INSPECTION AND REMOVAL REPORT - ARTIFICIAL ISLAND PROJECT SITE

104087-ENN-MMT-SUR-REP-WPD-UXO REVISION A | FOR USE OCTOBER 2022

ENERGINET

NORTH SEA OWF AND ENERGY ISLAND

UXO INSPECTION AND DISPOSAL SURVEY (WPD) FOR OFFSHORE WIND FARMS AND ENERGY ISLAND

NORTH SEA JUNE 2022



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ABBREVIATIONS AND DEFINITIONS

AF	As Found
BSB	Below Seabed
СМ	Central Meridian
DTU21	Denmark Technical University 2021
DPR	Daily Progress Report
DTM	Digital Terrain Model
DVR90	Dansk Vertikal Reference 1990
EEZ	Exclusive Economic Zone
EPSG	European Petroleum Survey Group
ESRI	Environmental Systems Research Institute, Inc.
ETRS	European Terrestrial Reference System
FME	Feature Manipulation Engine
FMGT	Fledermaus GeoCoder Toolbox
GIS	Geographic Information System
GNSS	Global Navigation Satellite System
GRAD	Gradiometer (Model T)
GRS80	Geodetic Reference System 1980
HF	High Frequency
HIPAP	High Precision Acoustic Positioning
INS	Inertial Navigation System
IHO	International Hydrographic Organisation
IMU	Inertial Measurement Unit
ITRF	International Terrestrial Reference Frame
LF	Low Frequency
MAG	Magnetometer
MBBS	Multibeam Backscatter
MBES	Multibeam Echo Sounder
MMO	Man Made Object
MSL	Mean Sea Level
MTL	Master Target List
μV	Micro Volt (10 ⁻⁶ volts)
M/V	Motor Vessel
NOVIT	German World War I underwater explosive, consists 60% TNT, 24% hexyl and 16% aluminium
OS	Out Survey
OWF	Offshore Wind Farm
POS MV	Position and Orientation System for Marine Vessels
POSPac	Position and Orientation System Package
PPS	Pulse Per Second
PtoP	Peak to Peak
QC	Quality Control
ROV	Remotely Operated Vehicle
RPS	UXO consultant, providing the ALARP certificate, to Energinet
S-CAN	Scalgo Combinatorial Anti Noise



SBET	Smoothed Best Estimated Trajectory
SIT	Surrogate Item Test
SOW	Scope of Work
SSS	Side Scan Sonar
THU	Total Horizontal Uncertainty
TIR	Target Inspection Report
TPU	Total Propagated Uncertainty
TSS	Product name for Teledyne Pipe & Cable Tracker
TVU	Total Vertical Uncertainty
USBL	Ultra Short Baseline
UTC	Coordinated Universal Time
UTM	Universal Transverse Mercator
UXO	Unexploded Ordnance
WP	Work Pack – Defines survey area and requirement



EXECUTIVE SUMMARY

NORTH SEA OFFSHORE WIND FARM UXO INVESTIGATION – ARTIFICIAL ISLAND PROJECT SITE		
INTRODUCTION		
Survey Dates	M/V Stril Explorer: 03 June to 10 June 2022	
Equipment	Multibeam Echo Sounder (MBES), Pipe tracker (TSS440).	
Coordinate System	Datum: European Terrestrial Reference System 1989 (ETRS89) Projection: Universal Transverse Mercator (UTM) Zone 32N, Central Meridian (CM) 9°E	

BATHYMETRY AND SEAFLOOR MORPHOLOGY

The minimum surveyed depth is 26.39 m and the maximum surveyed depth is 28.25 m. The depth range across the site is 1.86 m.

Slope angles across the site are typically very gentle (<1°).

SURFICIAL GEOLOGY

The seabed sediments in Artificial Island project site are dominated by GRAVEL and coarse SAND (medium to high acoustic reflectivity) and SAND (medium acoustic reflectivity).

Areas of ripples, indicative of mobile sediments, are present throughout the majority of the Artificial Island project site.

SEAFLOOR FEATURES AND CONTACTS

In total, 33 individual seabed magnetic anomalies were inspected in the Artificial Island project site.

From the total of the 33 magnetic anomalies, 2 were classified as UXO (targets 0065 and 0255 identified as German Moored mines), whilst 30 anomalies were classified as debris. 1 target (0171) was not found.



1 | INTRODUCTION

1.1 | PROJECT INFORMATION

Energinet are developing the proposed Offshore Wind Farm (OWF) and Artificial Island in the Danish sector of the North Sea (Figure 1). MMT have been contracted to provide geophysical survey (including 2D UHRS) and grab sampling in the east part of the 3 GW OWF project site (the MMT OWF survey area).

The project includes various survey areas which are detailed in Table 1.

The scope of work was divided into separate Work Packages (WP), detailed in Table 2.

This report covers Work Package D, UXO inspection 2.5 km x 2.5 km Artificial Island Project Site.

Table 1 Survey area details.

Description	Comment	
3 GW OWF Project Site	Complete project site area, including both the western and eastern zones.	
3 GW OWF Area of Investigation	MMT OWF survey area (eastern part of the 3 GW OWF project site)	
Artificial Island Area of Investigation	10 km x 10 km area around the Artificial Island Project Site	
Artificial Island Project Site	2.5 km x 2.5 km focused area for detailed development of the Artificial Island.	

Table 2 Work Package descriptions.

	Description	Survey Area
Work Package A – Offshore Windfarm	Geophysical site survey	MMT OWF survey area (zone east).
Work Package A – Energy Island	Geophysical site survey	Artificial Island Area of Investigation.
Work Package B	Magnetometry box survey	Box surveys within the MMT OWF survey area.
Work Package C	UHR seismic survey	Artificial Island Project Site.
Work Package D	UXO survey and inspection	Artificial Island Project Site.

A summary of the project details is presented in Table 3.

Table 3 Artificial Island project site inspection survey details.

