Scottish Hydro Electric Power Distribution plc

Sanday-North Ronaldsay Replacement Marine Licensing Support

High Level Navigational Risk Assessment

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ACRONYMS AND ABBREVIATIONS

ABBREVIATION	DEFINITION
AC	Alternating Current
AIS	Automatic Identification System
ALARP	As Low as Reasonably Practicable
AtoN	Aid to Navigation
BT	British Telecoms
CEMP	Construction Environmental Management Plan
CSV	Comma-Separated Values
DWT	Deadweight Tonnage
EMF	Electromagnetic Fields
EU	European Union
FIR	Fishing Industry Representative
FLMAP	Fisheries Liaison Mitigation Action Plan
FLO	Fisheries Liaison Officer
FSA	Formal Safety Assessment
HES	Historic Environment Scotland
HLNRA	High Level Navigational Risk Assessment
Hz	Hertz
IMO	International Maritime Organisation
IRPCS	International Regulations for the Prevention of Collision at Sea
KIS - ORCA	Kingfisher Information Service – Offshore Renewable and Cable Awareness
km	Kilometres
km^2	Square kilometres
KP	Kilometre Point
kV	kilovolt
m	Metres
MCA	Maritime and Coastguard Agency
MEA	Marine Environmental Appraisal
MGN	Marine Guidance Note
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
MMSI	Maritime Mobile Service Identity
MTS	Marine Traffic Survey
NM	Nautical Mile
NtM	Notice to Mariners

ABBREVIATION	DEFINITION
OCT	Open Cut Trench
OIMD	Operation, Inspection, Maintenance and Decommissioning Strategy
OoS	Out of Service
OREI	Offshore Renewable Energy Installation
RCZ	Recommended Clearance Zone
RP	Reference Point
Ro-Ro	Roll-on/Roll-off
RRM	Risk Reduction Measure
RYA	Royal Yachting Association
SAR	Search and Rescue
SHEPD	Scottish Hydro Electric Power Distribution
SOLAS	Safety of Life at Sea
TJP	Transition Joint Pit
UK	United Kingdom
UKHO	United Kingdom Hydrographic Office
UTC	Universal Time Coordinated
UXO	Unexploded Ordinance
VTS	Vessel Traffic Service
µT	microtesla

1 INTRODUCTION

This High Level Navigational Risk Assessment (HLNRA) provides an appraisal of navigational risk associated with the proposed Sanday-North Ronaldsay replacement cable installation ("the Project"). The cable will be constructed between the landfalls at Sanday and North Ronaldsay in the Orkney Archipelago. The cable will be approximately 11 kilometres (km) (including 5% contingency) from Transition Joint Pit (TJP) to TJP or 10.4 km from Mean High Water Springs (MHWS) to MHWS (including 5% contingency). An HLNRA approach has been utilised as being a proportionate way to assess the navigation and shipping risk posed by this Project, due to the short length of the proposed cable and therefore limited Zone of Influence of this Project.

A targeted Marine Traffic Survey (MTS) has been undertaken to describe the relevant shipping and navigational baseline, as understood through desk-based review, and is presented in Section 3. The HLNRA uses a Formal Safety Assessment (FSA) approach to identify and assess the risks to shipping and navigation presented by the project activities. The results of the FSA are contained within Section 4. This HLNRA should be read in conjunction with the following documents that together comprise the submission to the regulator:

- Sanday – North Ronaldsay Project Description (Document Ref: A-200853-S00-A-REPT-002);
- Marine Environmental Appraisal (MEA) (Document Ref: A-200853-S00-A-REPT-001);
- Marine Licence Application (MLA) Form (Document Ref: A-200853-S00-A-FORM-003);
- Inshore European Protected Species (EPS) Licence Application Form (Document Ref: A-200853-S00-A-FORM-001);
- Basking Shark Derogation Licence Application Form (Document Ref: A-200853-S00-A-FORM-002);
- Marine Construction Environmental Management Plan (CEMP) (Document Ref: A-200853-S00-A-PLAN-001);
- Cable Lay and Monitoring Plan (CLMP) (*applicable to the 2026 cable installation campaign*); and
- Cable Protection and Monitoring Plan (CPMP) (*applicable to the 2027 cable protection campaign*);
- North Coast and Orkney Fisheries Liaison Mitigation Action Plan (FLMAP);
- How SHEPD co-exists with other marine users document;
- Operation, Inspection, Maintenance and Decommissioning Strategy (OIMD); and
- Cost Benefit Analysis (CBA) Summary Report.

1.1 Project Overview

Scottish Hydro Electric Power Distribution plc (SHEPD) holds a licence under the Electricity Act 1989 for the distribution of electricity in Scotland. It has a statutory duty to provide an economic and efficient system for the distribution of electricity and to ensure that its assets are maintained to provide a safe, secure and reliable supply to customers.

Following a fault in February 2026 the current 11 kilovolt (kV) submarine power cable from Sanday to North Ronaldsay was determined to be unrepairable in April of the same year. As part of the statutory duties listed above, SHEPD has undertaken surveys and has begun preparing a replacement for this cable system, including consenting activities. As part of these activities, an FSA is required, and this document lays out an initial MTS, embedded risk mitigation measures, and provides a preliminary risk-ranking of threats that may result from the proposed the cable installation.

The proposed cable will be constructed between the landfalls of Sanday and North Ronaldsay (Figure 1-1 and Figure 1-2). The final cable route has yet to be determined. As such, to provide flexibility for final route engineering, this HLNRA consider an approximately 9.2 square kilometres (km^2) proposed cable corridor, within which the cable will be located, alongside two new onshore Aids to Navigation (AtoN). The final route selection will be based on further detailed route engineering and design parameters, while taking environmental and other constraints into account.

The cable will be trenched in the intertidal landfall locations, and surface laid with cable protection (tubular cable protection systems and two tonne rock bags) in the subtidal area. It is proposed to split the installation campaign in two parts; cable and nearshore tubular cable protection system installation in Autumn 2026 before the adverse winter weather, with the remaining subtidal cable protection installation following in Spring/Summer 2027. The total time for the initial cable installation is scheduled to be 37 days, with 3 days for initial cable laying and a further 28 days for intertidal trenching/protection installation. After the initial installation works, rock bag protection in Spring / Summer 2027 is expected to take a further 60 days. Full project description can be found in the Sanday – North Ronaldsay Project Description (Document Ref: A-200853-S00-A-REPT-002).

