C or Z, y= F, S or EQ1") - 1/1 and 1/3 octave spectrum: in 1.0 dB wide classes, based on Lxy (x= A, C or Z, y= F or S) - Dynamic range: 140 dB Sound Exposure Level LAE » 100ms logging » RTA logging of Lmin and Lmax » Event-triggered audio and data recording » Time weighting: Impulse (LxI, LxIeq with x= A, C, Z) » True peak level in 1/1 and 1/3 octave resolution » Clock-Impulse Maximum Level (TaktMax) and values as specified in DIN 45645-1 » Impulsiveness detection in accordance with BS4142:2014 and NordTest ACOU 112 • FFT function » High-resolution Zoom-FFT with selectable frequency ranges and resolution up to 0.4 Hz in the range of 5 Hz to 20 kHz » Recording of linear wav-files (24 bit, 48 kHz) • RT60 function » Reverberation time in 1/3 octave resolution • 1/12 octave Spectral Analyzer » Recording of linear wav-files (24 bit, 48 kHz)

Functions of Spectral Limits Option (optional)	• SLMeter/RTA function » True peak level in 1/1 and 1/3 octave resolution • FFT function » High-resolution Zoom-FFT with selectable frequency ranges and resolution up to 0.4 Hz » Sound mode: 5 Hz to 20 kHz » Vibration mode: 1 Hz to 20 kHz • 1/12 octave function » High-resolution RTA function "1/12 Oct + Tol" » Selectable 1/1, 1/3, 1/6 and 1/12 octave spectral resolution » Frequency band listening at rear speaker » Sound Mode: 11.5 Hz to 21.8 kHz » Vibration mode: 0.73 Hz to 1.36 kHz • FFT and 1/12 octave function » Capturing of multiple readings into the internal memory » Comparing measurement results against captures with relative or absolute curve display » Comprehensive tolerance handling with tolerance masks based on captures for passed/failed measurements » Export and import of tolerance and capture files • Noise Curves » Noise Rating NR according to ISO/R 1996-1971 » Noise Criteria NC in accordance with ANSI S12.2-2019 and -1995 » Room Noise Criteria RNC in accordance with ANSI S12.2-2019 » Room Criteria RC in accordance with ANSI S12.2-1995 » Preferred Noise Criteria in accordance with ASA 1971

Reporting and Analysis Software	
Data Explorer (optional)	• Enables the import of measurement data into the Data Explorer software • Powerful data processor for easy and fast analysis of sound level measurement data on PC
Sound Insulation (optional)	• Enables the import of RTA and reverberation time measurement data in 1/3 octave band resolution into the XL2 Sound Insulation Reporter software • Software provides all tools for fast data analysis and standardized reporting of airborne, impact and facade sound insulation measurements on PC • Standards ASTM E336, ASTM E413, ASTM E1007, ASTM E989, ASTM E966, ASTM E1332, BB93, DIN 4109, Document E, GB/T 19889, ISO 16283, ISO 140, ISO 717, ISO 10140, NEN 5077:2019, SIA 181:2006, SIA 181:2020
Room Acoustics (optional)	• Frequency response spectrum and Noise Curves • Room acoustic simulation according to Sabine or Eyring • Import of own sound absorber database and tolerances • Standards GB 50371, IEC 61260, ANSI/ASA S12.2-2019, DIN 15996:2020, ISO R 1996-1971, ASR A3.7:2021, DIN 18041:2016, ISO 3382-1:2009, ISO 3382-2:2008, ÖNORM B 8115-3:2015, ASTM C423-17, ISO 354:2003

Sound Power (optional)	• Enables the import of RTA and reverberation time measurement data in 1/1 and 1/3 octave band resolution into the Sound Power Reporter software • Software provides all the standard reports for sound power measurements • Standards ISO 3741, ISO 3744, ISO 3746, ANSI-ASA S12.51, S12.54, S12.56

Acoustic Analyzer	
FFT Analysis	• Real-time FFT with actual level, L_{eq}, L_{min}, L_{max} • Level resolution: 0.1 dB • Frequency Band Ranges: 7 Hz - 215 Hz, 58 Hz - 1.72 kHz, 484 Hz - 20.5 kHz with 143 frequency bins shown on display • Measurement Units: Volt, dBu, dBV and dBSPL • Optional with Extended Acoustic Pack or Spectral Limits: High-resolution Zoom-FFT with selectable frequency ranges and resolution up to 0.4 Hz in the range of 5 Hz to 20 kHz • Optional with Spectral Limits: Capture and tolerance function with multiple readings for comparative measurements and passed/failed analysis
Reverberation Time RT60	• Conforms with ISO 3382 and ASTM E2235 • 1/1 octave bands results from 63 Hz - 8 kHz, based on T20 and T30 • Optional with Extended Acoustic Pack: 1/3 octave bands results from 50 Hz - 10 kHz based on T20 and T30 • Range: 10 ms - 30 seconds • Minimum reverberation time (typical) » < 100 Hz: 0.3 second » 100 - 200 Hz: 0.2 second » > 200 Hz: 0.1 second • Measurement based Schroeder-method • Test signal: Impulse source or interrupted pink noise generated by the MR-PRO, MR2 or the included NTi Audio Test CD / USB Flash Drive

Polarity	• Checks polarity of speakers and line signals • Positive/Negative detection of wideband and individual 1/1 octave bands through internal microphone or XLR/RCA connector • Test signal: NTi Audio polarity test signal generated by the MR-PRO, MR2 or the included NTi Audio Test CD / USB Flash Drive
Delay Time	• Propagation delay between electrical reference signal and acoustic signal using the internal microphone • Range: 0 ms - 1 second (0 m - 344 m) • Resolution: 0.1 ms • Test signal: NTi Audio delay test signal generated by the MR-PRO, MR2 or the included NTi Audio Test CD / USB Flash Drive
Noise Curves	• Noise Rating NR according to ISO/R 1996-1971 • Noise Criteria NC in accordance with ANSI S12.2-2019 and -1995 • Room Noise Criteria RNC in accordance with ANSI S12.2-2019 • Room Criteria RC in accordance with ANSI S12.2-1995 • Preferred Noise Criteria in accordance with ASA 1971 • Application range of measurement microphones: » M2230: down to NC15 » M2340: down to NC15 » M2211: down to NC20 » M4261: down to NC25

1/12 Octave Analysis (optional)	• Actual level, Lmin, Lmax, Leq, Leq1", Leq4" • Selectable 1/1, 1/3, 1/6 and 1/12 octave spectral resolution • Measurement Units: Volt, dBu, dBV and dBSPL • Band pass filters (base 10) • Capturing of multiple readings into the internal memory • Comparing measurement results against captures with relative or absolute curve display • Comprehensive tolerance handling • Creating tolerance masks based on captures for passed/failed measurements
Cinema Meter (optional)	• Measurements in 1/3 octave resolution in accordance with SMPTE ST 202:2010 and SMPTE RP 200:2012 • An interactive assistant guides the user through dedicated measurement procedures. • Consists of » Spectral Limits Option NTi Audio # 600 000 376 » Cinema Assistant Option NTi Audio # 600 000 378

STIPA Speech Intelligibility (optional)	• Measurement in accordance with the standards » IEC 60268-16 (edition 2, 3, 4 or 5) » AS 1670.4 » BS 5839-8 » CEN/TS 54-32:2015 » DIN EN 50849:2017 » ISO 7240-16 » ISO 7240-19:2007 » DIN VDE 0833-4 » VDE V 0833-4-32:2016 » VDE 0828-1:2017-11 » NFPA 72 » UFC 4-021-01 • Direct measurement method (IEC 60268-16) • Frequency range: 125 Hz - 8 kHz in octave band • Modulation frequencies 0.63 Hz - 12.5 Hz in third-octave resolution • Single value STI and CIS test result • Ambient noise correction • Automated averaging of measurements • Modulation indices and individual band level results with error indicator • Test signal: NTi Audio STIPA signal generated by the MR-PRO, NTi Audio TalkBox or other audio players (download wav-file at https://my.nti-audio.com/support/xl2)

Audio Analyzer	
Conforms with Standards	• IEC 61672, IEC 60651, IEC 60804 • DIN EN 60065, VDE 0860, IEC 468-4
Level RMS	• True RMS detection in V, dBu, dBV, dBSPL (dBSPL not available for XL2-TA) • Power measurement in Watt W or dBm with flexible load setting from 1.0 to 9999 Ohm • Range XLR/RCA input: 2 µV - 25 V (-112 dBu to +30 dBu) • Accuracy: ± 0.5 % @ 1 kHz, • Flatness: ± 0.1 dB @ 12 Hz to 21.3 kHz • Bandwidth (-3 dB): 5 Hz to 23.6 kHz • Resolution: 3 digits (dB scale),5 digits (linear scale) or 6 digits (x1 scale)
Real-Time Analyzer RTA	Following measurement functions offer audio spectrum in Volt, dBu and dBV • Sound Level Meter • FFT • 1/12 Octave (optional with Spectral Limits)
Frequency	• Range: 9 Hz to 21.3 kHz • Resolution: 6 digits • Accuracy: < ± 0.003%
THD+N (Total Harmonic Distortion + Noise)	• Range: -100 dB to 0 dB (0.001% to 100%) • Minimum level: > -90 dBu • Fundamental frequency range: 10 Hz to 21.3 kHz • Measurement bandwidth: 2 Hz to 23.6 kHz • Resolution: 3 digits (dB scale) or 4 digits (linear scale) • Residual THD+N @ XLR/RCA input: < 2 µV

Scope	Auto ranging, auto scaling
Filter	• Frequency weighting: A, C, Z • Highpass 100Hz, 400 Hz, 19 kHz, • Bandpass 22.4 Hz - 22.4 kHz in accordance with IEC468-4
Remote Measurement (optional)	Querying measurement data online via the USB interface of the following functions: • Sound level meter and spectrum analyzer SLMeter/RTA • FFT analyzer • RT60 reverberation time • Audio analyzer RMS/THD+N • High-resolution spectral analyzer 1/12 Oct + Tol

Calibration	
Free-field Correction	• NTi Audio Class 1 Sound Calibrator » M2230: -0.1 dB » M2340: -0.1 dB » M2211: -0.1 dB » M2215: -0.1 dB • NTi Audio Class 1 Sound Calibrator with 1/4" Calibration Adapter, type ADP 1/4-P » M4260: +0.1 dB » M4261: +0.2 dB
Wind Screen Correction	• 50 mm Wind Screen: +0,12 dB • 90 mm Wind Screen: +0,19 dB • WP30/WP61 Wind Screen 90 mm: +0,19 dB

Calibration	• Recommended calibration interval: one year • Microphone calibration with external calibrator supported • Optional calibration certificate for new instruments available

Vibration Meter	
Channels	• 1 (Single-channel)
Parameters	• Real time measurement in » Acceleration: m/s2, g, in/s2, dB » Velocity: m/s, in/s, dB » Displacement: m, in, dB » Peak particle velocity PPV: mm/s, in/s » Levels: RMS, Peak, Peak-Peak
VibMeter	• Broadband level » Frequency range: 0.8 Hz - 2.5 kHz • Spectral » 1/1 octave band display: 1 Hz - 2.0 kHz sub ranges 1 Hz - 500 Hz or 4 Hz - 2 kHz » 1/3 octave band display: 0.8 Hz - 2.5 kHz sub ranges 0.8 Hz - 1.0 kHz, 2.5 Hz - 2.5 kHz » Broadband level measured with bandwidth (- 3dB): 0.7 Hz – 23.6 kHz • Display according to DIN 45669-1:2010 » Unweighted velocity v(t) » Maximum absolute velocity ¦v¦max » Averaging duration T_m » Measurement duration T_M

Filter	• Flat (no filter) Bandwidth (- 3dB): 0.7 Hz – 23.6 kHz • 10 - 1000 Hz according to ISO 2954 with decay rate = 18 dB / octave • 1 - 80 Hz, 1 - 315 Hz acc. to DIN 45669-1:2010 with decay rate = 12 dB / octave
Audio Recording in VibMeter	• Default » Recording of compressed wav-files (ADPCM - 4 bit, 24 kHz) » a new wav-file starts every 12 hours (max. wav-file size 512 MB) » Bandwidth: 2.0 Hz - 10.2 kHz • Optional: Extended Acoustic Pack » Recording of linear wav-files (24 bit, 48 kHz) » a new wav-file starts every 1 hours (max. wav-file size 512 MB) » Bandwidth: 2.0 Hz - 23.6 kHz
FFT Analysis	• Frequency range: 1 Hz - 1.69 kHz • Optional with Extended Acoustic Pack or Spectral Limits: High-resolution Zoom-FFT with selectable frequency ranges and resolution up to 0.4 Hz in the range of 1 Hz to 20 kHz
1/12 Octave Analysis (optional)	• Actual level, L_{min}, L_{max}, L_{eq}, Leq1", Leq4" • Selectable 1/1, 1/3, 1/6 and 1/12 octave spectral resolution • Measurement Units » Acceleration: m/s2, g, in/s2, dB » Velocity: m/s, in/s, dB » Displacement: m, in, dB • Band pass filters (base 10) • Frequency range: 0.73 Hz - 1.36 kHz

Maximum Input Level	• 353 m/s2, 36 g @ 20 mV/(m/s2) with ICP Adapter ASD
Residual Noise (typical) with ICP Adapter ASD	• 17 µV @ 0.7 Hz ... 23.0 kHz • 14 µV @ 1 Hz ... 315 Hz • 14 µV @ 1 Hz ... 80 Hz
Reference-measurement range	• Mid