CLIENT:	Energinet
PROJECT:	North Sea OWF and Energy island UXO Inspection and Disposal survey (WPD)
MMT SWEDEN AB (MMT) PROJECT NUMBER:	104087
SURVEY TYPE:	UXO Inspection and Disposal survey
AREA:	North Sea



CLIENT:	Energinet
SURVEY PERIOD:	June 2022
SURVEY VESSELS:	M/V Stril Explorer
MMT PROJECT MANAGER:	Karin Gunnesson
CLIENT PROJECT MANAGER:	Martin Bak Hansen





Figure 1 Overview of the project site, Artificial Island Area 2.5 x 2.5km, of WP-D.



1.2 | SURVEY INFORMATION - ENERGY ISLAND UXO INSPECTION AND DISPOSAL SURVEY

The Energinet Energy Island UXO Inspection and Disposal survey includes the following tasks:

- Project Management and Administration;
- Recorded video, TSS and MBES survey;
- Disposal of found UXO.

MMT OWF Survey area site investigation covers, approximately, a 526 km² area and is located roughly 90 km offshore the coast of Jutland (Figure 1). Within this, the Artificial Island area of investigation covers a 100 km² area which is sub-divided in to a 6.25 km² area for UXO GRAD and Ultra-High resolution MBES and SSS surveys (Artificial Island project site).

This report covers the 2.5 km x 2.5 km Artificial Island Project Site, UXO Inspection and Disposal survey.

1.3 | SURVEY OBJECTIVES

The survey objectives for the Artificial Island project sites inspection and disposal survey was to inspect 33 targets using WROV HD cameras to record video and acquire high resolution MBES and TSS data. Acquisition of the described data sets was to provide highly accurate data on where the targets were located within a 10 m x10 m area provided by the Client. This was carried out to be able to construct the Artificial Island site.

Energinet Energy Island UXO Inspection and Disposal survey includes:

- Inspection of 33 magnetic targets with WROV video, TSS and MBES;
- Removal of discovered objects to clear the area of interest;
- Disposal of potential UXOs discovered during survey.

1.3.1 DEVIATIONS TO SCOPE OF WORK

There was one deviation from the SOW. M/V Stril Explorer was tasked to reposition two PAM-buoys. The final location of the buoys is presented in Table 4.

Table 4 PAM buoys location.

PMA Buoy ID	Latitude (DDMMdddddd)	Longitude (DDMMdddddd)
NSE-5	56° 29.345093' N	56° 29.399695' N
NSE-6	6° 29.864957' E	6° 32.834509' E



1.4| PURPOSE OF DOCUMENT

This report presents the results from the UXO inspection and disposal survey for the Artificial Island project site.

This report also summarises the methods used to acquire and process bathymetry and TSS data in order to locate the 33 targets within their designated areas.

All data obtained from the UXO inspection have been correlated and compared against the existing background information to detect possible UXOs and dispose of them.

A full list of referenced reports is given in Table 5 (Reference Documents).

1.5| REPORT STRUCTURE

The results of the Artificial Island project sites inspection and disposal survey is presented in this report and include:

- A UXO target list;
- Residual grids of the As-Found, As-Left and Out surveys;
- Altitude grids of the As-Found, As-Left and Out surveys;
- GeoTiffs of the As-Found, As-Left and Out surveys;
- DTMs of the survey results.

The Artificial Island Project Site UXO Investigation Report (this report) chart series includes:

- Overview Chart
- Bathymetry Charts
- TSS Imagery Charts with Anomalies
- Seabed Morphology Classification Charts

1.5.1 UXO INVESTIGATION SURVEY REPORT

Attached to the report are the following appendices:

- Appendix A| Target Investigation Reports (TIR)
- Appendix B| UXO Master Target List (MTL)
- Appendix C| Chart List

1.5.2| CHARTS

The MMT Charts describe and illustrate the results from the inspection survey. Alignment Charts with the Scale of 1: 50 of the 33 inspected target areas include TSS magnetic data, high accuracy MBES DTMs, ROV Track lines and side scan Mosaic image.

A list of all produced charts is presented in Appendix C|.



OVERVIEW CHART

Shows coastlines, EEZ, and area of investigations.

BATHYMETRY PANEL

The bathymetry is presented as a shaded relief colour image with 0.25 m colour interval, overlain with contour lines (0.25 m (minor) and 1.0 m (major)) with depth labels. Since there is relatively little depth variation across the surveyed areas some charts may not have contour line data.

TSS IMAGERY PANEL

The TSS magnetic field imagery is presented for each of the survey inspection sites as an "as found" and an "as left". If a UXO was found there will be an As Found (AF), after disposal there will be an Out Survey (OS) to identify remaining debris and then an As Left (AL) after debris has been relocated, if applicable. If nothing is found the data will be presented as two AF; one for a 10 m x10 m area and one for an 15 m x15 m area. The magnetic anomalies are also presented in a Master Target List (MTL) and in the Target Inspection Reports (TIR) for each inspection site, see Appendix A].

SIDE SCAN SONAR MOSAIC PANEL

A side scan mosaic image is presented in the As Found (AF) Charts only. The data has been extracted from the earlier UXO survey. No As Left (AL) side scan sonar survey was conducted during the UXO inspection and disposal campaign.

1.6| REFERENCE DOCUMENTS

The documents used as references to this report are presented in Table 5.

Document Number	Title	Author
1100046209	Energy Island Danish North Sea Geoarchaeology and geological desk study	Client
104087-ENN-MMT-QAC-PRO- PROJMANU_REV03_UPDATED	Project Manual	MMT
104087-ENN-MMT-MAC-REP-SE_RevA	Mobilisation and Calibration Report – Stril Explorer	MMT
103783-ENN-MMT-SUR-REP-SUR-WPD	Survey Report Relume	MMT
103783-ENN-MMT-SUR-REP-OPREPWPD	Operations Report Artificial Island project site	MMT
103783-ENN-MMT-SUR-REP-SURVWPA	Survey Report WP-A	MMT
103783-ENN-MMT-SUR-REP-SURVWPAEI	Survey Report WP-A_EI	MMT

Table 5 Reference documents.