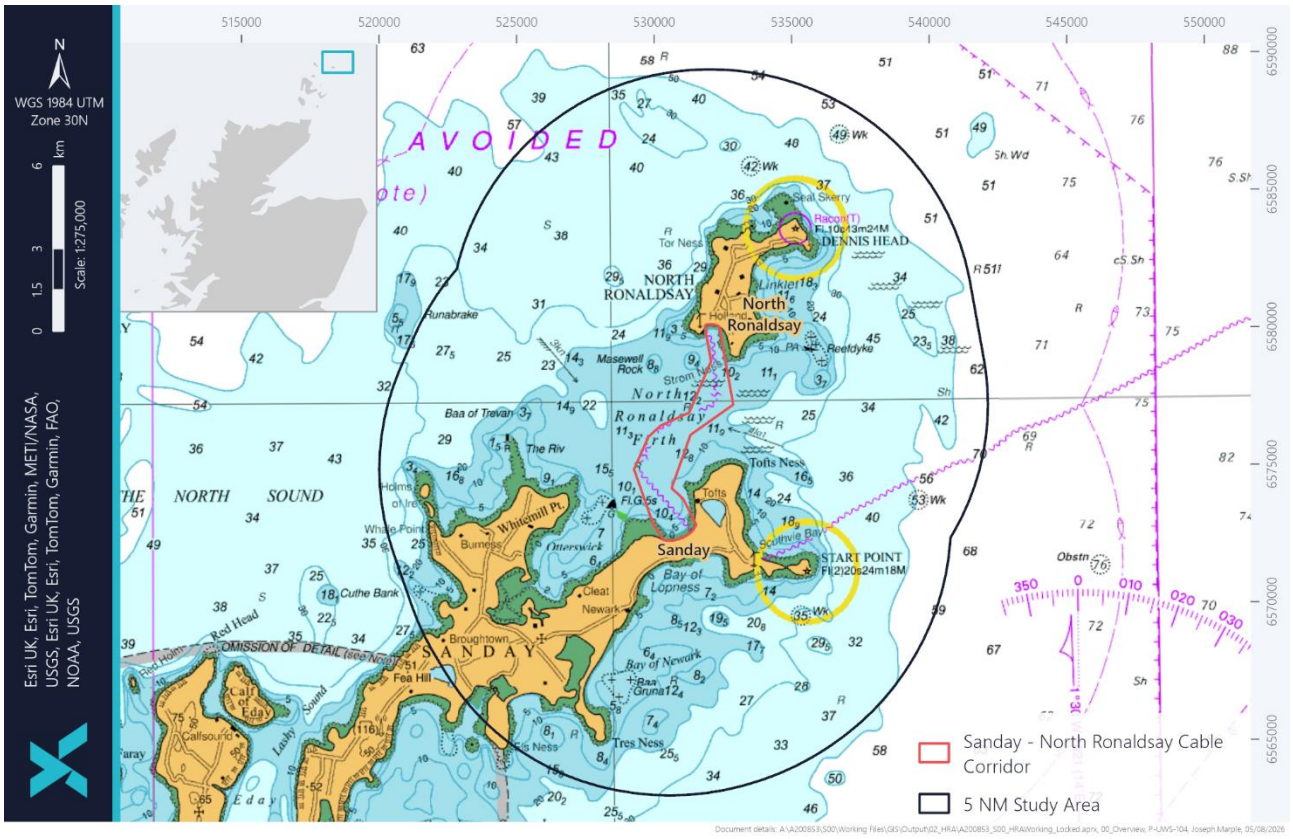


Figure 1-1 Sanday to North Ronaldsay Proposed Cable Corridor and Study Area

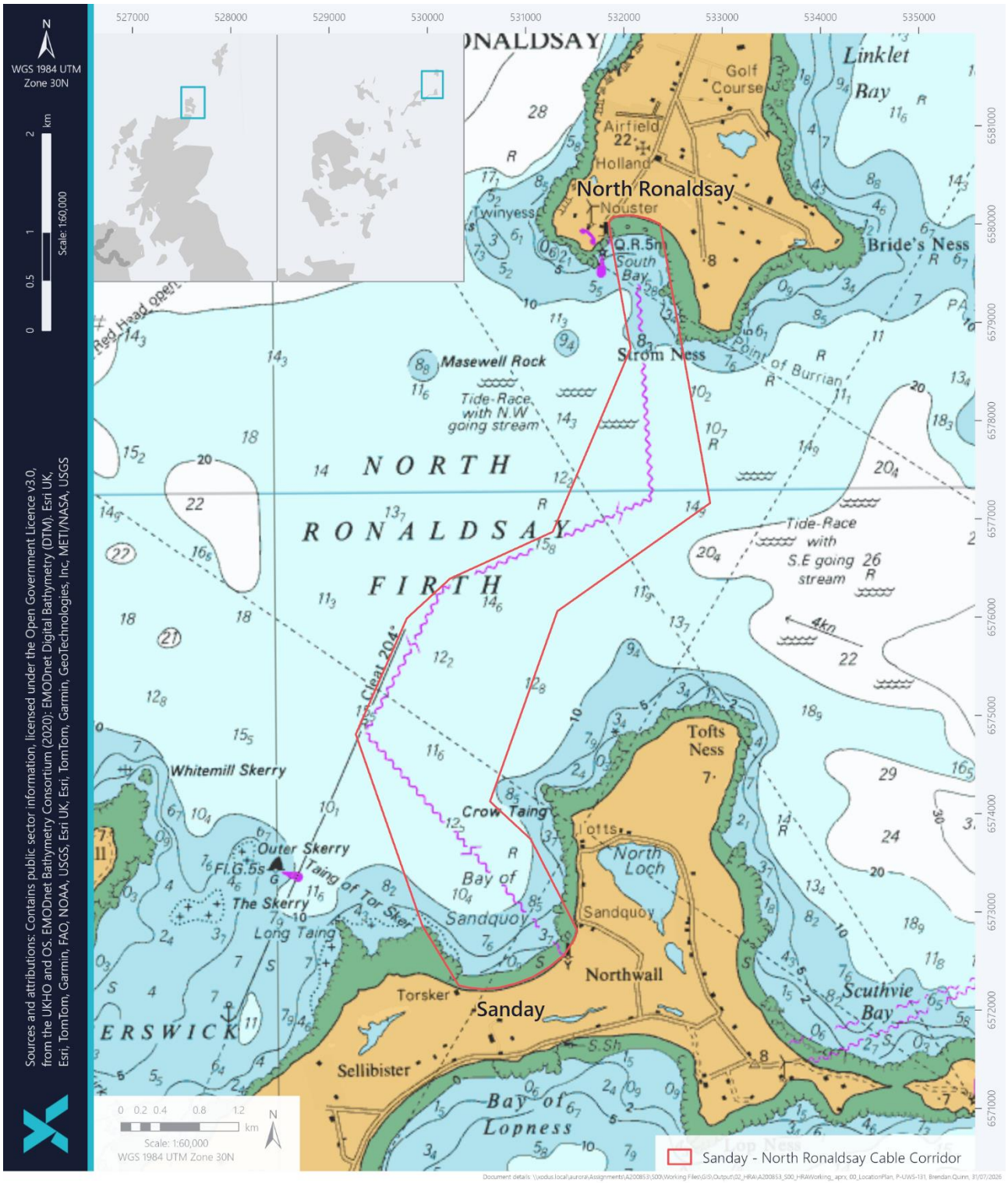


Figure 1-2 Sanday to North Ronaldsay Proposed Cable Corridor with Admiralty Chart 2250