Input / Output Interfaces	
Audio Inputs	• XLR balanced » Input impedance = 200 kOhm » Phantom power: +48 VDC switchable with maximum 10 mA supply current in accordance with IEC 61938 » Automated sensor detection for NTi Audio's ASD measurement microphones and pre-amplifier MA220 • RCA unbalanced with input impedance >30 kOhm • Built-in condenser microphone for polarity testing, delay measurements and voice note recording
Audio Outputs	• Built-in speaker • Headphone connector » 3.5 mm Minijack » mono monitor wired to both channels of stereo jack » Linear output signal over a measurement range of 57 dB in SLMeter measurement function
USB Interface	USB mini connector for data transfer to PC, XL2 Projector PRO and/or charging of Li-Po battery
Digital I/O	Connection interface to accessories • XL2 Input Keypad • Limit Light • Stack Light • Digital I/O Adapter PCB
TOSLink	24 bit linear PCM audio signal output (prepared for later firmware extension)

Memory	SD Card included (8 GByte), removable, storing measurement data in ASCII format, screen shots, voice notes and wav-files Data logging every second offers following noise monitoring periods: • Logging default noise levels: > 2 years • Additional logging of 1/3 octave data: > 6 month • Additional » compressed audio recording: > 1 week » linear audio recording: > 15 hours Optional 32 GB SD Cards are available for longer monitoring requirements; requires XL2 Firmware V4.10 or higher.
Power Supply	• Rechargeable Li-Po battery included » Type 3.7 V / 2260 mAh » Typical battery lifetime > 4 hours » Range: 3.3 - 4.5 VDC » Volume energy density = 339 Wh/l • Dry cell batteries type AA, 4 x 1.5 V » Typical battery lifetime > 4 hours » Range: 3.7 - 6.0 VDC • Linear external power supply 9 VDC » Range: 7.5 - 20.0 VDC @ minimum 6 Watt » Charges Li-Po battery during operation • USB-Power Supply » for short-term operation < 1 day » charging power is equal or less than power consumption

Power Supply	• External battery pack » 22 Ah battery pack: 4 days » 44 Ah battery pack: 8 days

General	
Clock	• Default » Real-time clock with lithium backup battery » Typical life backup battery: 8 years » Return instrument for battery replacement » Drift < 1.7 seconds per 24 hours • Special XL2 edition, NTi Audio # 600 000 356 » VCXTO clock » Drift < 0.04 seconds per 24 hours
Mechanics	• Tripod or microphone stand mount 1/4” • Wire stand mounted on rear side • Display: 160 x 160 pixels grey scale with LED back light • Dimensions (L x W x H) » 180 mm x 90 mm x 45 mm » 7.1” x 3.5” x 1.8” • Weight: 480 g (1 lb) including built-in Li-Po battery
Temperature	-10 °C to +50 °C (14° to 122°F)
Humidity	5% to 90% RH, non-condensing
Static air pressure	65 kPa to 108 kPa
Susceptibility to radio frequencies	Classification Group X

Electromagnetic Compatibility	CE compliant: EN 61326-1 Class B, EN 55011 class B EN 61000-4-2 to -6 & -11
Protection Rating	IP51
ATEX	• For applications in explosive atmospheres within zone 2 in accordance with IEC 60079 • Conforms to 2014/34/EU

24. Technical Data Microphones

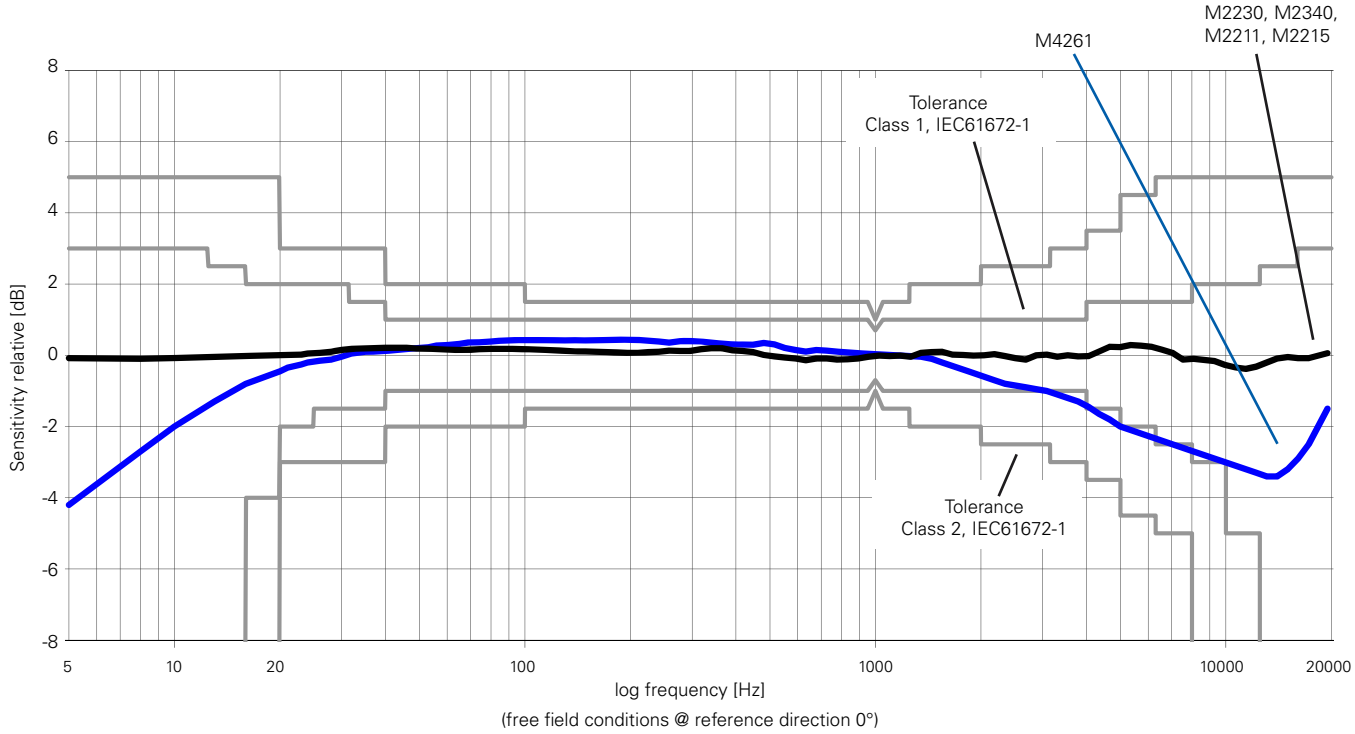
	M2230	M2340 (with self-test)	M2211	M2215 (high levels)	M4261
Classification with XL2 according to IEC 61672, ANSI S1.4	Class 1 Certified	Class 1	Frequency Response Class 1		Class 2
Consisting of	PreAmplfier MA220 + MC230 or MC230A Capsule	PreAmplfier MA230 + MC230A Capsule	PreAmplfier MA220 + Capsule 7052	PreAmplfier MA220 + Capsule 7056	M4261 microphone with permanently installed capsule
Microphone Type	Omnidirectional, pre-polarized condenser, free field microphone				
Capsule / Transducer	1/2" detachable with 60UNS2 thread, type WS2F according IEC 61094-4				1/4" permanently installed
PreAmplifier Type	MA220	MA230	MA220		-
System Self-test (CIC)	-	with XL2	-		
Flatness tolerance bands typical	±1 dB @ 5 Hz - 20 Hz ±1 dB @ >20 Hz - 4 kHz ±1.5 dB @ >4 kHz - 10 kHz ±2 dB @ >10 kHz - 16 kHz ±3 dB @ >16 kHz - 20 kHz				+1/-4.5 dB @ 5 Hz - 20 Hz ±1.5 dB @ >20 Hz - 4 kHz ±3 dB @ >4 kHz - 10 kHz ±4.5 dB @ >10 kHz - 16 kHz ±5 dB @ >16 kHz - 20 kHz
Actual Frequency Response	freely available as Excel-data, register product at https://my.nti-audio.com and contact info@nti-audio.com				
Frequency Range	5 Hz - 20 kHz				
Residual Noise Floor typical	16 dB(A)	17dB(A)	21 dB(A)	25 dB(A)	27 dB(A)
Maximum SPL @ THD 3%, 1 kHz, S_typical	137 dBSPL	138 dBSPL	144 dBSPL	153 dBSPL	142 dBSPL

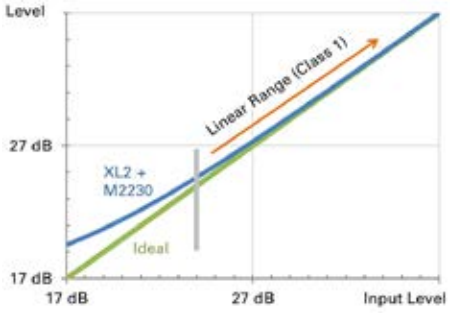
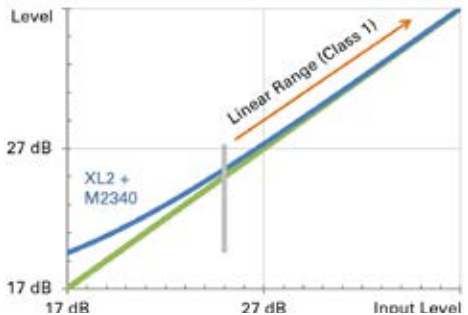
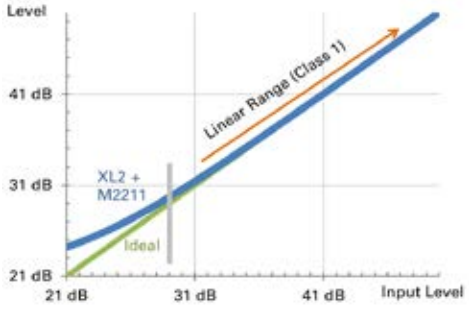
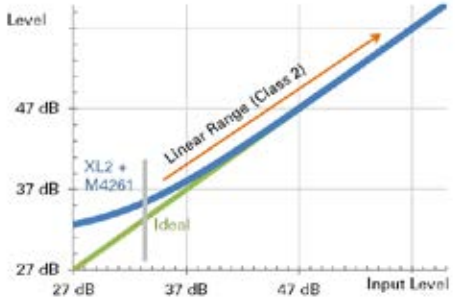
	M2230	M2340 (with self-test)	M2211	M2215 (high levels)	M4261
Sensitivity typical @ 1 kHz	-27.5 dBV/Pa ±2 dB (42 mV/Pa)		-34 dBV/Pa ±3 dB (20 mV/Pa)	-42 dBV/Pa ±3 dB (8 mV/Pa)	-36 dBV/Pa ±3 dB (16 mV/Pa)
Temperature Coefficient	< -0.01 dB / °C		< ±0.015 dB / °C		< ±0.02 dB / °C
Temperature Range	-10°C to +50°C (14°F to 122°F)				0°C to +40°C (32°F to 104°F)
Pressure Coefficient	-0.005 dB / kPa		-0.02 dB / kPa		-0.04 dB / kPa
Influence of Humidity (non-condensing)	< ±0.05 dB				< ±0.4 dB
Humidity	5% to 90% RH, non-condensing				
Long-term Stability	> 250 years / dB				-
Power Supply	48 VDC phantom power				
Current Consumption typical	2.3 mA	0.8 mA	2.3 mA		1.7 mA
Electronic Data Sheet	NTi Audio ASD in accordance with IEEE P1451.4 V1.0, Class 2, Template 27				
Output Impedance	100 Ohm balanced				
Connector	Balanced 3-pole XLR				
Diameter Dimensions	20.5 mm (0.8")				
Length Dimensions	154 mm (6.1")		150 mm (5.9")		
Weight	100 g (3.53 oz)				83 g (2.93 oz)
Environmental Protection	IP51				
Windscreen Diameter	50 mm (2")	90 mm (3.5")	33 mm (1.3")	33 mm (1.3")	33 mm (1.3")
Scope of Supply	Windscreen, Microphone Holder with Adapter 5/8" - 3/8", Manual				
NTi Audio #	600 040 050	600 040 230	600 040 022	600 040 045	600 040 070

Outdoor Measurement Microphones

	M2230-WP (M2230+WP30)	**M2340-WP (M2340+WP30)**	**M4261-WP (M4261+WP61)**
Classification with XL2 according to IEC 61672, ANSI S1.4	Class 1 Certified	Class 1	Class 2
System Self-test (CIC)	-	with XL2	-
Windscreen Diameter	90 mm (3.5”)		
Diameter Dimensions	36 mm (1.4”)	36 mm (1.4”)	36 mm (1.4”)
Length Dimensions	378 mm (14.9”)	378 mm (14.9”)	378 mm (14.9”)
Weight	430 g, 15.17 oz	430 g, 15.17 oz	413 g, 14.57 oz
Environmental Protection	IP54 in vertical position	IP54 in vertical position	IP54 in vertical position
Mounting	Standard 3/8” tripod mount included		
Optional Pole Mount Adapter	• Pole Mount Adapter PM 1” for pole diameter 25 - 33 mm (1-1.3”) NTi Audio # 600 040 067 • Pole Mount Adapter PM 1 1/4” for pole diameter 32 - 44 mm (1.25-1.75”) NTi Audio # 600 040 068		
NTi Audio #	600 040 050 + 600 040 060	600 040 230 + 600 040 060	600 040 070 + 600 040 080

Typical Frequency Response of Measurement Microphones



Linear Measurement Range acc. IEC61672 / ANSI S1.4 (typ. microphone sensitivity)	**XL2 + M2230:** 24 dB(A) - 137 dB	**XL2 + M2340:** 25 dB(A) - 138 dB
		
	XL2 + M2211: 29 dB(A) - 144 dB	**XL2 + M4261:** 33 dB(A) - 146 dB
		

Free Field - Pressure Correction Factors

If a measurement microphone is held in a free-field environment, then the measurement microphone acts at high frequencies like a reflector. The sound pressure increases in front of the microphone capsule membrane. M2230, M2340, M2211 and M2215 are free-field equalized measurement microphones, they compensate for the increased pressure internally. The calibration of the measurement microphones M2230 and M2340 with the B&K 4226 requires the accessory Adapter Ring MXR01, NTi Audio # 600 040 105. Please note, never touch the diaphragm of the measurement microphone capsule.