1.7| AREA LINE PLAN

The Artificial Island UXO investigation survey line spacing and minimum parameters are detailed in Table 6.

Table 6 Survey line parameters.

GEOPHYSICAL SURVEY SETTINGS	SCOPE
Project Site	Ca. 33 000 m ²
Line spacing GRAD, SSS, MBES	1.0 m

1.7.1 | ARTIFICIAL ISLAND PROJECT SITE MAIN LINES

Survey lines at each UXO inspection location within the Artificial Island Project Site were oriented N-S and performed with the TSS and MBES. An example is shown in Figure 2 below.





Figure 2 Line plan – Target investigation survey lines in the Artificial Island Project Site.



2 | SURVEY PARAMETERS

2.1 | GEODETIC DATUM AND GRID COORDINATE SYSTEM

2.1.1 | ACQUISITION

The geodetic datum used for the project is presented in Table 7 (MBES) and Table 8 (TSS).

Table 7 Geodetic parameters used during acquisition for MBES.

Horizontal datum: WGS 84		
Datum	World Geodetic System 1984 (6326)	
Ellipsoid	World Geodetic System 1984 (7030)	
Prime Meridian	Greenwich (8901)	
Semi-major axis	6 378 137.000 m	
Semi-minor axis	6 356 752.3142 m	
Inverse Flattening (1/f)	298.257223563	
Unit	International metre	

Table 8 Geodetic parameters used during acquisition for TSS.

Horizontal datum: ETRS89		
Datum	ETRS89	
Ellipsoid	GRS80	
Semi-major axis	6 378 137.000 m	
Semi-minor axis	6 356 752.3142 m	
Inverse Flattening (1/f)	298.257222101	
Unit	International metre	

2.1.2 | PROCESSING

The geodetic datum used during processing and reporting are presented in Table 9.

Table 9 Geodetic parameters used during processing.

Horizontal datum: ETRS89		
Datum	ETRS89	
Ellipsoid	GRS80	
Semi-major axis	6 378 137.000 m	
Semi-minor axis	6 356 752.3142 m	
Inverse Flattening (1/f)	298.257222101	
Unit	International metre	



2.1.3 | TRANSFORMATION PARAMETERS

The transformation parameters used to covert from acquisition datum (WGS 84) to processing/reporting datum (ETRS89) are presented in Table 10. The transformation will be used in the QINSy online software, although raw outputs from QINSy will be on the WGS 84 datum.

Table 10 Transformation parameters.

Datum Shift FROM WGS84 to ETRS89 (right-handed convention for rotation- COORDINATE FRAME ROTATION)		
Parameters	Epoch 2022.5	
Shift dX (m)	0.110250	
Shift dY (m)	0.067110	
Shift dZ (m)	-0.132890	
Rotation rX (")	-0.003543	
Rotation rY (")	-0.014426	
Rotation rZ (")	0.025962	
Scale Factor (ppm)	0.003300	

To verify that the transformation parameters have been correctly entered into the navigation system the following test coordinates were used (Table 11).

Table 11 Test coordinate for datum shift.

UTM Zone	Datum	Easting (m)	Northing (m)	Latitude	Longitude
	WGS84	-	-	54° 59' 59.998" N	13° 29' 59.989" E
32	ETRS 89	787756.3706	6104055.2342	54° 59' 59.979" N	13° 29' 59.956" E

2.1.4 | PROJECTION PARAMETERS

The projection parameters used for processing and reporting are presented in Table 12.

Table 12 Projection parameters.

Projection parameters		
Projection	UTM	
Zone	32 N	
Central Meridian	09° 00' 00'' E	
Latitude origin	0	
False Northing	0 m	
False Easting	500 000 m	
Central Scale Factor	0.9996	
Units	metres	



2.1.5 | VERTICAL REFERENCE

The vertical reference parameters used for processing and reporting are presented in Table 13.

Table 13 Vertical reference parameters.

Vertical Reference Parameters					
Vertical reference MSL					
Height model	DTU21				

2.2| VERTICAL DATUM

Global navigation satellite system (GNSS) tide was used to reduce the bathymetry data to Mean Sea Level (MSL) the defined vertical reference level (Figure 3). The vertical datum for all depth measurements was MSL via DTU21 MSL Reduction from WGS84-based ellipsoid heights.

This tidal reduction methodology encompasses all vertical movement of the vessel, including tidal effect and vessel movement due to waves and currents. The short variations in height are identified as heave and the long variations as tide.

This methodology has proven to be very accurate as it accounts for any changes in height caused by changes in atmospheric pressure, storm surge, squat, loading or any other effect not accounted for in a tidal prediction.

Within the Artificial Island project site, all positions lie below the sea surface so are referred to in the results section of this report as *depths*.

The bathymetric processing software packages EIVA NaviModel inherently stores MBES DTMs and sounding data with a positive down depth convention. Report imagery obtained from these packages show the data in this convention.



Figure 3 Overview of the relation between different vertical references.



2.3| TIME DATUM

Coordinated universal time (UTC) is used on all survey systems on board the vessel. The synchronisation of the vessel's on-board system is governed by the pulse per second (PPS) issued by the primary positioning system. All displays, overlays and logbooks are annotated in UTC as well as the daily progress report (DPR) that is referred to UTC.



3 | SURVEY VESSEL

3.1| M/V STRIL EXPLORER

UXO INSPECTION AND DISPOSAL SURVEY OFFSHORE

The offshore UXO Inspection and Disposal survey operation was conducted by the survey vessel M/V Stril Explorer (Figure 4). The vessel equipment is shown in Table 14.



Figure 4 M/V Stril Explorer.

Table 14 M/V Stril Explorer equipment.