1.2 Embedded Mitigation

Certain risk control or mitigation measures are embedded in the Project design through adherence to standard industry best practice, which are fundamental to how the Project will be executed. Details of the embedded mitigation which SHEPD are committed to implementing, and hence has been considered by this HLNRA, are presented in Table 1-1. All embedded mitigation are included within the marine CEMP (Xodus Document No. A-200853-S00-A-PLAN-001).

During the HLNRA, all proposed mitigation is considered when assessing the significance of risks.

Table 1-1 Embedded Mitigation and Principal Industry Best Practices Relevant to the Proposed Activities

MEASURE	DETAILS
Avoidance of trawling and anchoring over the cable	In line with guidance provided by the United Kingdom Hydrographic Office (UKHO), the International Maritime Organisation (IMO) and the Maritime and Coastguard Agency (MCA) within the Mariner's Handbook (NP100), and Marine Guidance Note (MGN) 661, SHEPD recommend that vessels should avoid demersal fishing and anchoring in proximity to subsea cables.
Production of a Marine CEMP	The Marine CEMP is designed to provide a consolidated point of reference for SHEPD and their marine contractors. It ensures all embedded and additional mitigation measures identified by the MEA and supporting documents are effectively disseminated to and implemented by the Project team during Project activities, thus ensuring that any potential environmental impacts are minimised.
All Project personnel will be trained and informed of their responsibility to implement the environmental and ecological mitigation outlined in the Marine CEMP	Toolbox talks, inductions, and awareness notices will be used to disseminate this information among all relevant personnel.
A Fisheries Liaison Officer (FLO) will be employed to manage interactions between cable installation vessels, personnel, equipment and fishing activity. This will be managed through the North Coast and Orkney Fisheries Liaison Mitigation Action Plan (FLMAP)	Employment of a FLO will ensure all commercial fisheries operators in the vicinity of the Project will be proactively and appropriately communicated with in terms of the proposed cable installation activities.

MEASURE	DETAILS
Consultation with commercial fishing stakeholders to identify acceptable and feasible mitigation options with the aim of minimising Potential effects on commercial fishing	SHEPD will, in consultation with commercial fishing stakeholders, work towards identifying acceptable and feasible mitigation options with the aim of minimising any potential effects on commercial fishing associated with the replacement of submarine electricity cable. There are various options available to mitigate the risks, including: • Continuing effective positive liaison with commercial fishing stakeholders through the pre-installation, installation and operational phases of any cable replacement; • Continued employment of FLO/Fishing Industry Representative (FIR) services until the completion of the replacement works; • Ensuring contractors comply with the contractor's obligations outlined above so as to minimise any interference to commercial fishing activities; • Managing the cable replacement works so as to minimise any potential effects on the marine environment, habitats and commercial fishing; • Raising awareness of the danger of fishing in the vicinity of submarine cable; • Adopting a hierarchical approach to submarine cable protection, taking account of sea users concerns; • Organising an installation phasing workshop (if new cable is required) to inform commercial fishermen of planned activities; • Organising installation schedules (if new cable is required) as far as is practicably possible in order to reduce the combined loss of fishing area associated with safety zones; • Distributing weekly notice of operations; • Providing information in plotter format to enable fishermen to easily interpret the information; and/or • Scouting surveys to identify potting areas and any other relevant static gear areas.
Notice to Mariners (NtM), local notifications to marine users, Clyde Cruising Club, Orkney Marinas, Kingfisher bulletins, Radio Navigational Warnings, and/or broadcast warnings will be promulgated in advance of any proposed works. The notices will include the time and location of any work being carried out, and emergency event procedures.	Ensure navigational safety and minimise the risk and equipment snagging. Notices will also be issued if any out of service (OoS) cables are removed or moved and chart updates will be provided.

MEASURE	DETAILS
Compliance with International Regulations for the Prevention of Collision at Sea (IRPCS) (IMO, 1972) and the International Regulations for the Safety of Life at Sea (SOLAS)	IRPCS are the international standards designed to ensure safe navigation of vessels at sea. All installation vessels will adhere to these rules, including displaying appropriate lights and shapes. SOLAS is an international maritime treaty which sets minimum safety standards in the installation, equipment and operation of merchant ships. The convention requires signatory flag states to ensure that ships flagged by them comply with at least these standards. In relation to the Project its compliance will ensure navigational safety.
As built survey data will be provided to the UKHO and Kingfisher for inclusion on Admiralty Charts and the Kingfisher Information Service – Offshore Renewable and Cable Awareness (KIS-ORCA) charts	Ensure navigational safety and minimise the risk of equipment snagging.
Engagement with Shipping and Navigation Consultees	Ongoing consultations with ports and harbour authority (Orkney Islands Council Harbour Authority) ensure continued awareness and communication of installation and harbour specific details relevant to minimising disruption. Ongoing consultation with fisheries as detailed within the North Coast and Orkney FLMAP to discuss the potential impacts as a result of the installation activities. Engagement with ferry operator (Orkney Ferries) and regular runners ensures awareness of the installation details which minimises disruption. Installation maintenance and decommissioning schedules arranged to minimise impact on ferry schedules. This may extend to working in night-time hours where practicable.
Engagement with Royal Yachting Association (RYA)	Stakeholder consultations with RYA Scotland to confirm how best updated cable routes are communicated with the local community.
Guard Vessels and Recommended Clearance Zone (RCZ)	A guard vessel or small support vessel, marshalling a 500 m RCZ may be used during the installation campaign where a potential risk to the asset or danger to navigation has been identified. The requirement for a guard vessel will be considered through consultation with the Orkney Islands Council Harbour Authority, ferry operator Orkney Ferries and Installation Contractor. The RCZ may be reduced to 250 m (or other agreed distance) for the Orkney Ferries and vessels carrying Orkney Islands Council Harbour Authority pilots. This will be implemented through ongoing communications and agreements between the Orkney Islands Council Harbour Master, the Orkney Ferries ferry operator, SHEPD and the cable installation contractor.
Installation of AtoNs	Two new AtoNs will be installed as part of the Project to ensure navigational hazards are marked appropriately.