The calibrator no longer offers free-field conditions. Therefore, the free-field equalization of the microphone must be compensated. This needs to be considered prior the calibration. The correction value needs to be added to the pressure response of the microphone.

Example:

- During the calibration, the XL2 measures the sound level in the calibrator. If the B&K 4226 calibrator is used and it is set to 16 kHz, then the XL2+M2230 reads just 86.7 dBA.
- The free-field sound level is calculated by summing the XL2 measurement value and the correction value (86.7 dB + 7.3 dB = 94.0 dB).

The following corrections apply with the B&K 4226 calibrator:

Nominal Frequency [Hz]	M2230, M2340 with MXR01 Adapter [dB]	M2230, M2340 [dB]	M2211 [dB]	M2215 [dB]	Measurement Uncertainty U [dB]
31.5	-0.3	0.0	-0.2	0.0	0.3
63	0.0	0.0	0.0	0.0	0.3
125	-0.2	0.0	-0.1	-0.1	0.3
250	-0.2	0.0	-0.1	-0.1	0.3
500	-0.2	0.0	-0.1	-0.1	0.3
1000	0.0	0.0	0.0	0.0	0.3
2000	0.1	0.3	0.1	0.0	0.3
4000	0.7	0.7	0.7	0.4	0.3
8000	2.7	2.6	4.5	4.7	0.4
12500	7.2	6.0	5.8	6.1	0.7
16000	7.3	7.3	7.9	7.9	0.8

Correction values for other calibrators for M2230 and M2340:

Type	Correction Value	Calibration Frequency	Calibration Level
NTi Audio CAL200	-0.1	1 kHz	114 dB
B&K 4231	-0.2	1 kHz	114 dB
Norsonic Nor-1251	-0.2	1 kHz	114 dB

Actuator Correction

The following free-field 0° incidence corrections apply for calibration using a protection grid actuator (e.g. B&K UA033, GRAS RA0014). Please note, never touch the diaphragm of the measurement microphone capsule. The maximum DC bias for the actuator calibration is 200 VDC.

M2211, M2215

Nominal Frequency [Hz]	M2211 [dB]	M2215 [dB]
31.5	0.0	0.0
63	0.0	0.0
125	0.0	0.0
250	0.0	0.0
500	0.1	0.0
1000	0.1	0.0
2000	0.6	0.2
4000	1.7	1.2
8000	4.2	3.9
12500	7.3	6.7
16000	9.2	9.0

M2230, M2340

The calibration requires the accessory Actuator Grid, NTi Audio # 600 040 112. The Actuator Grid comes with an insulation ring dedicated for this measurement method.

Nominal Frequency [Hz]	M2230, M2340 [dB]
<400	0.0
400	-0.2
500	0.0
630	-0.2
800	0.0
1000	0.0
1250	-0.1
1600	0.2
2000	0.2
2500	0.3
3150	0.8
4000	1.0
5000	1.6
6300	2.4
8000	3.6
10000	4.8
12500	6.5
16000	9.3
20000	11.7

Diffuse-field Sensitivity Level Correction

A diffuse sound field is characterized by the sound arriving at the receiver from all directions with more or less equal probability. The M2230, M2340, M2211, M2215 and M4261 are free-field equalized measurement microphones. The default frequency response refers to a 0° sound incidence. The diffuse-field sensitivity level correction is calculated by averaging the directional characteristics in accordance with IEC 61183. The corrections for diffuse-field conditions are documented in the following table and may be activated directly on the XL2; see Spectral Corrections. The directional response of the M2230 is described in the appendix.

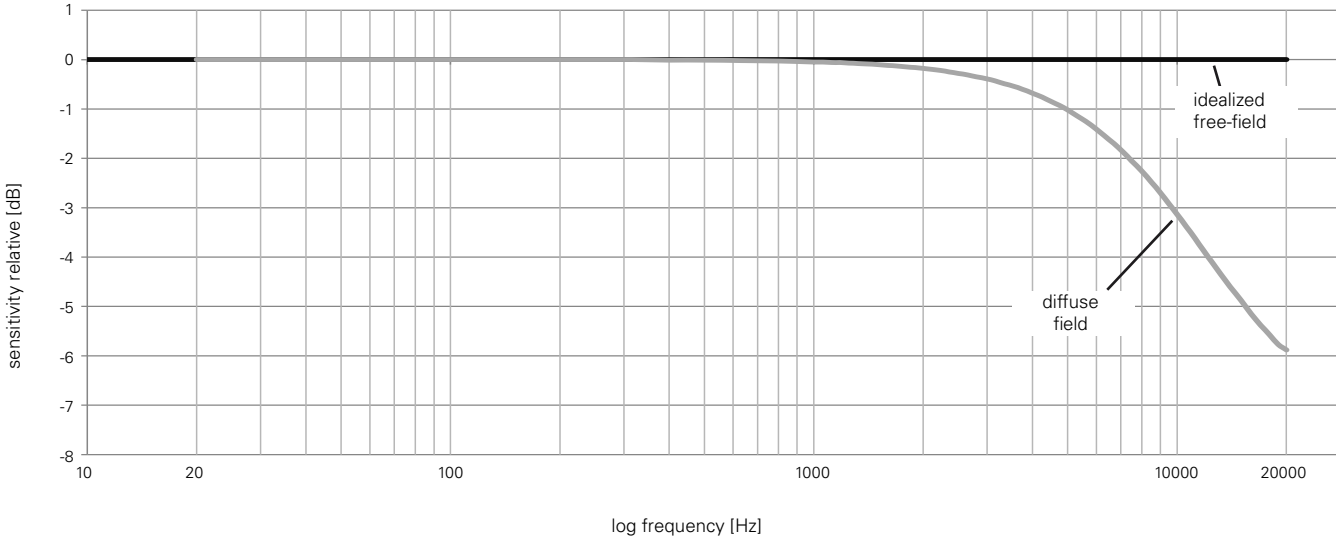
Example:

- The sound pressure level in a diffuse sound field shall be determined. The display of the XL2 with the M2230 reads 80.0 dBA for the 20 kHz third-octave band.
- The diffuse sound level is now calculated from the sum of the XL2 measurement value and the correction value (80.0 dB + 5.9 dB = 85.9 dB).

The diffuse-field sensitivity level correction is not necessary using a diffuse field equalized measurement microphone.

Nominal Frequency [Hz]	1/2" Microphone M2230, M2340, M2211, M2215 [dB]	1/4" Microphone M4261 [dB]
<63	0.0	0.0
63	0.0	0.0
80	0.0	0.0
100	0.0	0.0
125	0.0	0.0
160	0.0	0.0
200	0.0	0.0
250	0.0	0.0
315	0.0	0.0
400	0.0	0.0
500	0.0	0.0
630	0.0	0.0
800	0.0	0.0
1000	0.0	0.0
1250	0.1	0.1
1600	0.2	0.1
2000	0.2	0.1
2500	0.4	0.2
3150	0.6	0.3
4000	0.8	0.3
5000	1.3	0.5
6300	1.8	0.8
8000	2.5	1.1
10000	3.4	1.6
12500	4.4	2.2
16000	5.3	2.8
20000	5.9	3.4

Free-field and Diffuse-Field Sensitivity for M2230 and M2340



Spectral Correction for horizontal Sound Incidents using the Outdoor Microphone

The outdoor measurement microphone fulfills the requirements of IEC 61672 and ANSI S1.4 for vertical sound incidence. For compliance with horizontal sound incidence a spectral correction is employed in the associated XL2 Sound Level Meter.

Select **Calibrate Menu: Show Spec Correction** in the **System Settings.** This will enable the spectral correction field in the **Calibration** menu.

Spectral Correction for horizontal sound incidents:

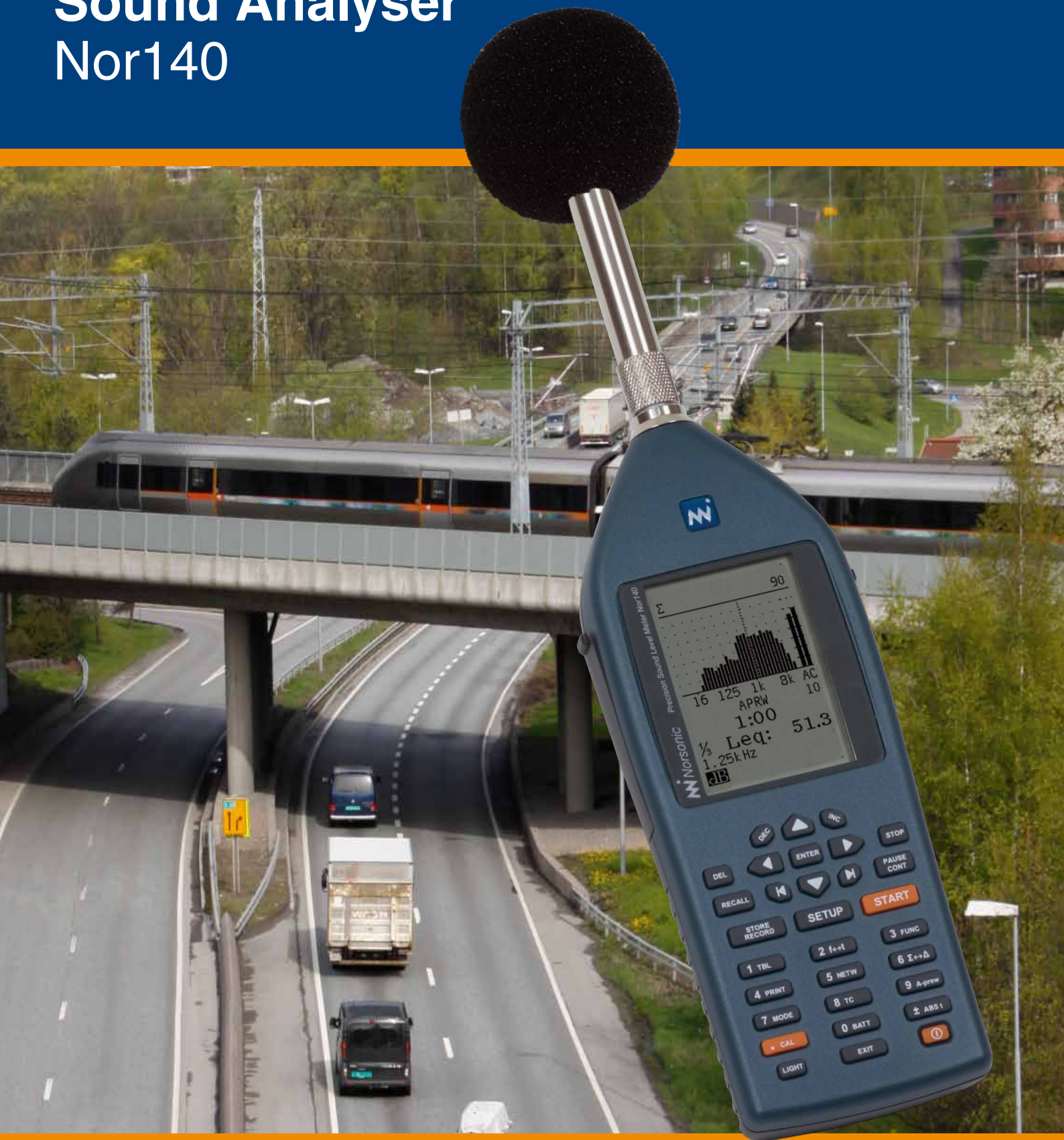
Nominal Frequency [Hz]	WP30 Weather Protection [dB]		WP61 Weather Protection [dB]	
	1/3 Octave	1/1 Octave	1/3 Octave	1/1 Octave
<800	0.0	0.0	0.0	0.0
800 1000 1250	0.0 0.0 0.1	0.0	0.0 0.0 0.0	0.0
1600 2000 2500	0.2 0.3 0.7	0.4	0.2 0.3 0.8	0.4
3150 4000 5000	1.3 2.0 2.7	2.0	1.4 2.1 2.5	2.0
6300 8000 10000	2.9 3.3 3.9	3.4	2.3 2.4 2.8	2.5
12500 16000 20000	4.6 6.4 6.8	5.9	3.0 3.1 3.1	3.0

25. Technical Data PreAmplifier

	MA220 PreAmplifier	MA230 PreAmplifier with self-test (CIC)
Microphone PreAmplifier	Compatible with 1/2" microphone capsules type WS2F in accordance with IEC61094-4	
Frequency Range (-3dB)	4 Hz - 100 kHz	1.3 Hz - 50 kHz
Residual Noise Floor typical	1.9 µV(A) at C_in 15 pF ≙ 5.6 dBA @ 42 mV/Pa	2.4 µV(A) at C_in 15 pF ≙ 9.1 dBA @ 42 mV/Pa
Frequency Response Flatness	±0.2 dB	±0.1 dB, 10 Hz - 20 kHz
Phase Linearity	< 1° @ 20 Hz - 20 kHz	
Maximum Output Voltage @ THD 3%, 1 kHz	21 Vpp ≙ 7,4 Vrms ≙ 138,9 dBSPL @ 42 mV/Pa	22 Vpp ≙ 7,8 Vrms ≙ 139,3 dBSPL @ 42 mV/Pa
Electronic Data Sheet	Containing user calibration data; default factory sensitivity = 4.9 V/Pa Read/write by XL2 Audio and Acoustic Analyzer NTi Audio ASD in accordance with IEEE P1451.4 V1.0, Class 2, Template 27	
Impedance	Input: 20 GOhm // 0.26 pF, Output: 100 Ohm balanced	
Power Supply	48 VDC phantom power, 2.3 mA typical	48 VDC phantom power, 0.8 mA typical
Attenuation	< 0.17 dB (Rphantom 2x 6.8 kOhm)	< 0.07 dB (Rphantom 2x 6.8 kOhm)
Connector	Balanced 3-pole XLR	
Thread for Capsule	60 UNS2	
Weight	90 g, 3.17 oz	
Dimensions	Length 142.5 mm (5.6"), diameter 20.5 mm (0.8")	
Temperature Range	-10°C to +50°C (14°F to 122°F)	
Humidity	5% to 90% RH, non-condensing	
NTi Audio #	600 040 040	600 040 200

The product specifications may vary based on the mounted microphone capsule type.