Equipment	Model
Primary Positioning System	Applanix POS MV 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
Secondary Positioning System	C-Nav 3050 using C-NavC2 corrections on the SF1 service
Primary Gyro and INS System	Applanix POS MV 320
Secondary Gyro and INS System	Sonardyne Lodestar 300
Underwater Positioning System	Kongsberg HiPAP 501
Survey Navigation System	QPS Qinsy
Surface Pressure Sensor	Vaisala Pressure Sensor
Sound Velocity Sensor	Valeport SVX2, deployed over the side



The WROV used was a Kystdesign Suppoeter 07 WROV, for full equipment list see Table 15

Instrument	Name
Primary Positioning and INS System	Sonardyne SprintNav 500
Secondary Positioning and INS System	iXblue OCTANS 3000
Sound Velocity Sensor	Valeport MiniSVS
Conductivity, Temperature, Depth (CTD) Probe	Valeport MiniCT
Pressure Gauge	Valeport MinilPS
Obstacle Avoidance Sonar	Gemini 720is
Altimeter	Tritech PA500 (500 kHz)
USBL Transponder	HiPAP cNODE's
Doppler Velocity Log (DVL)	Sonardyne Syrinx, co-mounted to INS (600 kHz)
Multibeam Echo Sounder	R2Sonic 2024 (200-400 kHz, optional 700 kHz)
Electomagnetic Survey System	Teledyne TSS440
Colour Camera	Mini Colour Subsea HD Camera
Colour and Zoom Camera	Imenco Subsea Camera 18 x zoom
Underwater Lasers	Dual DSPL Sealaser 100
LED Flood Light	4 x Cathx Aphos 4 (7000 lumen) 2 x ROS Q-LED III (3500 lux)
LED Spot Light	4 x ROS MV LED (890 lumen)
Hydraulic Dredge Pump	DeepC 6"

Table 15 Kystdesign Supporter 07 WROV positioning and survey equipment list.



3.2 | OPERATIONAL SUMMARY

This section provides a summary of the operations on board the M/V Stril Explorer (Table 16) during the offshore UXO Inspection and Disposal survey (WPD) operation between 2022-06-01 and 2022-06-10.

M/V STRIL EXPLORER

The mobilisation for the project 104087, offshore UXO Inspection and Disposal survey commenced on 01 of June 2022 in Thyborøn, Denmark.

The project's kick-off meeting was carried out alongside Thyborøn on 02 June 2022 prior to departure.

A series of calibration tests were performed between 03 and 04 June 2022 at locations within the 2.5 km x 2.5 km Artificial Island Project Site. For more information, see report titled:

104087-ENN-MMT-MAC-REP-SE.

Between 04 and 09 June 2022, M/V Stril Explorer conducted UXO survey operation of the Artificial Island project site.

On 10 June 2022, M/V Stril Explorer demobilised in Thyborøn, Denmark.

Table 16 Survey	/ tasks – M/V	Stril Explorer.
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TASK	DATE	DESCRIPTION
Transit	2022-06-01	Transit to Thyborøn, Denmark
Mobilisation	2022-06-01 and 2022-06-03	Mobilisation alongside Thyborøn, Denmark
Calibrations and verifications	2022-06-03 - 2022-06-04	Alongside Thyborøn and offshore
UXO Survey	2022-06-04 – 2022-06-09	UXO survey operations
Demobilisation	2022-06-10	Demobilisation alongside Thyborøn, Denmark



4 | DATA PROCESSING AND INTERPRETATION METHODS

4.1| BATHYMETRY

The objective of the processing workflow is to create a Digital Terrain Model (DTM) that provides the most realistic representation of the seabed with the highest possible detail. The processing scheme for MBES data comprised two main scopes: horizontal and vertical levelling in order to homogenise the dataset and data cleaning in order to remove outliers.

The processing of the MBES data was performed in the EIVA software suite comprising of NaviEdit, NaviModel and Sonardyne Janus for post processed navigation.

The ROV navigation data was post processed in Janus and exported, then applied to the data held within the NaviEdit database.

After the post-processed position and error data is applied, a Global Navigation Satellite System (GNSS) tide is calculated from a logged ellipsoidal file and the DTU21 data model, to reduce the depths to MSL.

Several stages have been performed in the processing of the bathymetry data. These can be summarised as:

- Importation of Raw MBES data (NaviScan.SBD) in to the NaviEdit Jobplanner.
- MBES data was then corrected and compensated for the variations in sound velocity, ray bending, and other environmental/atmospheric effects.
- Post-processed navigation was applied to the data.
- Depths reduced to the project specified vertical datum.
- A DTM was created in NaviModel at the project specified resolution to undertake the next stage of processing.
- The MBES data underwent iterative analysis and corrective measures to ensure that all per definition outliers are flagged as rejected.
- This used both manual editing and the use of analytical algorithms such S-CAN SCALGO filtering and/or EC-3D filter followed by manual verification of the affected area to ensure the survey objective has been met.
- The MBES data was then reviewed against the survey specifications to ensure that it has met the project criteria.
- Required products were then exported from NaviModel and NaviEdit.



The work flow diagram for MBES processing is shown in Figure 5.



Figure 5 Workflow MBES processing.

The dataset underwent QC steps to check for vertical alignment before products were created.

Bathymetric contours were generated from the 20 cm DTM in combination with scaling factors applied to generalise the contours to ensure the charting legibility.



4.2| TSS

The objective of the TSS 440 processing workflow is to create background compensated grids representing the most realistic representation of the changes in magnetic field with the highest detail possible. The processing workflow for TSS data main goals is to remove background noise and to show current induced magnetic field as clearly as possible.

The processing of the magnetic data was performed in Oasis Montage software with Oasis resources developed by MMT to speed up and simplify processing.

The TSS processing workflow includes several steps that are summarized below:

- Copy and import raw data to a new database; two databases were created for each target, one as left and one as found.
- Navigational corrections; compensation for outliers and navigation jumps.
- Quality insured the sample density (4Hz), sample separation and altitude was within the acceptable limits.
- Magnetic data was compensated for outliers and background noise.
- A magnetic grid and an Altitude grid was created with the project specified requirements and underwent iterative analysis to make sure no outliers or background noise was in the grids.
- Peak of magnetically induced anomalies was identified and added to a target database along with its magnetic properties.
- Target database, databases and grids was exported using the project specified values and formats.