2 METHODOLOGY

2.1 Introduction

This HLNRA uses the baseline shipping data from the MTS to inform a high-level desk-top FSA process which identifies and assesses hazards to all relevant navigation or shipping activities, from the Project. The process provides a hazard log which ultimately demonstrates that suitable risk management measures have been applied to the development and that risks are both reduced to As Low As Reasonably Practicable (ALARP) and trackable.

2.2 Baseline Conditions

2.2.1 Marine Traffic Survey

Relevant baseline marine traffic conditions have been established by undertaking a review of historic Automatic Identification System (AIS) data for a 10 nautical mile (NM) wide study are, centred on the Project cable corridor (the study area). The IMO requires that all ships of ≥ 300 gross tonnage engaged on international voyages, cargo vessels of ≥ 500 gross tonnage not engaged on international voyages, and all passenger ships regardless of size built on or after 1st July 2002, are fitted with an AIS. All European Union (EU) registered fishing vessels of length 15 m and above are required to carry AIS equipment by EU directive. Smaller fishing vessels (below 15 m) as well as recreational craft are not required to carry AIS, although a proportion does so voluntarily. As such smaller vessels are likely to be underrepresented in the AIS data.

AIS data was used to assess the patterns and intensity of shipping activity in the vicinity of the Project cable corridor. AIS records were acquired for a full year between the dates 14th of July 2025 to 13th of July 2026 Universal Time Coordinated (UTC). The data was supplied by Kpler (industry standard commercial AIS data supplier) with all standard parameters (longitude, latitude, vessel Maritime Mobile Service Identity (MMSI) number, status, speed, course, heading and timestamp) and the following additional parameters:

- Deadweight tonnage (DWT);
- Vessel length;
- Vessel draught;
- Vessel type;
- Vessel name;
- Previous port; and
- Next port.

AIS data was received in a raw, point-based table format in multiple comma-separated values (CSV) files and quality checked. The entire point-based dataset was subsequently converted to vessel tracks using in-house developed Python tools that use the unique MMSI, journey information (previous port and next port) and the timestamp associated with each individual AIS record. Vessel tracks were created where each AIS record was 'connected' by a line to another that shares the same MMSI and vessel type and that falls under a specified time and distance threshold.

In this case, sequential AIS point records were connected where the intervening time or distance did not exceed 120 minutes or 20 miles, respectively. These thresholds were set to strike a balance between ensuring the connectivity of valid points across the assessment area so that a singular journey is not broken into multiple lines and therefore misrepresent the volume of transits or trajectories, and accurately reflects the direction or route of a transect.

Vessel density grids for the study area were produced by overlaying a 0.5 km^2 hexagonal grid and determining the density of tracks within each cell. The tracks are subsequently 'reattached' to the ship-specific attribute data base to enable further analysis. Each track line or trajectory will have a start and end time and date taken from the minimum and maximum timestamp value for the range of AIS points associated with that track line, allowing for temporal analysis of vessel distributions. Vessels were determined to be transiting during the day where the journey end time was between 06:30 (06:30 AM) and 18:30 (06:30 PM) and during the night where the journey end time was between 18:30 (06:30 PM) and 06:30 (06:30 AM).

2.3 Consultation

Initial stakeholder meetings were undertaken with the Maritime and Coastguard Agency (MCA), the Northern Lighthouse Board and Orkney Islands Council to discuss the cable fault, replacement methods and timelines when the fault occurred.

A consultation meeting was also held on 17th August 2026 with Orkney Islands Council Harbour Authority, Orkney Ferries, Orkney Fishermen's Association and RYA to understand key concerns to navigation from the Project, which has informed the FSA. Orkney Ferries runs the ferry service in the vicinity of the proposed cable corridor which is located in the Orkney Islands Council Harbour Authority's Statutory Harbour Area at the North Ronaldsay landfall. During the meeting the stakeholders were broadly content that all relevant commercial fisheries and other sea users had been identified. RYA noted that small leisure crafts should not be impacted by the cable due to the depth where it transitions from OCT to surface laid cable. The stakeholders also advised that while lobster and crab creeling does take place in the wider study area, there is only limited evidence of scallop dredging, reducing any snagging risk. All stakeholders stressed the importance of NtM to ensure local sea users are informed of the Project.

The outputs and advice from the consultation meetings have been considered in this HLNRA.

2.4 Formal Safety Assessment

2.4.1 Introduction

The FSA process provides a structured and systematic method for evaluating and controlling risk within a defined framework. The process is implemented using a classic risk matrix approach broadly in line with the IMO FSA Guidelines (IMO, 2018) and the MCA Methodology for Assessing the Marine Navigational Safety & Emergency Response Risks of Offshore Renewable Energy Installations (OREI).

This approach is qualitative and comprises the following principal elements:

- Hazard/impact identification;
- Identification of existing risk control measures;
- Risk assessment;
- Identification of additional risk control measures; and
- Cost benefit considerations.

The outcome of these elements is the formulation of recommendations to inform decision-making for all relevant parties. Further detail on each element is provided below.

2.4.2 Hazard/Impact Identification

Considering the Project components and activities, feedback received during consultation, baseline information provided in the MTS, and expert judgement/industry experience, a list of all relevant hazards, as well as their worst potential outcomes is compiled. The hazards are categorised according to Project phase with the operational phase referring to the condition where the cable is installed, and sea surface activities have ceased. Installation, maintenance, and decommissioning phases translate to the presence of vessels, typically restricted in their manoeuvrability, within the cable corridor.

2.4.3 Identification of Existing Risk Control Measures

All existing risk control measures are identified such that they can be incorporated into the risk assessment process. These include mandatory requirements and good industry practice as well as project specific measures that are prescribed/predefined as forming part of the Project design (Table 1-1).

2.4.4 Risk Assessment

Each risk pathway is individually evaluated against specific criteria and assigned categories for severity of the hazardous outcome consequences and likelihood or frequency of the occurrence. The definitions used in the FSA to evaluate the consequence and frequency of impacts are shown below in Table 2-1 and Table 2-2. Note that there is no established consensus for risk matrix category definitions within the IMO, MCA or across wider industry. The categories applied here are considered appropriate for this HLNRA.