Sound Analyser
Nor140



Norsonic

Applications:

- Environmental noise
- Sound recording
- Building acoustics
- Reverberation time
- Noise source identification
- Industrial hygiene
- Low frequency measurements
- Remote noise monitoring
- Product development
- Quality control
- Sound power
- Speech intelligibility - STIPA
- Vibration measurements
- HVAC noise
- Low noise measurements

Features:

- Precision integrating sound level meter to IEC 61672 class 1
- Handheld real-time 1/1- or 1/3-octave frequency analyser (0,4Hz-20kHz)
- Measurement of A-weighted levels simultaneously with either C- or Z-weighted levels
- Parallel detection of SPL, L_{Eq}, L_{min}, L_{max}, L_E and L_{peak}
- 120 dB dynamic range giving a “one-range” instrument
- Measures L_{peak} levels up to 140 dB
- Parallel detection of F, S and I time constants
- USB 2.0 and High-speed RS-232 serial interface (115 kbaud)
- SD memory card and large high speed internal memory
- Sound recording in 8, 16 or 24 bit format with 12 or 48 kHz sampling
- Up to 90 sec high, contrast, graphical audio recording pretrigger
- High-resolution graphical backlit display
- Manual or automatic storage of results
- Automatically repeated measurements with clock synchronization
- Pause/Continue function with back erase feature
- Results displayed as dB or linear values
- Numerical printouts
- AC output signal
- Signal generator
- Windscreen correction
- Noise floor correction
- Support for IEPE sensors
- NC, NR and RC rating
- Multiple language selection
- Moving L_{eq}

The Nor140 – more than just a Sound Level Meter

The precision handheld sound analyser Nor140, covers the widest range of applications, packed into the smallest real time analyser featuring sound recording present on the market today!

Norsonic's philosophy has always been to cover all possible applications within one modular instrument platform. We were the first company introducing software options. This enables functional expansion to take place when you need it and not necessarily at the time you purchase the instrument. The design is based on decays of experience making intuitive and easy to use field instrumentation. The Nor140 is Norsonic's second generation of handheld sound level meters featuring sound recording.

The Nor140 is more than a Sound Level Meter, it is a measurement platform used in Environmental Noise Monitoring Systems as well as a front end in Nor850 - our Multi-channel Building Acoustic and Sound Power Analyser.

Quality and durability - 3 years warranty

After the introduction the Nor140 immediately became a success. The user-friendliness, the broad range of applications covered by this single instrument and associated PC software makes the Nor140 to a market leader. It is covered by a 3 years warranty and is type approved by all the prestigious national approval laboratories worldwide, such as PTB in Germany and LNE in France. The Norsonic retrofit policy, allowing the users to add options later when needed, the frequent release of new software features combined with durability and Norsonic quality ensures that you do the right decision when purchasing a Nor140.

The instrument platform

By listening to key customers and our long experience in designing sound level meters, every effort has been made to design a rugged, small and lightweight, yet powerful instrument platform.

Clear display - user friendly

The large backlit display with a mirror effect is excellent to read in sunlight. The backlight is only needed in dark environments.

The instrument is designed to be operated by the same hand that holds the instrument. There is no need for a stylus. Real keys ensure tactile feedback to the user. The dust and splash proof rubber covers for the connectors and SD memory card together with the high friction coating on rear cover ensures an optimum grip and user comfort. A range of factory setup together with the possibility for the user to create his/her own setups minimise the risk of making mistakes when preparing the instrument prior to a measurement run. For simple use, the three orange buttons is what is needed to make a measurement; power on – calibrate – start measurement.

Memory – Storage handling

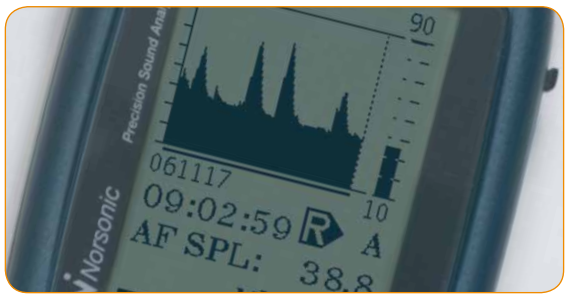
The instrument contains both an internal memory and an exchangeable SD memory card. The internal memory features the same structure as the SD card, but it is mainly intended for high-speed sampling applications. A backup copy of the current measurement is made every two minutes. This ensures that if a power interrupt occurs, a maximum of two minutes of data may be lost. The measurement is also automatically saved when a battery low warning is given. A special feature is making the instrument to auto restart and continue to measure after a power failure condition. This is especially useful for long term monitoring applications. To optimise the user friendliness four types of storage modes are supported:

Manual: The user manually stores the measurement.

Automatic: The instrument stores all results automatically when a measurement is completed or if stop is pressed.

Repeat: Same as automatic but it automatically restarts a measurement.

Synchronous: Same as repeat but the first measurement will be truncated to allow synchronisation to the next whole clock hour.



Interfaces and connectors

The instrument has one USB 2.0 high-speed data interface and one high speed RS232 interface. The multi I/O socket additionally contains several digital I/O ports for different control applications such as remote start/stop of the measurement process or audio recording and Go/NoGo signals for quality control applications. Two analogue outputs are available. One is dedicated to the signal generator output (optional), the other for AC output of the measured signal. A separate connector is available for Tacho meter (RPM) input.

The microphone input connector is a traditional 7 pin LEMO connector. This standard was invented by Norsonic in the early nineties, now widely adopted by most of the world's sound measuring equipment manufactures. In the Nor140 we have added two useful features to this standard, improving its original functionality. Firstly IEPE® power is added thereby allowing the use of signal line powered sensors such as accelerometers and electret microphones with IEPE® preamplifiers. This removes the need of expensive adaptors or cables for connection to the instrument. The second feature is the built-in calibration oscillator for verification of outdoor microphones; a great advantage on long term noise monitoring projects.

Power management

Our users told us that it is important to be able to change batteries in the field, and that the unit must use standard batteries that may be obtained anywhere. Hence, we designed it to use four standard AA-cell batteries. However, the instrument also accepts rechargeable batteries. A battery monitor tells the user the status of the batteries. The instrument may also be directly connected to any 12V source such as a car battery via the external DC input connector. An interrupt free inter-connection between internal batteries and external powers ensures a power system with the highest possible security.

Preamplifier and microphone

The Nor140 is delivered with a 1/2" microphone Nor1225 and preamplifier Nor1209. In some markets Nor1227, a prepolarised version of Nor1225 is delivered. Both types are a 50mV/Pa free field microphone. The instrument has user selectable diffuse field (random incident) and windscreen correction networks. The preamplifier Nor1209 is a low noise preamplifier that can drive long microphone cables without any loss in performance. For special applications other types of microphones and preamplifiers, such as 1/4" types or 1/2 " low noise microphone systems like the GRAS 40HL may be connected. The preamplifier Nor1209 has a built-in microphone check facility (SysCheck) allowing remote verification of the Norsonic range of outdoor microphones.

One measurement range

The Nor140 has more than 120 dB dynamic span in a single measurement range. This makes the use of the instrument easy since there is no gain control to adjust; all measurements are covered by one range. The wide dynamic range covers all applicable functions such as the spectral weighting networks, real time 1/1- and 1/3-octave filters as well as the FFT option.

In order to extend the flexibility of the instrument a special high range mode can be selected. This shifts the upper measurement range by 10 dB to 150 dB with the standard Nor1225 microphone and up to 190 dB with special 1/4" microphones.

A self-noise compensation feature can also be selected to extend the lower measurement range of the A, C or Z network. This typically extends the measurement range downwards by 7 to 10 dB.

The Measured functions

The functions available with the Nor140 include

SPL	Time-weighted Sound Pressure Level (F, S, I)
L_{max}	Maximum Time-weighted Sound Pressure Level
L_{min}	Minimum Time-weighted Sound Pressure Level
L_{eq}	Time-Average Sound Pressure Level
L_{eqI}	Time-Average Impulse-weighted Sound Pressure Level
L_E	Sound Exposure Level
L_{EI}	I-Time weighted Sound Exposure Level under measured functions
L_{peak}	Maximum Peak Level
L_N	Statistically Calculated Exceedance Level
RT	Reverberation time, T20 and T30 (Optional)
NC	Noise Criteria value
NR	Noise Rating value
RC	Room Criteria value

STIPA Speech Transmission Index for Public Adress system (Optional)

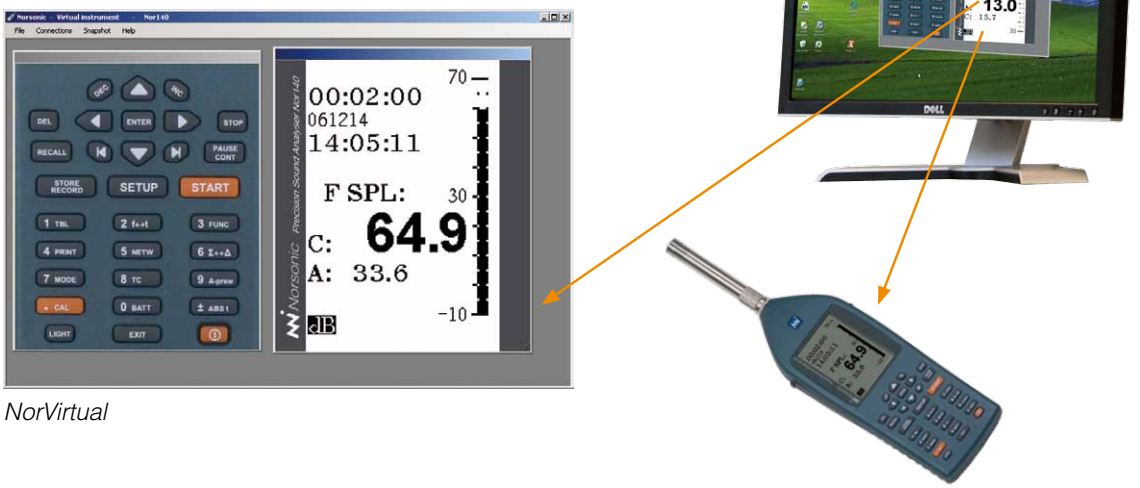
T_{max5} "Takt Maximalpegel" according to DIN45657 (Optional)

Moving L_{eq} with adjustable window length (Optional)

The spectral weighting functions A- and C- or Z-weighting are available for all functions including the L_{peak}. The SPL, L_{max} and L_{min} functions are measured for all the three time constants F, S and I. All the above functions are also measured in each band if 1/1 or 1/3 octave analyses extensions are added with the exception of L_{peak}.

NorVirtual instrument

Included in the Nor140 delivery is the Virtual Instrument software; a PC program that brings a virtual version of the instrument onto your PC screen. The user may remotely operate the keyboard, and view a picture of the instrument display on the PC screen. A useful tool for seminars, schools and similar applications where more than one person needs to view the operation of the instrument and the display.



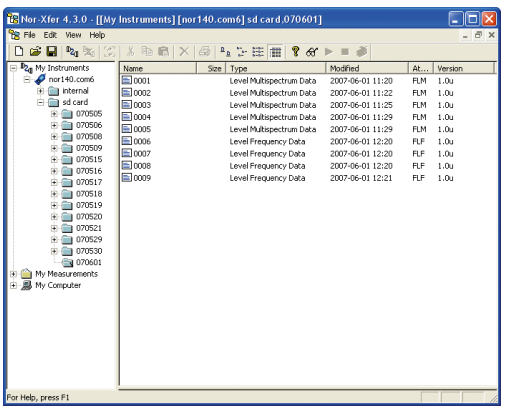
NorVirtual

NorXfer

Also supplied with the instrument is the PC data transfer software NorXfer. This program transfers and converts the measurement results from the internal memory or from the SD memory card to the PC. The data can then be seamlessly used by all other Norsonic post processing programs, such as NorReview, NorBuild or NorPower.