At each investigation site, an As Found (AF) survey will be conducted to identify an accurate location of the anomaly. If no anomaly is detected, a secondary As Found (AF2) survey is conducted in a larger area.

If an anomaly is detected, it is excavated. If the anomaly is identified as debris, the debris is relocated outside of the survey area. After the debris is relocated, an As Left (AL) survey is conducted at the investigation site to ensure the anomaly has been removed from the site.

If an anomaly is detected, excavated and determined to be a UXO, the target is assessed by an expert with the Danish Navy. After assessment, the target is subject to disposal by explosives. After the target is destroyed an Out Survey (OS) is conducted to assess whether debris remains in the area. Remaining debris is relocated outside the survey area. After the debris is relocated, an As Left (AL) survey is conducted at the investigation site to ensure the anomaly has been removed from the site.





The work flow diagram for TSS processing is shown in Figure 6.

Figure 6 MMT specific workflow for processing TSS data.

Grids and target lists were exported according to the SOW, Project Manual, and client specific requests.

Magnetic grids for this project were created with 0.2 m cell size and 0.5 m blanking distance using minimum curvature.

Altitude grids were created with 0.2 m cell size and no blanking distance using direct gridding.

Altitude and Magnetic grids were exported as GeoTIFFs (.tif) and Floating point (.flt). An example is provided in Figure 7.

The target list was exported as a .csv with the channels specified in the SOW.

The database was exported as a .csv according to project specifications stated in the SOW.





Figure 7 Example of As Found grids created with the project specific requirements and exported as GeoTiffs.



5 | PROCESSED DATA QUALITY

5.1| BATHYMETRY DATA

The processed MBES bathymetry data meets the required specifications. Checks were made during acquisition and in post-processing to ensure that sounding density conformed to the 16 soundings per 1.0 m cell criteria (Figure 8). The high ping frequency used for MBES acquisition meant that the data density achieved far exceeded the required density with some cells having hundreds of soundings. The figure below shows that DTM grids with 0.2m gridding met the specifications set for 1.0 m gridding.



Figure 8 Artificial Island project site sounding density per 0.2 m cell.



5.2| TSS DATA

The processed TSS data quality meets the project specific requirements and is of good quality. Quality control of the raw data, processed data and finished products was carried out to ensure that the project specifications was meet throughout the survey. Some factors we looked at was that the sample separation was not more than 20 cm on average over 25 fiducials and that the sample frequency of 4 Hz was kept. The 1.0 m line spacing meant that there was no cross track or along track gaps during the whole survey of all 33 targets. The detection range of 2.2 m (determined during the MAC / SIT trails) meant that low fly's (below 0.3 m) was required at two targets that was not detected at the normal flying height (around 0.6 m above seabed). One of the two was detected using this method.



An example of the TSS data density can be seen below in Figure 9.

Figure 9 Sample separation grid for target 0003 As-Found. For a cell to be green it needs to be less than 20 cm from the last cell. So even if a lot of these cells would be red, the density requirement would still be meet.

The altitude requirement of staying below 1.0 m was meet for all As-Found surveys but was not for all As-Left surveys because of the depression in the seabed caused by dredging. The WROV is unable to keep the altitude below 1.0 m without the risk of damaging the equipment. These areas were accepted by the on-board Clients Reps (see Figure 10).





Figure 10 Target 0001 As-Found altitude grid on the left and As-Left altitude grid on the right. Green means altitude above the seabed is below 1.0 m and red means it is above 1.0 m.



In Figure 11, a magnetic grid of target 0065 is presented showing the low noise levels: green is 0 μ V, yellow is 10 μ V and pink is 40 μ V or higher. The average noise level was between 0 - 6 μ V.

Figure 11 Target 0065 μ V grid shows a circular shaped anomaly with a smaller anomaly close by. The main anomaly has a peak value of 6315 μ V and the smaller one has 155 μ V. Observe the lighter green area in the north part of the grid, its where the data is noisiest.



6 | BACKGROUND DATA AND CLASSIFICATIONS

Client provided background information from previous surveys and the GIS database was the main resources used during data interpretation.

6.1 | SEABED GRADIENT CLASSIFICATION

The seabed gradient is classified as very gentle, < 1°, for the whole Artificial Island - UXO Inspection and Disposal survey area.

6.2| SEABED SEDIMENT CLASSIFICATION

The interpretation of surficial sediment types was derived from the main offshore survey work and is presented in the report 103783-ENN-MMT-SUR-REP-SURVWPAEI-02. It was derived from the acoustic character of the high frequency side scan sonar (SSS) data, and the interpretations aided by multibeam echo sounder (MBES) bathymetric 3D surfaces, multibeam backscatter (MBBS) and sub-bottom profiler (SBP) data, along with the results from the grab sample campaign (the latter two datasets from the MMT OWF survey area). During the review of the SSS survey data, higher intensity sonar returns (darker grey to black colours) were interpreted as relatively coarser grained sediments, and lower intensity sonar returns (lighter grey colours) were interpreted as relatively finer grained sediments. Bathymetric data was used to assist in boulder field interpretation and to correct for the effects of seabed slope on sonar returns.

Table 17 defines the Mosaic images in the charts for the specific sediment type present in UXO survey area. All particle sizes refer to the soil classification in ISO 14688-1 (2002).

ID	SSS Image	BS Image	Acoustic Description	Lithological Interpretation	Class*
			Low acoustic reflectivity. No texture. Texture indicates wave and stream working of the sediment.	MUD and SANDY mud Predominantly mud (silt & clay), may contain sand.	1a
			Low to medium acoustic reflectivity. No texture.	Muddy SAND Predominantly sand with variable fractions of mud (silt & clay).	1a

Table 17 Sediment classification.