Table 2-1 Severity of Consequence of Hazard/Impact Criteria

SEVERITY/MAGNITUDE	CRITERIA DESCRIPTION
High	• Loss of life, or multiple serious injuries; • Major/Severe damage to infrastructure or vessel; • Maritime operations/activities halted indefinitely; • Major commercial impact; and/or • Tier 3 environmental response – national assistance needed.
Medium	• Serious injury to person; • Notable damage to infrastructure or vessel; • Protracted operational delays; • Moderate commercial impact; and/or • Tier 2 environmental response – external assistance needed.
Low	• Minor injury(s) to person; • Minor/local damage to equipment or vessel; • Minor operational delays; • Minor commercial impact; and/or • Tier 1 environmental response – local assistance needed.
Negligible	• No significant operational impacts; • No significant operational impacts; and/or • Minor environmental emissions, no spill response required.

Table 2-2 Likelihood Criteria

LIKELIHOOD	CRITERIA DESCRIPTION
Remote	Never occurred during SHEPD's activities but has been known to occur in the wider industry.
Unlikely	Has occurred in SHEPD's activities in the past but as an isolated incident under exceptional circumstance.
Occasional	Has occurred on more than one occasion during SHEPD's activities in the past.
Likely	Occurs regularly during SHEPD's activities.

The likelihood and consequence categories are combined for each hazard using the risk matrix shown in Table 2-3, which is used to derive a risk tolerability level of either Unacceptable, Tolerable or Broadly Acceptable, with unacceptable or tolerable risks being considered to be significant in Environmental Appraisal terms, and "broadly acceptable" considered to be not significant. Definitions of each risk tolerability level are provided in Table 2-4.

Table 2-3 Risk Matrix

FREQUENCY					
	Frequent	Broadly Acceptable	Tolerable	Unacceptable	Unacceptable
	Occasional	Broadly Acceptable	Tolerable	Tolerable	Unacceptable
	Unlikely	Broadly Acceptable	Broadly Acceptable	Tolerable	Tolerable
	Remote	Broadly Acceptable	Broadly Acceptable	Broadly Acceptable	Tolerable
	-	**Negligible**	**Low**	**Medium**	**High**
		SEVERITY OF CONSEQUENCE			

Table 2-4 Tolerability Definitions

TOLERABILITY	DEFINITION
Broadly Acceptable (Low Risk - not significant)	Generally regarded as acceptable and adequately controlled. At these risk levels the opportunity for further reduction is limited.
Tolerable if ALARP (Moderate Risk - significant)	Typical of the risks from activities which people are prepared to tolerate to secure benefits. There is however an expectation that such risks are properly assessed, appropriate mitigation measures are in place, residual risks are ALARP and that risks are periodically reviewed to monitor if further controls are appropriate.
Unacceptable (High Risk - significant)	Generally regarded as unacceptable whatever the level of benefit associated with the activity. Significant risk mitigation or design modification required to reduce risk to tolerable (ALARP).

2.4.5 Identification of Additional Mitigation Measures

Where risks are assessed as being "unacceptable" or "tolerable if ALARP" after factoring in the embedded mitigation measures already identified, further additional risk mitigation measures are considered and identified where necessary and practicable.

2.4.6 Cost-benefit Considerations

To formulate recommendations for decision-making, any additional risk mitigation measures identified are subjected to a qualitative cost-benefit comparison in order to justify the measure and establish a residual risk categorisation and basic ALARP position.

2.4.7 Risk Assessment Table/Hazard Log

The HLNRA output has been presented in a table, such that the hazards for each of the Project phases and their associated mitigation measures (embedded and additional) are captured to provide a single auditable hazards and effects log. The output of the assessment can be seen in Table 4-1.

3 MARINE TRAFFIC SURVEY

This section covers the relevant shipping and navigation baseline within the study area, providing a summary of key navigational features and shipping activity as determined from analysis of AIS data. Analysis of shipping and navigation is important, due to potential interactions between existing vessel traffic and the proposed cable infrastructure and Project vessels, particularly during the installation phase.

3.1 Key Navigational Features

An overview of all relevant key navigational features is provided in the following sections and presented in Figure 3-1.

3.1.1 Ports and Ferry Routes

The "Kirkwall – North Ronaldsay – Papa Westray" ferry service is an inter-island maritime connection operated by Orkney Ferries Ltd. The route links the Orkney Mainland port of Kirkwall with the remote northern islands of North Ronaldsay and Papa Westray. Nouster Harbour serves as North Ronaldsay's ferry landing facility. The harbour is the North Ronaldsay's primary marine access point and is located on the island's southern coastline within Nouster Bay. During stakeholder consultation an additional ferry route which intersects the proposed cable corridor was identified by Orkney Ferries (see Figure 3-1). Whilst confirmed as a formal ferry route, it is only used when adverse weather conditions prohibit the taking of the less-sheltered primary routes which pass to the west of Sanday. The secondary route takes a southeastern path from North Ronaldsay to the east Sanday, depicted in Figure 3-5. These adverse weather conditions are most likely to occur during winter months when the ferry reduces its operating schedule to two journeys per week.

The "Kirkwall – North Ronaldsay – Papa Westray" ferry route approaches approximately 100 metres (m) to the west of the proposed cable corridor within the Nouster Harbour Area on North Ronaldsay, in close proximity to where the designated proposed landfall location.

3.1.2 Cables and Aids to Navigation

The only cable which intersects the proposed Project cable corridor is the existing Sanday to North Ronaldsay power cable which will be replaced as part of this Project. An active BT telecommunications cable is present within the eastern portion of the study area (Figure 3-1), but this is not within the cable corridor.

As confirmed during stakeholder consultation with the Orkney Islands Council Harbour Authority, seasonal small craft moorings will be removed in preparation for cable installation works.

There are a number of Aids to Navigation (AtoNs) within the study area, notably the Outer Skerry starboard hand lateral mark, and a red navigation light on the Nouster ferry pier. There are no AtoNs within the project cable corridor, with the exception of the yellow cable marker boards with denote the landfalls of the existing faulted Sandar-North Ronaldsay cable, and these will be replaced once the new cable is installed.

No charted anchorage areas intersect the proposed cable corridor, with the closest Otterswick anchorage area located approximately 2.2 km to the southwest (Figure 3-1).

3.1.3 Wrecks, Obstructions and Recreation

Wreck locations were identified using Marine Themes Vector data layers from Emapsite and the open-source Global Wrecks and Obstructions database provided by the UKHO, and displayed on Figure 3-1.