NorReport is an add-in module to the NorXfer. This reporting program enables the user to create Excel templates for calculation and reporting. A vast range of standard templates exist to cover for the local markets need. The measured data can also be directly converted into Excel or text files

Two optional extensions (not included in standard delivery) can be added to NorXfer. Option 1 is modem control, and option 2 is remote control of all Nor140 functions and setup parameters.



NorXfer

The Nor 140 as an Environmental noise monitoring analyser

The large memory and the time synchronising capabilities of the Nor140 makes it well suited to any environmental noise measurement and as a front-end in noise monitoring systems – perfect for community noise as well as indoors in workshops etc.

The high dynamic range makes the setup easy and ensures reliable measurements in all situations.

Source identification is possible thanks to the sound recording feature and eight markers, where four can be set for independent source coding.

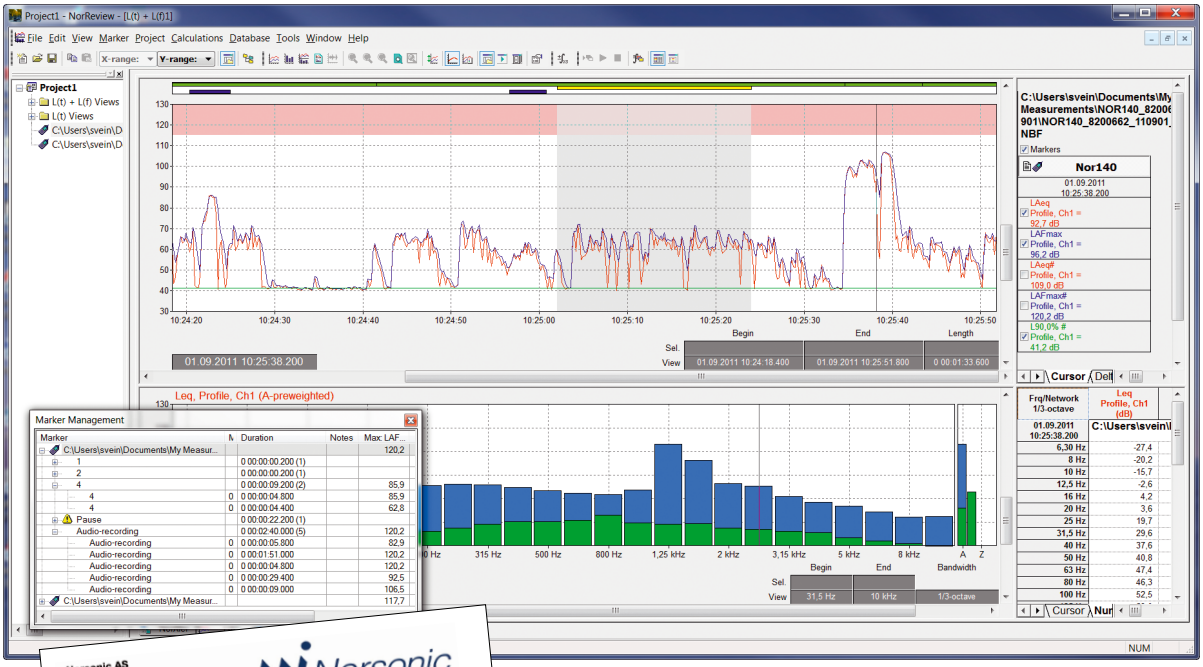
- Huge memory, both internal and on a removable SD card
- Sound recording
- 8 marker functions
- Precise internal clock for accurate timing between several Nor140 instruments
- Profile measurements with level vs. time resolution from 25ms to 199h
- Multi spectrum
- Statistical calculations, even in frequency bands
- 120dB dynamic range, also for the 1/1-octave and 1/3-octave real time filters
- Pure tone detection
- Microphone check
- Advanced post processing reports using NorReview software
- L_{den} calculation using NorReview software

The Nor140 is designed to be left unattended for monitoring noise either as a measurement device in a larger sound monitoring system or semi-permanently for some days or weeks. The measurement results can be collected by swapping the SD memory card or downloaded via modem or LAN/WLAN/Bluetooth connections. In the latter case the remote control program NorMonit can automatically control this process. A manual remote option is possible using NorXfer with applicable software extensions.

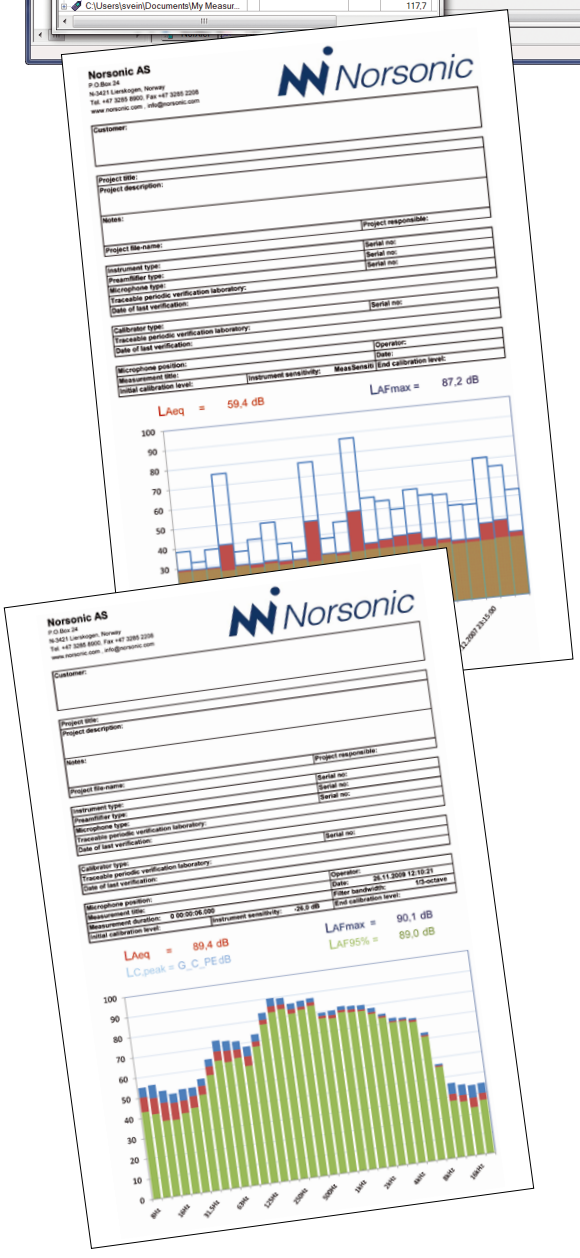
An internal sine wave calibration oscillator feeds a calibration signal to the preamplifier/microphone combination (SysCheck) to perform a daily microphone check - no external device or power supply is needed.

NorReview is a powerful tool for analysing and reporting the captured data. NorReview is, as other Norsonic products, modular and provides in its basic version a view of L(t) data and will perform basic calculations and reporting. Fully configured the software can perform Lden calculations, automatic event reporting and calculation, replay of sound files with moving cursor along the L(t) graph, multi project handling including storage of pictures, text files etc. along with the measurement data.

Nor1210 and Nor1216 outdoor microphones, Nor1520 and Nor1530 environmental cabinets



Nor1026 NorReview software



A special pure tone extension is available in order to perform tonal analysis.

NorReview may also be extended to display real time data on line in a noise monitoring system, in either single or multi-channel configurations.

Due to its flexibility and easy remote control programming, the Nor140 is widely used by many prestigious customers in their measurement applications. An example is Topsonic, a world leading company supplying advanced Airport Noise Monitoring systems. The Nor140 has been supplied to a numerous airports worldwide as a part of Topsonic's Airport Noise Monitoring systems.

Norsonic offers a complete line of products for use in environmental noise monitoring systems. We supply enclosures for permanent monitoring installations, environmental cases for semi-permanent installations, outdoor microphones for applications in tough environments, cables, modems, weather stations and post-processing software.

Noise nuisance recorder

The Nor140 is the third generation of noise nuisance recorders from Norsonic. This is a very cost effective method of investigating domestic noise complaints, particularly those occurring outside normal office hours.

A novel approach to this application is embodied in the Nor140 through its digital recording of the actual sound at the same time as the measurement.

All calibration and range settings automatically relate to both the measurement and recording part of the system greatly simplifying the set up; there is even a default “annoyance recorder mode” that can be accessed directly when switching on.

The instrument is housed within a tamper proof case and the only external components are the measurement microphone, mains connections and the plaintiffs hand switch. This hand switch has been specifically designed to make it suitable for use by subjects with limited manual dexterity and will activate the audio record for a predetermined period; the default setting is 60 seconds but may be set for any period between 1 second and 24 hours.

The default set up also provides up to 90 seconds of pre-trigger recording allowing the vital information occurring just before the switch was pressed to be recorded.

With the Video Noise Nuisance Recorder system Nor521A, Norsonic sets a new standard for this measurement application. The System is hosted in a small weatherproof case with a Nor140 and a small robust PC recording the video along with the noise and audio data from the Nor140. Unlike CCTV, video recording is only collected/stored when a hands-witch is activated or set trigger levels are exceeded – which saves valuable officer time. The system offers a one minute video and audio pre-trigger.

Pure tone detection

Many environmental noise measurement criteria require compensation for the presence of pure tones. These standards are now moving away from the earlier purely subjective method of tone detection to a more scientifically quantified method. These methods require a detailed FFT analysis, and masking calculations, carried out to determine the prevalence of audible tones.

The optional FFT mode together with the NorReview software will enable you to analyse the noise in accordance with these new requirements. As a spin-off, any measurement task requiring the auto-spectrum of a full frequency range FFT with less than 3 Hz line separation is also supported.

The measured noise spectrum is shown as a normal FFT spectrum during the acquisition process.

Video noise nuisance recorder system Nor521A

Building acoustics

Sound insulation measurements

The Nor140 with the Building Acoustics option is a complete measurement tool for making both airborne and structureborne (impact) sound insulation measurements in accordance with the ISO 140, ASTM, and other national standards. A step-by-step menu takes the operator through all required 1/3-octave real-time measurements until the final sound reduction index is presented graphically on the screen in accordance with the ISO 717 Standards. Other national indices may be calculated in combination with the optional NorBuild software.

This feature includes analysing sound level measurements and averaging of multiple microphone positions, both in the source- and the receiving-rooms, measurement of the background noise level as well as measurements of the reverberation time in multiple locations in the receiving room. An on-board calculator uses the actual room dimensions to calculate the room volume V and insulation area S. The correct sound reduction index (R_w, $D_{nT,w}$, $D_{n,w}$, $L_{n,w}$ or $L_{nT,w}$) is then presented graphically on the instrument screen.

Alternatively, the Nor140 may be used to measure the survey grade sound insulation based on 1/1-octave real-time frequency spectra in accordance with the ISO 10052 Standard.

Reverberation time measurements

The Nor140 measures the reverberation decay based on either impulse or noise excitation. All frequency bands are measured either in 1/1- or 1/3-octave real-time spectra, and presented on the screen one-by-one.

Two reverberation time values are calculated for each decay in each frequency band. The T_{30} is calculated from 5 dB below the excitation signal down to 35 dB, but the Nor140 will additionally calculate the T_{20} value. All values are normalised to the required 60 dB decay time.

On-board noise generator

The Nor140 is equipped with an on-board noise generator supplying both white and pink noise. During the level and reverberation time measurements, the generator is turned on and off in synchronization with the actual measurements.

The generator contains a unique spectrum shaper feature allowing the adjustment of source room noise in accordance with the requirements in ISO 140 part 3 and 4. This requirement set a maximum value of 6 dB between all neighbour frequency bands. Simply run a short test measurement and the source room spectrum will be modified as close as possible to this requirement.

Complete reports

The Nor140 building acoustics measurements are seamlessly transferred to a PC for further post-processing. The full sound insulation report is generated by use of the NorBuild software package, and the final report sheets are calculated in accordance with ISO 140/717, ASTM or other national standards.

Wireless measurement system

By connecting the Nor520 Bluetooth transceiver, one Nor140 may be used as one wireless measuring channel in the Nor1516B wireless sound insulation system. By using two separate Nor140 instruments in such a system, the operator gets a unique wireless measurement system that performs complete sound insulation measurements in the field without all the hassle and problems of long microphone extension cables.

Swept-Sine measurement technique

The recent ISO 18233 Standard opens up for use of alternative measurement techniques for sound insulation testing. Hence, the Nor140 together with the CtrlBuild control software is optionally available with the new SweptSine measurement method. This new technique is useful when measurements have to be performed in background noise conditions where traditional technique will not enable any measurements to be made at all.

SweptSine technique may also be used for the measurement of extremely short reverberation times.

Remote measurement control, singel dual or multichannel

Norsonic offers two solutions for full PC control of the actual Building Acoustic measurement process. The reporting program NorBuild software may be extended with the CtrlBuild module. By use of this module, the user may perform dual channel sound insulation measurement controlling two Nor140, either using cabels or wireless using the Nor520 long range Bluetooth system. The software allows the user to retake measurements by serial scanning through the frequency range using 1/3-octave band filtered noise. This feature is handy when background noise is high compared to the measured receiving room levels. Norsonic also offers the state of the art building acoustic analyser system, Nor850, where the Nor140 may be used as a front end. The Nor850 takes the user interface to another level of user friendliness and its sophistications supports all needed functionality both for field and laboratory use. Both systems support the SweptSine measurement technique offered by the Nor140.