ID	SSS Image	BS Image	Acoustic Description	Lithological Interpretation	Class*
			Medium acoustic reflectivity, slightly grainy texture.	SAND Predominantly sand, may have minor fractions of clay, silt and/or gravel.	1b
			Medium to high acoustic reflectivity. Slightly grainy to grainy texture, coarse texture in places.	GRAVEL and coarse SAND Predominantly gravelly sand, may contain silt. The ratio between sand and gravel can vary within this sediment type.	2a

* Danish Råstof-bekendtgørelsen

Note: the definition MUD has been used to keep in line with the TSG standards. MUD is comprised of SILT and/or CLAY.



7 | RESULTS

7.1| GENERAL

The results from the Artificial Island project UXO inspection and disposal survey are presented in this report. The Master Target List is presented in Appendix A| containing all information available about the target inspections.

7.2| BATHYMETRY

Overall, the bathymetric depth changes moderately across Artificial Island project site. The minimum surveyed depth is 26.39 m at 350 089.60 E, 6 264 468.00 N at the northeast of the area surveyed. The maximum surveyed depth is 28.25 m at 348 453.80 E, 6 263 071.90 N in the southwest part of the survey area. The depth range across the site is 1.86 m.

Profile data derived from the IN and OUT surveys were used to illustrate the seabed morphology before and after target removal or clearance. These were documented within the TIR reports (Appendix A|). DTMs from each survey were subsequently used to calculate the volume of sediment removed during dredging operations.

7.3 | SIDESCAN SONAR

The side scan sonar mosaics used as background data were provided by the Client and will be delivered for the specific inspection areas. No new side scan sonar data has been collected during this UXO inspection and disposal survey.

7.4 | CONTACTS AND ANOMALIES

7.4.1| TARGTES DESCRIPTION SUMMARY

A summarised description of the position and type of target for each inspected and found target is presented in Table 18.

Targets ID nomenclature was kept as defined in the background data provided by the Client (first column of Table 18). However, to reduce the number of characters used in the software and for an easy reading of the target name, a *Simplified Target ID* was used in QINSy. NaviModel and Oasis projects (second column of Table 18). All products produced are using the Simplified Target ID as target name.

In the target name (Simplified Target ID column in Table 18) it is possible to differentiate 4 nomenclatures:

- Target ID (ex: 0041): target identified by the Client to be investigated as a possible UXO;
- Target ID_letter (ex: 0041_a, 0279_b): additional targets found during the TSS As-Found survey within the 10m x 10m target box of the identified target;
- Target ID_letter_number (ex: 0279_a1): additional targets found at the same location of Target ID_a that was not identified as an individual anomaly during the TSS As-Found survey.
- Target ID_number (ex: 0401.1, 0402.1). additional targets found at the same location of the identified target that was not identified as an individual anomaly during the TSS As-Found survey.



Table 18 Target description summary.

Target ID	Simplified Target ID	Easting AS-Found	Northing As-Found	Target type	Target description	Comment
WPD_EI_GRAD_0001	0001	348098.67	6263951.19	Debris	Metal steel beam	
WPD_EI_GRAD_0002	0002	348081.74	6263725.80	Debris	Possible metal parts of the main wheels mechanism of an aircraft	
WPD_EI_GRAD_0003	0003	348106.10	6262939.16	Debris	Metal steel pipe or pole	
WPD_EI_GRAD_0006	0006	348096.49	6262893.83	Debris	Metal steel pipe or pole	
WPD_EI_GRAD_0007	0007	348086.28	6262867.68	Debris	Metal steel pipe or pole	
WPD_EI_GRAD_0041	0041	348444.63	6263062.98	Debris	Metal steel wire	
WPD_EI_GRAD_0041_A	0041_a	348444.63	6263062.98	Debris	Metal steel wire	Possible part of target 0041
WPD_EI_GRAD_0060	0060	348567.60	6264012.46	Debris	Metal pipe with a rope attached	
WPD_EI_GRAD_0065	0065	348485.31	6264164.74	UXO	German Moored mine	
WPD_EI_GRAD_0065_A	0065_a	348489.40	6264168.47	Debris	Metal wire	
WPD_EI_GRAD_0091	0091	348588.49	6262483.43	Debris	Metal wire	End of wire found inside the target box of target 0095
WPD_EI_GRAD_0095	0095	N/A	N/A	Debris	Part of a metal wire	By Client decision, this target was allocated to target 0091 because it was a continuation of it
WPD_EI_GRAD_0123	0123	348743.13	6262559.30	Debris	Metal wire	
WPD_EI_GRAD_0128	0128	348755.84	6263612.84	Debris	L-shaped metal pipe	Estimated weight of 70 kg
WPD_EI_GRAD_0147	0147	348907.01	6262283.43	Debris	Round metal ring	
WPD_EI_GRAD_0171	0171	N/A	N/A	Debris	N/A	Target not found after TSS surveys inside 10m x 10m and 15m x15m targets boxes
WPD_EI_GRAD_0210	0210	349180.43	6262872.31	Debris	Rectangular unknown metal piece	