The closest UKHO dataset wreck is named WANJA and categorised as "distributed remains of wreck". This wreck is located approximately 2.4 km west of the southern section of the proposed cable corridor (Figure 3-1). However, whilst not detailed in the UKHO nor Global Wrecks datasets, the Project's geophysical of the cable corridor has identified a structure which is presumed to be a wreck. Whilst not a confirmed wreck, the structure will be treated as a wreck and avoided with a minimum 25 m buffer radius during cable routeing. The closest features identified from the Emapsite Marine Themes Vector data were submerged rock obstructions, the closest of which located approximately 490 m from the proposed cable corridor.

Neither the UKHO nor the Marine Themes Vector dataset display any wreck nor obstruction which intersects the proposed cable corridor.

No RYA clubs, training centres, marinas or recreational boating areas are identified within the study area.

Key Navigational Features

- Sanday - North Ronaldsay Cable Corridor
- 5 NM Study Area

Wreck & Obstruction Category

- Dangerous wreck
- Non-dangerous wreck
- Wreck showing any portion of hull or superstructure
- Distributed remains of wreck
- Wreck from geophysical survey
- Obstruction Points (Marine Themes)

Transport

- Beacon, Lateral, Port
- Beacon, Special purpose/ general
- Buoy, Lateral, Starboard
- Ferry Routes
- Orkney Ferries Confirmed Ferry Route
- Navigation Line
- Harbour area

Industrial

- Marine farm/culture
- Pile
- Onshore turbine
- Cables

Administrative

- Anchorage Area

Sources and attributions:
Contains public sector information, licensed under the Open Government Licence v3.0, from the UKHO and OS.Esri UK, Esri, TomTom, Garmin, FAO, NOAA, USGS, Esri UK, Esri, TomTom, Garmin, GeoTechnologies, Inc, METI/NASA, USGS

0 0.5 1 2 3 4 km
Scale: 1:125,000
WGS 1984 UTM Zone 30N
N

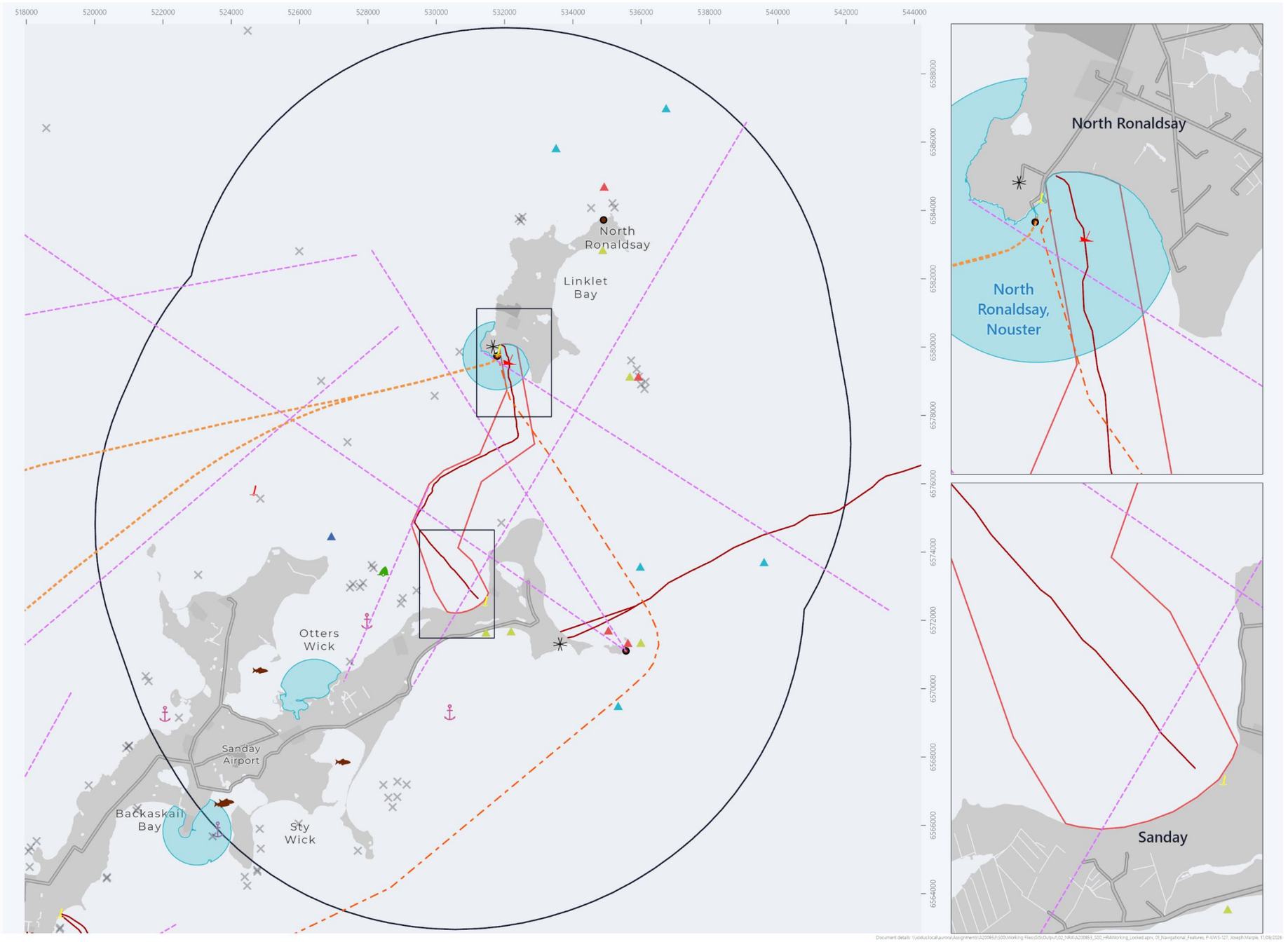


Figure 3-1 Key Navigational Features.

3.2 Baseline Shipping Activity

3.2.1 Overview and Temporal Changes

A total of 907 and 163 vessel tracks were recorded within the study area and the proposed cable corridor respectively, between the dates of 14th of July 2025 to 13th of July 2026 (the studied year) (Table 3-1). These tracks were associated with 297 unique vessels, and 187 unique routes, based on previous and next port information captured in the AIS data. The busiest routes were associated with the passenger vessels Earl Thorfinn, Northerly Venture, and Earl Sigurd (Figure 3-5).

Some seasonal variation is observed, with spring and summer recording higher track line counts in both the study area and the proposed cable corridor, when compared to autumn and winter. Within the study area, vessel activity recorded an average of 75 tracks per month, with January, February, and March being the quietest months (Figure 3-3). In the proposed cable corridor, vessel activity averaged 14 tracks per month, with January, February, and December being the quietest months (Figure 3-4).