Other applications

Speech intelligibility – STIPA

The speech transmission index, STI, has shown to be a valuable tool for objective assessment of the speech intelligibility. The basis for the STI-index is that speech intelligibility is to a large extent is based on the slow amplitude modulation of octave band sound levels due to the acoustic environment in the test area.

A simplified version of the STI-metric, known as STIPA, is an option in the Nor140 instrument. Adding the STIPA option to Nor140 turns the analyser into a powerful tool for analysing the Speech Transmission quality in public areas. The method can be used to compare the speech transmission quality at various positions and under various conditions within the same listening space. STIPA replaces the former used RASTI method as a more accurate method compared to RASTI.

A measurement in one listening position takes about 13 sec. Unlike many other STIPA measurement systems, the Nor140 can also correct the results for the background noise. In addition all calculated indexes are displayed, not only the single STIPA value. This feature is valuable for engineers optimising the room acoustics in public spaces or other areas where the speech quality is important.

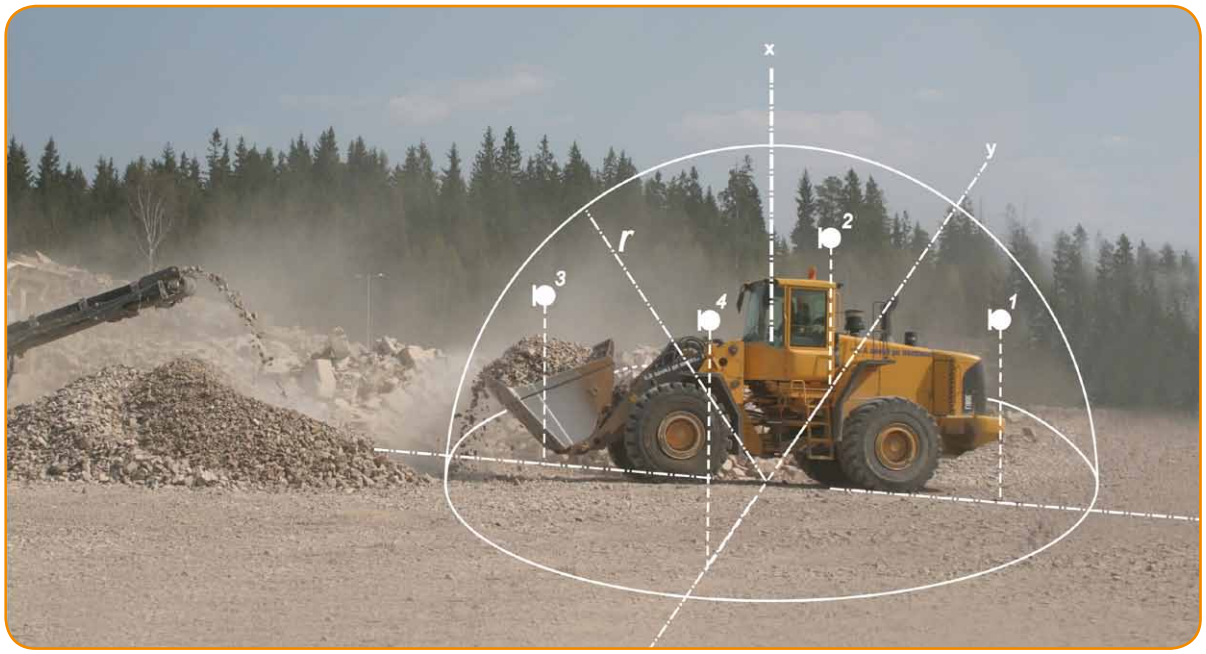
The method is made according to the requirements in IEC 60268-16 (2003-05): Sound system equipment – Part 16: Objective rating of speech intelligibility by speech transmission index.

The option includes an audio-CD with the required excitation signal. The STIPA-method is suitable for assessing speech intelligibility in rooms or auditoria as well as for public address systems. It may in general be used as a replacement for RASTI which normally should be applied only for room acoustic measurements. The result is presented as a STI-value and a CIS-value. The latter is normally used for assessing the quality of sound systems for emergency purposes (IEC 60849).

Vibration measurements

Thanks to its broad frequency response the Nor140 is suitable for both sound and vibration applications. The low frequency response extends down to 0,4 Hz in 1/3 octave band mode and FFT mode. The results can be displayed in dB or in Engineering Units.

IEPE® powered accelerometers can be directly connected to the instrument without use of any external power supply. Norsonic supplies a carefully selected range of accelerometers, all IEPE® powered, well suited for use with the Nor140.



Sound power

Sound power level may be calculated from sound pressure level measurements using almost any type of sound level meter. However, the methods described in the different standards involve quite a lot of calculation before the final sound power figure can be reported.

The Nor140 supports on board measurements and calculations according to ISO 3746. You simply specify measurement surface, its dimensions, the location of your measurement object (on the floor, against a hard reflecting wall or in a corner), apply the correction factors and start your measurement. The sound power will then be calculated and displayed in a tabular form.

Norsonic offers two solutions for full PC control of measurement and calculation of Sound Power according to various standards, such as ISO 374x. The simple solution is NorPower. The program guides you through the measurement process and reports the data as described in the standard. NorPower is a valuable tool for engineers working with product development, product control or certification. The program allows you to use single channel measurements using Nor140 as a frontend.

For multichannel Sound Power measurements, Norsonic offer a state of the art solution with the Nor850 analyser, where the Nor140 may be used as a front end. The Nor850 takes the user interface to another level of user friendliness and its sophistications supports all needed functionality both for field and laboratory use.

Audiometer calibration

Audiometry is the testing of hearing ability. Audiometric tests determine a subject's hearing levels with the help of an audiometer. For reliable test results, it is essential that audiometers are regularly calibrated in accordance with the relevant standards.

Nor140 can be equipped with the option for audiometer calibration which provides the ability for acoustical measurement of frequency and level of the test signal as well as harmonic distortion.

Measurement take only 2 seconds and is performed in an intuitive way presenting the 1/3 octave band spectrum together with a result table containing values for frequency of the test tone, level of the test tone, $L_{Z,eq}$ and harmonic distortion.

Optional extensions

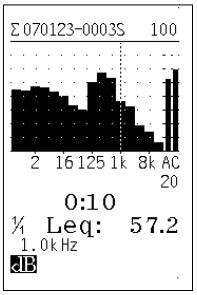
The Nor140 may be extended with a large selection of optional features, thereby allowing you to tailor the instrument to your specific requirements. Optional features may be ordered and installed at any time by just adding a new set of option codes.

Norsonic is continuously improving the features in the No140. New firmware adding new features to the instrument is frequently released. This ensures the user that a Norsonic instrument is kept up to date years after the initial purchase. We therefore reserve the rights to amend any of the information given in this leaflet in order to take advantage of new development.

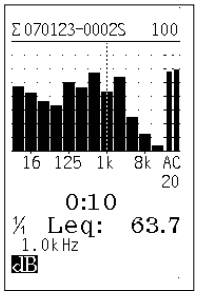
Option 1: 1/1-octave real-time filters

- Parallel 1/1-octave real-time filters covering the 0.5 Hz - 16 kHz frequency with full dynamic range.
- All filters fulfil the IEC 61260 class 1 digital IIR base 10 requirements and ANSI S1.11-2004 Class 1.
- 120 dB “one-range” even in the filter band.
- Results are displayed both graphically and numerically.
- A-weighting (pre-weighting) feature available on displayed results.

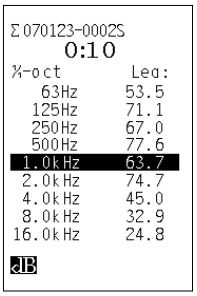
When fitted with option 1, the Nor140 can perform real time frequency analysis in octaves covering the frequency bands 0.5 Hz to 16 kHz in one range. A limited frequency range 8 Hz - 16 kHz can be set in order to avoid low frequency noise. A 3 Hz 3rd order high pass filter is then enabled in the analogue input stage to prevent overload due to low frequency noise. The wide frequency range with full dynamic range of more than 120 dB makes the instrument well suited for both vibration and noise measurements.



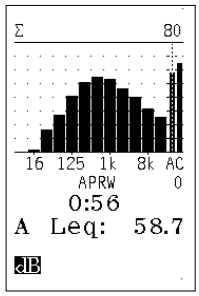
1/1-octave spectrum 0,5 Hz - 16 kHz



1/1-octave spectrum 8 Hz - 16 kHz



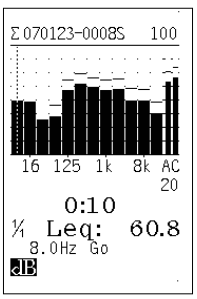
1/1-octave numeric table



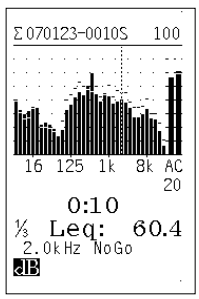
1/1-octave spectrum A-weighted

Option 2: Reference spectrum with “Go/NoGo” comparison

- Compare any measured frequency spectrum with a pre-selected reference spectrum.
- Both upper and lower reference spectrum available.
- “Go/NoGo” warning for quality control applications.
- TTL output signal for automated systems.



1/1-octave reference spectrum



1/3-octave reference spectrum

The reference spectra feature is used for comparison of any measured frequency spectrum with a pre-selected user defined spectrum. It functions for 1/1-octave, 1/3 octave and the spectral weighting networks. The measured spectrum may be compared to an upper limit, a lower limit or both. If the measured signal exceeds the boundaries, a “NoGo” warning is given on the screen, and a digital signal is set on the I/O port. The “NoGo” flag is also stored as a part of the measurement. The “Go/NoGo” comparison is selectable between instantaneous during a running measurement or after a measurement is elapsed. The duration of digital output signal may be set between 0 and 99 sec. Option 2 requires that minimum option 1 be installed!

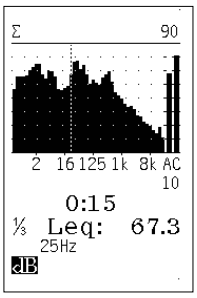
An alarm lamp kit, Nor268 with opt.1, is available as accessories.

Option 3: 1/3-octave real-time filters

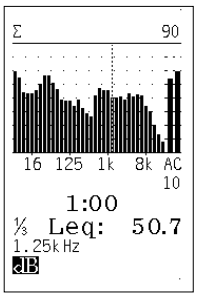
- Parallel 1/3-octave real-time filters covering the 0.4 Hz - 20 kHz frequency range in one span.
- All filters fulfil the IEC 61260 class 1 digital IIR base 10 and ANSI S1.11-2004 Class 1 requirements 120 dB “one-range” even in the filter bands.
- Results are displayed both graphically and numerically.
- A-weighting (pre-weighting) feature available on displayed results.

When fitted with option 3, the Nor140 can perform real time frequency analysis in 1/3 octave covering the frequency bands 0.4 Hz to 20 kHz in one range. A limited frequency range covering 6.3 Hz - 20 kHz can be set to avoid low frequency noise. A 3 Hz 3rd order high pass filter is then enabled in the analogue input stage to prevent overload due to low frequency noise. The wide frequency range with full dynamic range of more than 120 dB makes the instrument well suited for both vibration and noise measurements.

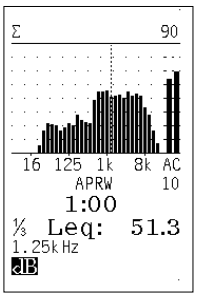
Option 3 requires that minimum option 1 be installed



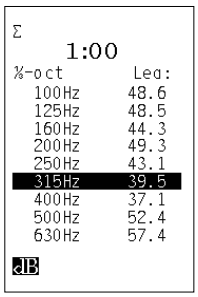
1/3-octave spectrum 0,4 Hz - 20 kHz



1/3-octave spectrum 6,3 Hz - 20 kHz



1/3-octave spectrum A-weighted

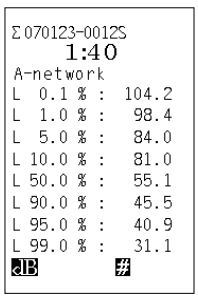


1/3-octave numeric table

Option 4: Statistical calculation of L_N values

- Calculate 7 fixed LN values ($L_{1\%}$, $L_{5\%}$, $L_{10\%}$, $L_{50\%}$, $L_{90\%}$, $L_{95\%}$ and $L_{99\%}$).
- Parallel calculation of 1 editable LN value selectable within the range 0.1 – 99.9 %.
- Statistical calculations based on 0.2 dB class widths covering a total range 130 dB.
- Parallel statistical calculation on both A- and C-/Z-weighted networks.
- If real-time filters are installed (option 1 or 3), statistical calculations are available for the individual filter bands as well.

The back-erase feature, which deletes up to the ten most recent seconds of acquired global data prior to a pause upon resuming, updates the statistics buffers as well to maintain consistency.



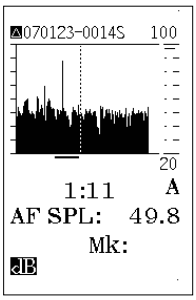
Statical L_N table

Option 5: Parallel F, S and I time weightings

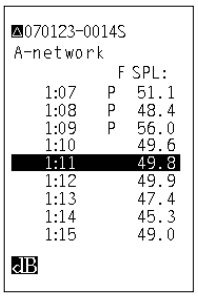
- Simultaneous measurement of F, S and I time weightings.
- Parallel measurement of three different SPL, L_{min} and L_{max} functions based on F, S and I time weightings.
- Parallel calculation of Leq, $L_{eq,}$I, L_E and L_{EI} functions using no time constant and I time weighting simultaneously.
- The parallel measurement using three time weightings is available on both A- and C-/Z-weighted networks and the real time 1/1 and 1/3 octave filter.