Target ID	Simplified Target ID	Easting AS-Found	Northing As-Found	Target type	Target description	Comment
WPD_EI_GRAD_0210_A	0210_a	349181.00	6262875.78	Debris	Small metal piece	
WPD_EI_GRAD_0210_B	0210_b	349181.91	6262876.07	Debris	Small metal piece	Part of target 0210_a
WPD_EI_GRAD_0220	0220	349284.82	6263782.01	Debris	Metal pipe	
WPD_EI_GRAD_0238	0238	349431.22	6263342.24	Debris	Metal pipe	
WPD_EI_GRAD_0240	0240	349507.82	6263412.20	Debris	Metal beam	
WPD_EI_GRAD_0255	0255	349588.64	6262363.13	UXO	German Moored mine	
WPD_EI_GRAD_0279	0279	349660.25	6263061.95	Debris	Metal pipe or beam	
WPD_EI_GRAD_0279_A	0279_a	349658.84	6263066.50	Debris	Metal pipe or beam	Possible part of target 0279
WPD_EI_GRAD_0279_A1	0279_a1	349658.84	6263066.50	Debris	Small metal plate	Found at same location as target 0279_a
WPD_EI_GRAD_0279_B	0279_b	349656.39	6263072.41	Debris	N/A	Target not investigated by Client decision
WPD_EI_GRAD_0291	0291	349879.21	6263326.04	Debris	Metal pipe	
WPD_EI_GRAD_0307	0307	349909.78	6263438.53	Debris	Metal bar	
WPD_EI_GRAD_0307_A	0307_a	349912.40	6263441.57	Debris	Metal lid	Possible lid from metal bucket
WPD_EI_GRAD_0323	0323	349928.62	6262801.40	Debris	Metal anchor with chain	Estimated weight of 200 kg – 250 kg
WPD_EI_GRAD_0343	0343	349959.39	6262255.61	Debris	Metal bar	Estimated weight 5 kg
WPD_EI_GRAD_0352	0352	350076.46	6264480.81	Debris	Rectangular metal steel plate	Estimated weight of 10 kg
WPD_EI_GRAD_0383	0383	350322.99	6264102.24	Debris	Coiled metal wire	
WPD_EI_GRAD_0393	0393	350284.60	6264464.80	Debris	Metal wire	
WPD_EI_GRAD_0399	0399	350154.22	6264029.12	Debris	Metal anchor	Estimated weight of 120 kg
WPD_EI_GRAD_0401	0401	350261.01	6263969.92	Debris	Metal bar	Estimated weight of 25 - 30 kg
WPD_EI_GRAD_0401.1	0401.1	350261.01	6263969.92	Debris	Small metal bar	Possible part of target 0401
WPD_EI_GRAD_0401.2	0401.2	350261.01	6263969.92	Debris	"U" shaped metal small bar	Possible part of target 0401



Target ID	Simplified Target ID	Easting AS-Found	Northing As-Found	Target type	Target description	Comment
WPD_EI_GRAD_0401.3	0401.3	350261.01	6263969.92	Debris	Small metal bar	Possible part of target 0401
WPD_EI_GRAD_0402	0402	350257.12	6263968.24	Debris	"L" shaped metal bar or beam	
WPD_EI_GRAD_0402.1	0402.1	350257.12	6263968.24	Debris	Small metal piece	Found at same location as target 0402 and possible part of it
WPD_EI_GRAD_0402_A	0402_a	350252.78	6263970.99	Debris	Section of a metal chain	
WPD_EI_GRAD_0402_B	0402_b	350252.47	6263968.55	Debris	N/A	Target not investigated by Client decision
WPD_EI_GRAD_0487	0487	349360.27	6264230.40	Debris	Half cylindrical metal shaped debris	
WPD_EI_GRAD_0497	0497	348927.89	6262437.90	Debris	Metal wire	
WPD_EI_GRAD_0548	0548	349173.98	6262564.28	Debris	Unknown cylindrical shaped metal object	Estimated weight of 150kg

7.4.2 | TARGETS INSPECTION SUMMARY

A summarised description of inspection activities performed, including visual imaging, and actions to uncover each inspected and found target is presented in Table 19.

Table 19 Target inspection summary.

Simplified Target ID	Image	Inspection activity	Action required
0001	Ann Goldonia Van Jallan Andrea	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated



Simplified Target ID	Image	Inspection activity	Action required
0002	1 di parti parti di	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated
0003	Les 106-007 2 - 400 LS -	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated
0006	Bat ACCESS THE THE THE THE THE THE THE THE THE THE	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated
0007		 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated



Simplified Target ID	Image	Inspection activity	Action required
0041	1 for each of the second	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated
0041_a	An honden 6 2000 6 2000 7 2	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated
0060	Registration of the second sec	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated
0065	An defore an share e cance of e cance of e cance of e cance of e cance of e cance of e cance of e c	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and classified as UXO. No relocation allowed, disposal required. Buoy placed to mark UXO position for later disposal. Disposal with explosives performed by Danish Navy EODs. Post-explosion TSS survey performed to show anomaly removed. 	Disposal performed by Danish Navy EODs



Simplified Target ID	Image	Inspection activity	Action required
0065_a	to a contraction of the contract	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated
0091	1 бар даар даар оо	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated
0123	Anna All All All All All All All All All Al	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated
0128	Base Stat (SBC)2 and State 1 in a	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated



Simplified Target ID	Image	Inspection activity	Action required
0147	e a mai	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated
0171	And the second sec	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. No target found, TSS performed in 15x15m area No target found, client informed and accepted to move on 	No action was required, nothing was found
0210	e de	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated
0210_a	Reg Hr. Constant of the second s	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated



Simplified Target ID	Image	Inspection activity	Action required
0210_b	North INVERTIGATION CONTRACTOR OF A CONTRACTOR	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated
0220	And in the set of the	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated
0238	Li fa falan o for inter- to for inter- to for inter- bilitation de la falancia de	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated
0240	Hone Dividing to a Dividing to Dividing to Dividing to a Dividing to a Dividing to a Divid	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated



Simplified Target ID	Image	Inspection activity	Action required
0255	En e de la conserva d	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and classified as UXO. No relocation allowed, disposal required. Buoy placed to mark UXO position for later disposal. Disposal with explosives performed by Danish Navy EODs. Post-explosion TSS survey performed to show anomaly removed. 	Disposal performed by Danish Navy EODs
0279	La revari 2 Anno 10 3 Anno 10	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated
0279_a	A SCHERE H AND AND A SCHERE AN	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated
0279_a1	Automation of the second	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated



Simplified Target ID	Image	Inspection activity	Action required
0279_b	Catality takes	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated
0291	and for the second	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated
0307	Bank of official to the second s	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated
0307_a	ber (1000) the month to construct the second seco	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated



Simplified Target ID	Image	Inspection activity	Action required
0323	new officing the start of the s	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated
0343	tan too an	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated
0352	ter de la constante de la constant	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated
0383	e norme de la construcción de la	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated



Simplified Target ID	Image	Inspection activity	Action required
0393	After state the source of the	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated
0399	and the first of the second seco	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated
0401	And ALCOURT	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated
0401.1	Ref. BASH 19 January 20 Janu	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated



Simplified Target ID	Image	Inspection activity	Action required
0401.2	Service And Servic	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated
0401.3	And second 1 Second 2 Se	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated
0402	R BRUE B B B B B B B B	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated
0402.1	R ARCA S R ARCA	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated



Simplified Target ID	Image	Inspection activity	Action required
0402_a		 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated
0487	A BLOOM N B	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated
0497	and Kroofdi and Stars and And Stars and And And And And And And And And And A	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated
0548	Auge: 600 Auge:	 Visual inspection of the expected target position performed with WROV video cameras. TSS survey performed for anomaly detection. Excavation of the site performed, debris found and relocated. Post-excavation TSS survey performed to show anomaly removed. 	No action was required, debris relocated

Full details of all the targets magnetic properties are presented in Appendix A| and Appendix B|.



7.4.3 | UXO DISPOSAL

Figure 12 to Figure 15 are showing the before and after disposal completion by the Danish Navy EOD specialists of targets 0065 and 0255. Detailed information about these targets is presented in Appendix A| Target Investigation Report (TIR).



Figure 12 Target 0065 as found after dredging/excavation.







Figure 13 Target 0065 after disposal by the Danish Navy EOD specialists.

Figure 14 Target 0255 as found after dredging/excavation.



Figure 15 Target 0255 after disposal by the Danish Navy EOD specialists.



Both UXOs were identified as German moored mines from the Second World War (WWII) which contains mainly steel. The type of explosives of both mines contained about 300 kg novit and about 10% aluminium. Both mines also had chemical horns as fuses.

7.4.4| TARGETS NOT FOUND

Only one of the 33 targets was not identified on the first 10 m x 10 m TSS As-Found survey, target 0171 (Figure 16). According to the project specific procedure, when a target is not found by the first TSS survey inside the 10 m x10 m target box, a second TSS As-Found survey must be performed inside the 15 m x 15 m target box (Figure 17). Both TSS As-Found surveys showed no anomalies detection.

A TSS check with WROV tether was performed to verify if equipment was working correctly and it was verified there were no issues with the coils (a magnetic signature was detected by all coils).

Since no TSS hits were found on target 0171 in 10 m x 10 m and 15 m x 15 m target boxes during both TSS As-Found surveys, Client Rep on-board approved that nothing was found at the location and no further action required.



Figure 16 TSS As-Found magnetic grid on the left side and TSS As-Found altitude grid on the right side performed within the 10 m x 10 m target box.



Figure 17 TSS As-Found magnetic grid on the left side and TSS As-Found altitude grid on the right side performed within the 15 m x 15 m target box.



8 | CONCLUSIONS

In summary, 33 targets were inspected from 03 to 09 June 2022:

- 30 targets were identified as metal debris and were relocated outside the 10 m x 10 m survey target box area;
- 1 target was not found within the 10 m x 10 m or the 15 m x 15 m survey target box areas;
- 2 targets were identified as UXOs; same type of German moored mine from the Second World War (WWI). UXOs were properly disposed of by the Danish Navy EOD specialists.

11 targets of opportunity were found and inspected during the survey;

- 10 targets were classified as metal debris and were relocated outside the survey area;
- 1 target was an unknown debris and was relocated outside the survey area.

All 33 target inspection sites were confirmed clear by Client Reps on-board and by the Danish Navy EOD specialists before leaving any of the target sites.



9 | DATA INDEX (META DATA)

The deliverables listed in Table 20 accompany this report.

Table 20 Deliverables.

П

ltem	Group	Data Product
1.	Bathy data	Bathymetry - Un-gridded soundings, (X,Y,Z) values in ASCII format. (As Found and As Left).
2.	Bathy data	Bathymetry - Gridded soundings, 0.20m resolution, (X,Y,Z) values in ASCII format (tiled following the UTM grid). (As Found and As Left).
3.	Bathy data	Bathymetry - Gridded soundings, 0.20m resolution, geotiff stored in esri file geodatabase (untiled). (As Found and As Left).
4.	Bathy data	Bathymetry - Gridded soundings, 1.00m resolution, (X,Y,Z) values in ASCII format (tiled following the UTM grid). (As Found and As Left).
5.	Bathy data	Bathymetry - Gridded soundings, 1.00m resolution, geotiff stored in esri file geodatabase (untiled). (As Found and As Left).
6.	Bathy data	Contours, dxf. (As Found and As Left).
7.	Bathy data_GIS	Bathymetry - Bathymetric contour curves with 50cm interval, as TSG object CONTOURS_LIN. (As Found and As Left).
8.	Bathy data_GIS	Bathymetry - Vessel tracks, as TSG object TRACKS_LIN, indicate equipment carrier and equipment type in attributes. (As Found and As Left).
9.	Bathy data	SVP - sound velocity profiles as SVP comparison spreadsheet. Additional delivery.
10.	TSS data	TSS files CSV-format.
11.	TSS data	Gridded data as a relevant file (.flt, .grd, .tif). (As Found, Out Survey (when applicable) and As Left).
12.	TSS data_GIS	TSS instrument tracks, as TSG object TRACKS_LIN, indicate equipment carrier and equipment type in attributes. (As Found, Out Survey (when applicable) and As Left).
13.	TSS data_GIS	TSS targets as TSG object TSS_ANOMALY_PTS, anomaly characteristics provided in attributes. (As Found and As Left)
14.	Interpreted Data_GIS	Man-Made-Objects, as TSG object MMO_PTS with the following characteristics included in the attributes– bathymetry, side scan sonar and magnetometer
15.	Report	UXO Investigation and disposal survey report (charts as enclosures)
16.	Report	Operations report.
17.	Video	Video files for applicable operational tasks, .mp4 format.



APPENDIX A | TARGET INVESTIGATION REPORT (TIR)



APPENDIX B | UXO MASTER TARGET LIST (MTL)



APPENDIX C | CHART LIST