352 tracks within the study area were observed during summer months, accounting for 38.8% of total track line counts across the study year. Within the proposed corridor specifically, 43 tracks were recorded during the same period accounting for 26.3% of total tracks across the study year. Autumn and winter experienced a decrease in vessel tracks within the study area, with autumn accounting for 20.8% and winter accounting for only 14.7%. The same months experienced similar decreased vessel track presence within the proposed cable corridor, with autumn accounting for 17.1% and winter accounting for only 11%. Spring shows an interesting deviation, as within the study area this season accounts for 25.5% of vessel tracks for the year, but within the proposed corridor the same season accounts for 45.3% of tracks for the year.

The difference in track count between day (06:30 – 18:30) and night (18:30 – 06:30) is illustrated in Figure 3-2 and Table 3-1. Track counts recorded during the day are consistently higher across all seasons, most notably for summer with 75.6% (266 tracks) of activity during the day compared to 24.4% (86 tracks) at night-time within the study area. With the proposed cable corridor, the autumn saw the largest difference between day and night activity with 85.7% (24 tracks) of activity occurring during the day and 14.2% (4 tracks) occurring at night-time.

In terms of vessel types, passenger vessels were the most frequent within the study area particularly in May (40), June (38) and April (36). Within the study area recreational vessels experienced the most significant surge, jumping from single digits in winter months (December – 9, January – 9, and February – 5) to 51 tracks in the summer month of July. In line with this observation, passenger vessels were also the most frequently observed vessel type within the proposed cable corridor, with the difference that the peak months of observation were May (17 tracks) and April (16 tracks). Particularly within the proposed cable corridor, passenger vessels accounted for 42.9% of all observations (Figure 3-4).

July was the busiest month for the study area (124 tracks) whilst April was the busiest month for the proposed cable corridor (33 tracks). The day with the highest vessel activity within the study area was September 6th when 13 vessel tracks were recorded. While the busiest day for the proposed cable corridor was on April 14th which recorded six (6) tracks.

Table 3-1 Vessel Tracks Per Season and Day/Night.

SEASON	TRACK LINE COUNTS					
	Study Area			Cable Corridor		
	Day	Night	Total	Day	Night	Total
Autumn	136	53	189	24	4	28
Winter	95	39	134	12	6	18
Spring	168	64	232	57	17	74
Summer	266	86	352	34	9	43
Grand Total	665	242	907	127	36	163

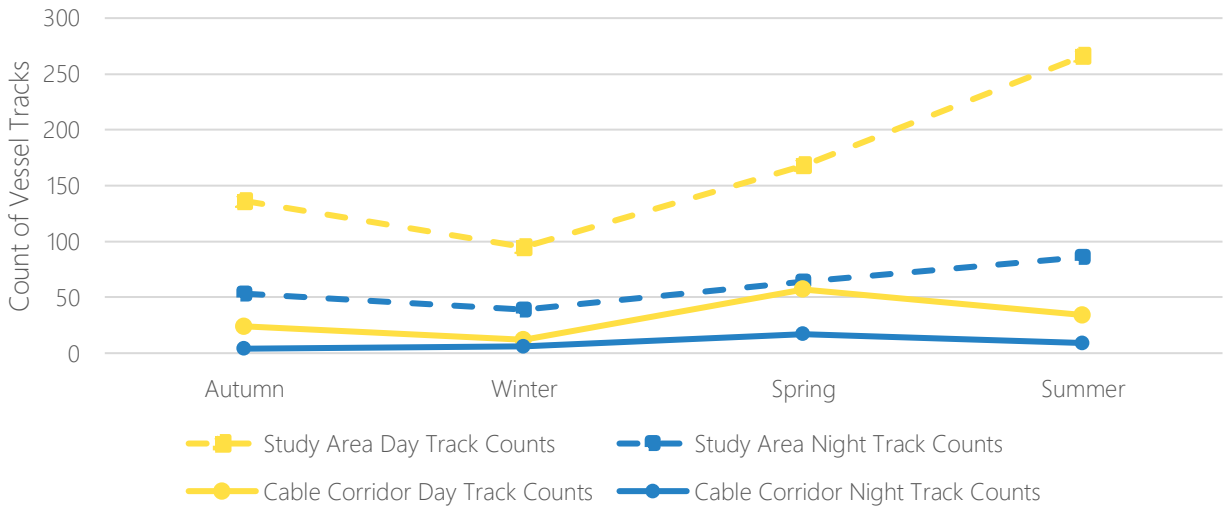
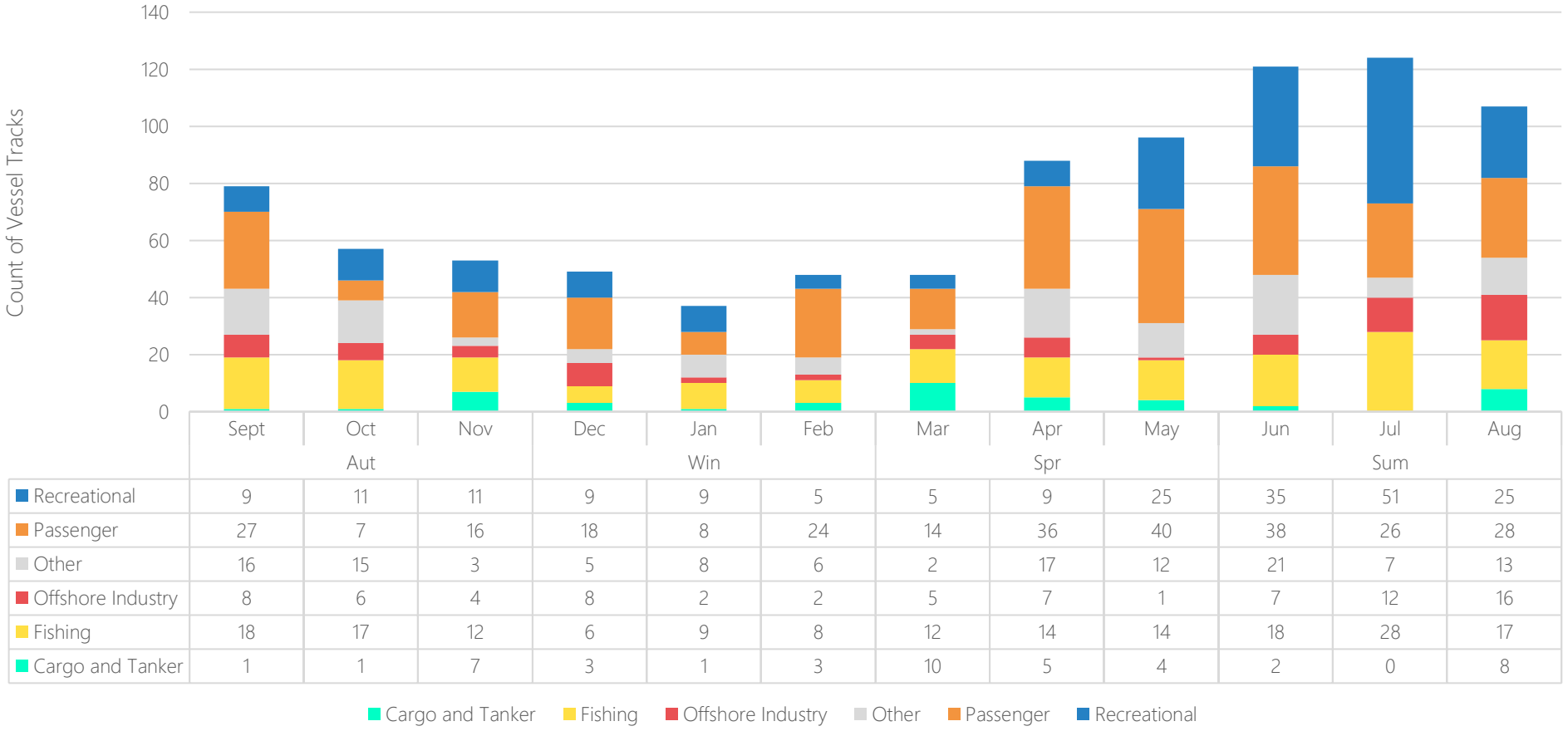