Option 6: Level versus time measurements

- Measures the time “Profile” (level vs. time) of the noise signal with preset time resolution simultaneously with the overall “Global” measurement.
- Selection of preset intervals within the 1 second to 199 hours interval range.
- Automatic level versus time storage of L_{Aeq}, L_{Amax} and L_{Cpeak} (or L_{Zpeak}).
- Automatic multispectrum storage of Leq and Lmax if option 1 is installed
- Level versus time measurement continues during a paused Global measurement.
- Automatic markers identify any pause, stop or continue of the measurement as well as recording and overload.
- Real-time graphical and numerical display of the level versus time results.



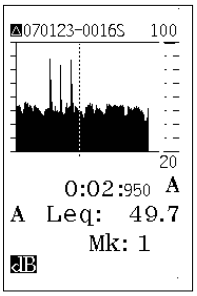
Level versus Time



L(t) numeric table

Option 7: Advanced Level versus time measurements

- Selection of preset intervals within the 25 msec to 199 hours interval range.
- Free selection of any A- and C-/Z-weighted functions to be stored at each pre-set interval.
- Possible operator marker settings during the measurement.
- Selection of 3 different single markers and 1 toggle marker.



L(t) with markers

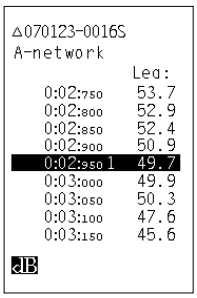


Table with markers

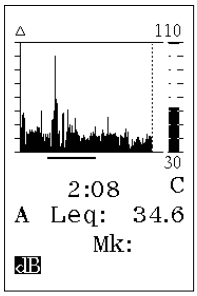
The enhanced time profile mode allows logging of L_{eq}, L_{max}, L_{min}, L_{peak}, L_e and SPL for all weighting networks and frequency bands for time constant F, S and I in parallel if option 5 parallel time constant is enabled. The user may select from one to all available parameters to log. The time resolution is from 25 ms logging to memory. If the frequency analysis option is installed, these values may be measured too, both as time profile multi spectrum values and as global values.

User controlled source coding
With option 7, the instrument gets eight marker functions, where as four are user defined. Three of these are single markers and one is a toggle marker.

Option 7 requires that minimum option 6 be installed.

Option 8: Sound recording

- Storage of the sound signal itself synchronised with the acquired noise data onto the SD-card or the internal memory.
- Triggered by an external hand-switch, by a level trigger or by a manual key push.
- 8, 16 or 24 bit accuracy.
- 12 or 48 kHz sampling.
- 0 - 96 dB digital gain.
- Reference calibration tone can be added at the beginning of the first recording in a measurement.



Lt with recording marker

This option is especially useful for source identification. The sound recording can be trigged by an external hand switch, by a level trigger (requires option 16) or by a manual key push. An adjustable pretrigger records events up to 99sec before the trigger point.

Several recording formats are supported, ranging from 8, 16 or 24 bit and with sampling rates of 12 or 48 kHz. Using 48 kHz sampling and the stored sound signal may be used for further processing. The Nor140 has a large dynamic range – exceeding 120 dB. This means that if you try to play back the signal on your PC you will – in most cases - hear nothing! To overcome this problem a special digital gain, 0 – 96 dB can be added to the sound recorded signal without affecting the calibration or measured values.

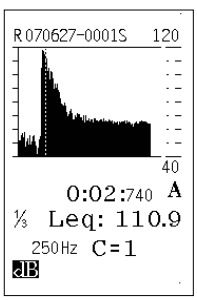
Another useful feature is that you may play a 10 sec reference tone - sine wave, pink or white noise in the beginning of a measurement to set a reference level when later replaying recorded data.

Option 8 requires that minimum option 6 be installed.

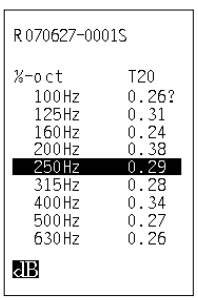
Option 9: Reverberation time measurement

- Reverberation time based on impulse or noise (option 10) excitation.
- Calculates both T20 and T30; backward integrated decay for impulse.
- Displays the graphical reverberation decay for each frequency band.
- Covers the 63 – 8000 Hz frequency bands for the 1/1-octave filters.
- Covers the 50 – 10000 Hz frequency bands for the 1/3-octave filter.
- Possible to store the reverberation time measurement as a wave-file.

Option 9 requires that minimum option 1 be installed.



Reverberation decay



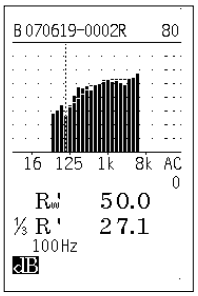
Numerical RT table

Option 10: Noise Generator

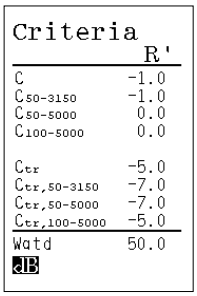
- Produces white or pink noise excitation signals with adjustable output level.
- Synchronization of noise signal with measurement start and stop.
- Allows noise excitation of reverberation time measurements if used with option 9 Reverberation time.
- Automated spectrum shaper feature to reduce neighbour frequency band differences as required in ISO 140 part 3 and 4.
- Impulse and continuous noise.

Option 11: Building Acoustic measurement

- Extends the Nor140 instrument into a complete single channel building acoustic analyser.
- Synchronises excitation in the source room with the measurement operation.
- Makes room averaging of multiple microphone positions for sound level and reverberation time measurements for ISO 140/717 users.
- Calculates the survey and engineering grade airborne sound insulation ratings $R_{'w}$, $D_{'n,w}$, and $D_{'nT,w}$.
- Calculates the survey and engineering grade impact sound insulation ratings $L_{n,w}$ and $L_{nT,w}$.
- Calculates the correction terms C, Ctr and Ci including the extended frequency versions.



Results



Corrections

- In conjunction with NorBuild, can easily calculate rating per ASTM and other National Standards.
- Allows remote use in combination with the Nor1028/3 CtrlBuild software package.
- Can be used for cable-free measurements using the Nor520 Bluetooth transceiver.
- Fulfils the requirements of the survey grade ISO 10052 Standard.

Option 11 turns your Nor140 into a powerful single channel building acoustic analyser. All the required parameters for performing both airborne and impact sound insulation are calculated. Using the Nor140 for measuring building acoustic, both airborne and impact noise has never been easier. With the Nor1028 NorBuild or Nor850 sound insulation reporting program, Norsonic offers a powerful and user-friendly building acoustic solution.

Option 11 requires that minimum option 1, 3, 9 and 10 be installed.

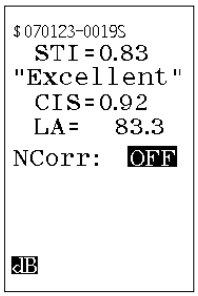
Option 12 Swept-Sine measurements

- Used in combination with the CtrlBuild remote control feature of the NorBuild or the Nor850, the Nor140 may perform advanced sound insulation measurement using the innovative Swept-Sine technique.
- Building acoustics measurements using impulse response measurement technique as described in ISO 18233 enables the measurement of sound insulation and reverberation time under severe background conditions.
- Performs tests of dividing walls with extreme sound insulation indices.
- Measures extreme short reverberation times.

Option 13: STIPA (Speech Transmission Index) measurement

- Calculates the STIPA speech transmission index.
- Fulfils the requirements of the IEC 60268-16 Standard for STIPA.
- Includes signal excitation CD (Nor1034) for use through separate public address. loudspeaker system or portable CD-player.
- Background noise correction.

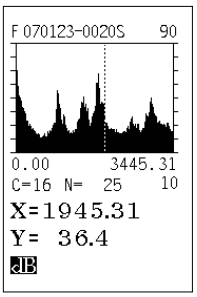
Option 13 requires that minimum option 1 be installed.



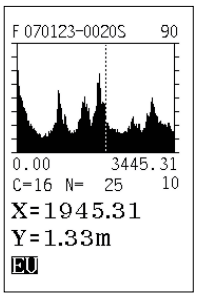
STIPA results

Option 14: FFT measurement

- 8000 line FFT analysis with 1.46Hz line resolution.
- Covers the 1.46 – 9.6 kHz frequency range.
- Both engineering units and dB.
- Pre-selection of 1 - 1028571 averages.
- Useful when searching on problems with rotating machinery.
- Fulfil the requirements for FFT analysis when searching for tonality according to the ISO/DIS 1996-2 Annex C (2005) standard.
- Display compression in binary sequence 1 – 64.



FFT spectrum with dB

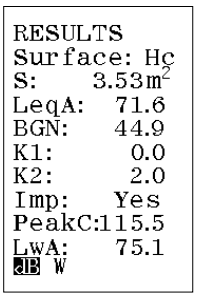


FFT spectrum with Engineering Units

Option 15: Survey Sound Power measurement

- Calculates the survey grade LWA sound power level based on multiple measurement positions on a theoretical hemisphere above a noise source placed on a reflective floor.
- Automatic correction of background noise level.
- Fulfils the requirements of the ISO 3746 Standard.

This option allows the user to perform survey grade LWA sound power level measurements in the field without any other external device. A perfect tool for verifying the sound power level of equipment after installation. A graphical wizard guides the user through the measurement – easy and intuitive to use!

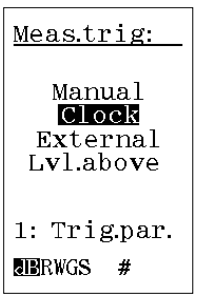


Sound Power results

Option 16: Measurement trigger

- Trigger the start of a measurement based on the internal clock, level threshold or external TTL signal such as hand switch Nor263A.
- Level threshold trigger used in combination with Repeat storage makes an automatic event measurement device.
- The audio recording is triggered based on the clock, level threshold or external TTL signal such as hand switch Nor263A.

The measurement and audio recording trigger can be set independently of each other.
A special pre-trigger feature on the audio recording can be set up to capture up to 99 seconds of the audio signal prior to the trigger point.



Measurement Trigger

Option 17 Audiometer calibration

- Calculates frequency of the pure tone, Level of the pure tone, $L_{Z,eq}$ and Harmonic distortion based on the 1/3 octave frequency spectrum
- Frequency range: 20 Hz – 17766 Hz
- Frequency accuracy: 0.3%
- Frequency resolution: 0.1 Hz
- Harmonic distortion resolution: 0,1%

Option 17 requires that minimum option 3 is installed

Option 18: Extended measurement range

- Microphone self-noise compensation at the lower-levels
- Compensate all measured function of the A- and C-/Z-weighting networks
- Adjustable microphone self-noise levels for use of other microphones
- Improves the lower measurement range by typically 7 - 10 dB
- Shifts the measurement range 10 dB upwards (i.e. 25 - 147 dBA)
- Possible to detect L_{peak} levels up to 150 dB without changing microphone

Accessories and software

Below is a list of carefully selected accessories for the Nor140. This is just a view of the most popular accessories. Please contact your local Norsonic sales office or the factory if you need other accessories than listed.

Nor340	Mains Adaptor, 90-230 Vac input with standard EU mains plug, 12 Vdc output.
Nor342/SLM	Portable battery pack with fuse protection, 7Ah, 12V, including charger and cable for connecting battery to Nor140.
Nor263A	Remote hand switch with 5m cable for external triggering of start or audio recording (if applicable) on Nor140 (require option 16).
Nor1251	Precision Microphone Calibrator with 114dB pressure level. Supplied with accredited calibration certificate.
Nor1216	Outdoor microphone for community and aircraft noise for both permanent and temporary applications. With SysCheck facility. Fulfils IEC60651, IEC61672 type 1 and ANSI S1.4 type 1. Protection class IP55 against dust and water. Complete with microphone type Nor1227 or Nor1225, preamplifier Nor1209A with heater to minimize condensation problems.
Nor1217	Outdoor microphone for community and aircraft noise for temporary applications. Uses the preamplifier and microphones supplied with the Nor140. Fulfills IEC60651, IEC61672 type 1 and ANSI S1.4 type 1. Protection class IP55 against dust and water.
Nor268	Relay interface unit for connection to digital output on Nor140. Requires 24 - 240 Vac.
Nor268/01	Rotating signal alarm lamp for connection to Nor268, relay interface unit. 220V connection.
Nor520A	Wireless Bluetooth module for Nor140. More than 100 meter transmission in free field if used together with Nor520A/PC, PC Bluetooth adapter.
Nor518A	Rugged case with space for 2 x Nor140, PC and cables. For dual channel building acoustic applications.
Nor1506B	Portable environmental "Pelican" case with sun screen, room for measuring instrument Nor140, Outdoor Microphone, Nor4610 Moxa 3G-modem, Nor1251 Calibrator, and two batteries Nor344. One battery supplies the Nor140 and the other the Nor4610 allowing more than one week of operation.
Cables:	**Nor1408A** Microphone cable. Specify length **Nor4525** USB Data cable for interfacing Nor140 and Nor13x instruments to PC via USB port. (included in delivery) **Nor4549** Trigger cable (2m) for nested triggering of Nor140 **Nor1441B** RS232 Cable (2m) for connection of to PC with 9-pin connector. **Nor4513B** Cable for simultaneous connection to RS-232 interface and AC(Flat) output. **Nor4514A** Cable (2m) for AC output (BNC)

A large range of various application software for evaluation controlling and reporting is available.
The most used packages are listed below:

Nor850	A new measurement concept, mainly designed for multichannel use (2 or more channels) This product offer unique user friendliness and support Nor140 as a standalone measurement channel. Support Building acoustics, sound power and general analyser applications.
Nor1028	NorBuild 3.0. PC-software for calculating and presenting graphically the Sound Insulation Indices according to the field measurement Standards ISO-140/4, /5 and /7 as well as ISO 717/1 and /2. Results are based on measurement files from Nor140 which are stored on the PC itself. Alternatively results are imported by using the instrument remote control module Nor1028/3 CtrlBuild feature.
Nor1026	NorReview 5.x. Postprocessing software for graphically and numerically review of the Level vs. time profile and frequency spectrum. Advanced calculation module, event and recording handling. Generates Word-reports of basic measurement functions/graphs for further editing by operator. Perform Quick-Calc analysis as well as insert markers at selected time intervals. Runs user defined Excel macro functions and enables the user to prepare user-defined reports with the NorReport feature. Audio recordings may be replayed on PC installed media-player or Norsonic player with "running cursor".
Nor1035	NorPower. PC-software for calculating and presenting graphically the Sound Power indices according to the measurement Standards in the ISO374x series. Results are based on measurement files which are stored on the PC itself. Alternatively results are imported by using the instrument remote control module Nor1035/3 CtrlPower feature.

Option packages:	**Standard package** containing the basic Nor140 with the options 1, 3, 4 and 5. **Environmental package** containing the basic Nor140 with the options 4, 5, 6, 7, 8 and 16. **Building Acoustic package** containing the basic Nor140 with the options 1, 3, 9, 10 and 11. **Consultant package** containing the basic Nor140 with the options 1, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 16.

Technical specifications

ANALOGUE INPUTS
Number of channels: 1
Input connector:
7 pin LEMO connector for Norsonic microphone systems.
Microphone: Nor1225, 1/2", free-field, 50 mV/Pa.
Preamplifier: Nor1209 (Normal) or IEPE-type by menu selection.
Preamplifier supply voltage:
±15 volt, max 3 mA
Polarisation voltage:
0 V and 200 V, selectable.
Maximum input signal: ±11 V peak
Preamplifier IEPE®:
Supply current: 4mA
Supply voltage: 24V
Input impedance:
>100 kΩ, <650 pF

Measurement range: 0,3 µV - 7Vrms (10 Vpeak) in one range corresponding to -10 dB to 137 dB (140 dB peak) with a microphone sensitivity of 50 mV/Pa. Option 18 shifts the measurement range to 147 dB (150 dB peak) by reducing the microphone sensitivity.

Highpass filter
The input section is equipped with an analogue highpass filter to reduce noise from wind or other sources with frequencies below the frequency range for measurements. The filter is switched on if the limited frequency range is selected (>6,3 Hz).
Filter type: 3rd order HP filter (-3 dB at 3,4 Hz, Butterworth response).

Analogue to digital conversion
The analogue input signal is converted to a digital signal by a multi-range sigma-delta converter with an effective sampling frequency of 48 kHz. The anti-aliasing filter is a combination of an analogue and a digital filter.

Frequency weightings
Simultaneous measurement of A- and C-weighting or A- and Z-weighting. 1/1 octave band or 1/3 octave band levels may be measured simultaneously if options providing these weightings are installed.
1/1 octave filters: 0,5 - 16000 Hz, class 1, digital IIR filters, base 10 system (IEC 61260) and ANSI S1.11-2004 Class 1.
1/3 octave filters: 0,4 - 20000 Hz, class 1, digital IIR filters, base 10 system (IEC 61260) and ANSI S1.11-2004 Class 1.
Level detector
Detector type: Digital true root-mean-square (RMS) detection, resolution 0.1 dB which may optionally be increased to 0.01 dB for indicated levels in the range –9.99 to 99.99 dB.
Crest factor capability: The crest factor is only limited by the peak-value of the signal.

Simultaneous measurement of the following functions: SPL, L_{max}; L_{min}; L_{eq}; L_E; L_{peak}; L_N; L_{eql}; L_{EI}; L_{TMax5}.

Indication range
The calibration of the instrument allows microphones with sensitivity in the range -84 dB to +15.9 dB relative to 1V/Pa to be applied. The corresponding display range for the indicated sound level is -50 dB to +180 dB.

Self-noise levels
The self-noise is measured with the calibration set to –26.0 dB corresponding to a microphone sensitivity of 50 mV/Pa. For voltage input, the level 0 dB then corresponds to 1µV. Typical values for the self-noise are 5 dB lower than the values stated.

Noise measured with 18 pF microphone dummy and microphone preamplifier Nor1209, averaged over 30 s of measurement time:
A-weighted: 13 dB
C-weighted: 15 dB
Z-weighted: 25 dB
1/3 oct: 6.3 Hz to 250 Hz: 10 dB
1/3 oct: 315 Hz to 20 kHz: 5 dB

Noise measured with Nor1225 microphone and preamplifier Nor1209, averaged over 30 s of measurement time:
A-weighted: 18 dB
C-weighted: 22 dB
Z-weighted: 30 dB
1/3 oct: 6.3 Hz to 250 Hz: 15 dB
1/3 oct: 315 Hz to 20 kHz: 10 dB

Power supply
Batteries: 4 cells, IEC LR6, AA-sized
Typical battery life time: up to 14 hours

Overall Performance
The Nor140 fulfil the following standards set for sound level meters, 1/1-octave and 1/3 octave filters: IEC61672-1:2002 class 1, IEC60651 class 1, IEC60804 class 1, IEC61260 class 1, ANSI S1.4-1983 (R2001) with amendment S1.4A-1985 class 1, ANSI S1.43-1997 (R2002) class 1, ANSI S1.11-2004 class 1.

External DC: 11 - 16V. Power consumption approximately 1.2W depending on selected modes of operation. The mains adapter Nor340 is recommended for use with the instrument. If the external supply falls below 9 V, the instrument will use the internal batteries if available. If the instrument switched itself off due to loss of power, it will automatically switch on and resume normal operation after reapplying the external DC supply.

Display
The display is a monochrome, trans-reflective LCD graphical display with 160×240 pixels (W×H) with automatic temperature compensation for contrast and viewing angle. Pressing the light key illuminates the display. The light switches off automatically two minutes after the last operation of any key. The bargraph display covers 80 dB which may be scrolled in 10 dB steps to cover the total range.

Signal generator output
Max output voltage: ±10V
Output impedance: <100Ωohm. The output is short-circuit proof to GND and output current is in excess of 3 mA.
Gain accuracy at 1 kHz: ±0.2 dB
Frequency response re. 1 kHz: ±0.5 dB for 20 Hz < f< 20 kHz

AC-out: 3,5 mm stereo jack. Both channels have identical signals driven by two separate amplifiers. Load impedance shall be 16 ohm or more. Output voltage is generated by the 48 kHz DAC based on data from DSP. Full scale on the display bargraph corresponds to 100 mV.
Output impedance: Less than 10 ohm, AC-coupled 100 µF.
Gain accuracy 1 kHz: ±0,2 dB
Frequency response re. 1 kHz: ±0,5 dB for 20 Hz < f < 20 kHz.

USB interface: USB type 2.0
USB socket: B411
Serial I/O port:
RS232 port, 9600 - 115200 baud.

Digital inputs: 3
Digital outputs: 4

SD Memory Card
The instrument may use SD memory card for storing of setup information, sound recordings and measurement results. SD memory card included in the delivery.

Data storage
Measured data is stored in the internal memory of the sound level meter or on the SD memory card. The internal memory is of the "flash" type retaining the information without battery supply. Approximately 25 Mbyte is available for the data storage.

Environmental condition for operation
Temperature: –10°C to +50°C
Humidity: 5% to 90% RH, dewpoint less than 40°C.
Atmospheric pressure: 85 kPa to 108 kPa.

Environmental condition for storage
Temperature: –30°C to +60°C
Humidity: 5% to 90% RH, dewpoint less than 40°C.
Atmospheric pressure: 50 kPa to 108 kPa.

Dimensions:
Depth: 30 mm **Width:** 75 mm
Weight incl. batteries: 410 g
Length, excl.microphone/ preamplifier: 210 mm
Length, incl. microphone/ preamplifier: 292 mm

Some of the features listed in this leaflet may be optional in certain markets. Contact your local representative or the factory for details.
Norsonic is continuously improving the features in the No140. New firmware adding new features to the instrument is frequently released. This ensures the user that a Norsonic instrument is kept up to date years after the initial purchase. We therefore reserve the rights to amend any of the information given in this leaflet in order to take advantage of new development.

Distributor:

Norsonic
P.O.Box 24, N-3421 Lierskogen, Norway
Tel: +47 32 85 89 00 Fax: +47 32 85 22 08
info@norsonic.com www.norsonic.com

09.2013

Appendix C: Shutdown Report

Appendix C is included as an attachment.

Date (UTC; YYYY-MM-DD)	**First Time of Detection** (UTC; YY-MM-DDT HH:MM)	**Last Time of Detection** (UTC; YY-MM-DDT HH:MM)	**Sighting Location**		**Species ID/Species Group** (common name)	**Animal Behavior**	**Total number of animals (best estimate)**	**Animal's Direction of Travel** (relative to vessel)	**Was there any noise source activity (pile driving) during detection?** (Hammer activity ON, OFF)	**Piling activity at initial detection**	**Distance from the animal(s) to the pile at initial detection**	**Distance from the animal(s) to the pile at final detection**	**Closest distance from pile being driven (active) (use if needed)**	**Time at closest distance to the pile being driven (active)**	**Closest distance from pile being driven (silent) (use if needed)**	**Time at closest distance to the pile being driven (silent)**	**Shutdown Zone**				**Shutdown Details**				
			Latitude (decimal degrees)	**Longitude** (decimal degrees)													**Applicable pile SZ size** (meters)	**Animal inside pile SZ zone?** (Y/N)	**Time animal entered pile SZ zone** (UTC; HH:MM)	**Time animal left or was last detected in the pile SZ zone** (UTC; HH:MM)	**Did a shutdown/power-down occur?**	**Time Shutdown Called For** (UTC; HH:MM)	**Time Equipment was Shutdown** (UTC; HH:MM)	**Pile Identification Number**	**Time Pile Driver was restarted or powered back up after Shutdown/Power-down** (UTC; HH:MM)
2023-09-07	2023-09-07 22:06	2023-09-07 22:17	41.00262	-70.46060	Common dolphin	Porpoising, Breaching / Jumping / Acrobatic behaviour, Swimming below surface	50	towards vessel	Hammer ON	Full energy pile driving	1200	2050	500	22:07	500	22:10	750	Yes	22:07	22:12	Yes, shutdown	22:07	22:07	AU-38	22:33

Appendix D: Vineyard Wind 1 Monitoring and Mitigation Table

Appendix D is included as an attachment.

OCS-A 0501 MASS USA

VINEYARD WIND

Vineyard Wind 1 Pile Driving Monopile Mitigation Zones

(until November 30, 2023)

Species / Species Group	Minimum Visual Clearance Zone		Shut-down Zone	PAM Clearance Zone		Level A Harassment Zone [HZ]	Level B HZ
	Clearance Zone	Clearance Delay Duration[1]		PAM Clearance Zone	PAM Monitoring Zone		
North Atlantic right whale (NARW)	**Any distance**	May 15 - October 31: until 30 minutes (min) of visual monitoring confirms no further detection of NARW(s)	**Any distance**	10 km	10 km	3,191 m	5,720 m
Unidentified large whale within 1,000 m of pile	Any unidentified large whale sighted within **1,000 m** of the pile that cannot be identified to species is treated as a NARW for purposes of clearance and delay.	See above	Any unidentified large whale sighted within **1,000 m** of the pile that cannot be identified to species is treated as a NARW for purposes of a shut-down in pile driving.	-		-	-
Mysticetes- humpback, fin, minke, sei	500 m	30 min	500 m	500 m		3,191 m	5,720 m
Sperm whales	500 m	30 min	500 m	500 m		43 m	5,720 m

[1] Pile driving may commence when either the marine mammal(s) has voluntarily left the respective clearance zone and been visually confirmed beyond that clearance zone, or, when 30 minutes have elapsed without re-detection (for mysticetes, sperm whales, Risso's dolphins and pilot whales) or 15 minutes have elapsed without re-detection (for all other marine mammals).

Species / Species Group	Minimum Visual Clearance Zone		Shut-down Zone	PAM Clearance Zone		Level A Harassment Zone [HZ]	Level B HZ
	Clearance Zone	Clearance Delay Duration[1]		PAM Clearance Zone	PAM Monitoring Zone		
Risso's dolphins and Pilot whales	160 m	30 min	160 m	160 m		43 m	5,720 m
Dolphin sp. (bottlenose, common, Atlantic white-sided)	160 m	15 min	160 m	160 m		43 m	5,720 m
Pinnipeds	160 m	15 min	160 m	160 m		153 m	5,720 m
Harbor porpoise	160 m	15 min	160 m	160 m		71 m	5,720 m
Sea turtles	500 m	30 min	500 m	-		-	2,944 m