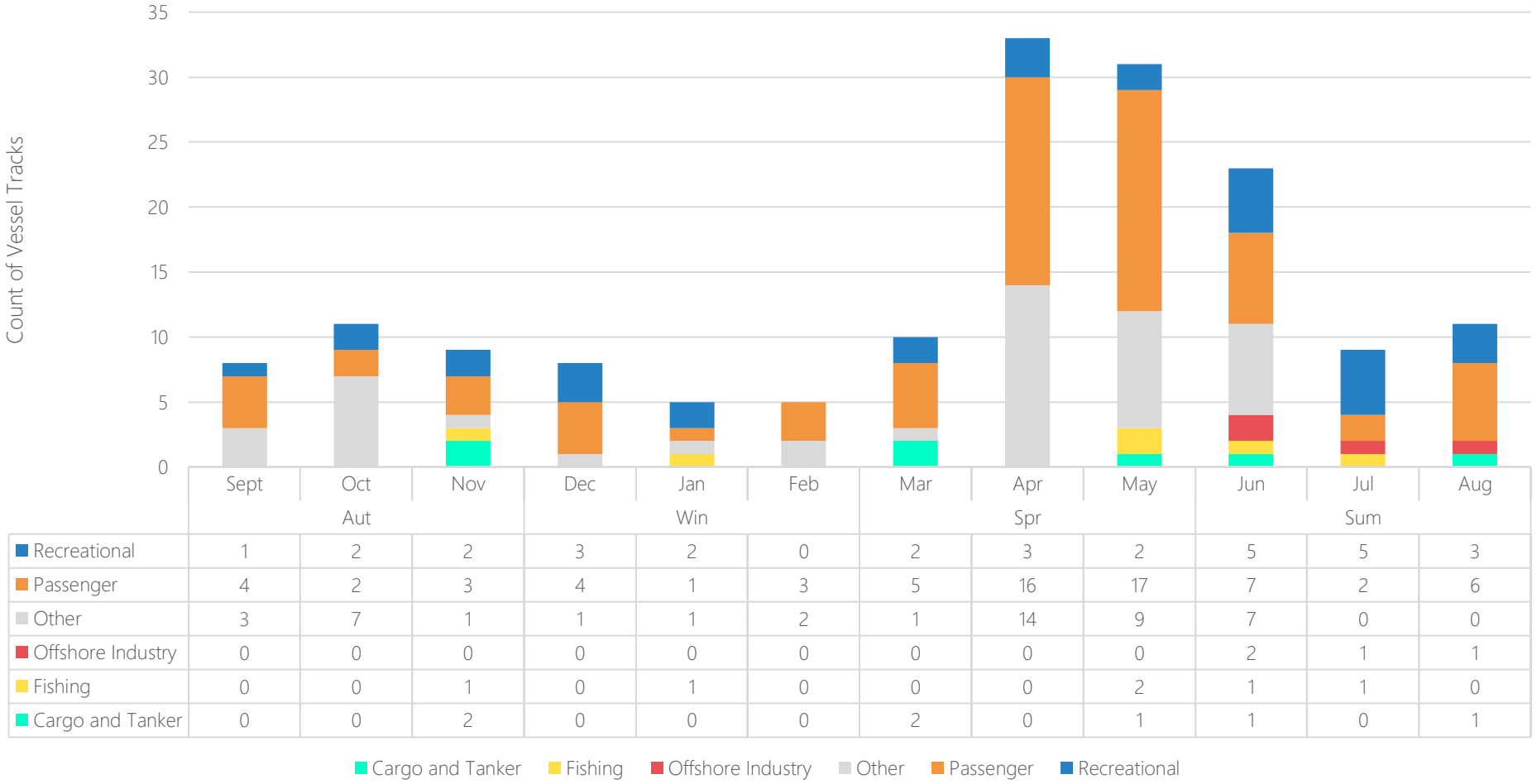
Figure 3-2 Vessel Tracks Per Season and Day/Night

In total, fewer vessels were observed during the night (18:30 to 06:30), accounting for 26.7% and 22% of the total number of tracks within the study area and proposed cable corridor, respectively. Overall, this represents a 63.6% reduction in vessel traffic during the night within the study area and a 71.7% reduction within the proposed cable corridor (Figure 3-6). All vessel types observed a reduction in tracks during the night, with passenger vessels decreasing from a total of 253 during the day to 29 during the night.



	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
	Aut			Win			Spr			Sum		
Recreational	9	11	11	9	9	5	5	9	25	35	51	25
Passenger	27	7	16	18	8	24	14	36	40	38	26	28
Other	16	15	3	5	8	6	2	17	12	21	7	13
Offshore Industry	8	6	4	8	2	2	5	7	1	7	12	16
Fishing	18	17	12	6	9	8	12	14	14	18	28	17
Cargo and Tanker	1	1	7	3	1	3	10	5	4	2	0	8

Figure 3-3 Seasonal and Monthly Summary of Vessel Types Within the Study Area



	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
	Aut			Win			Spr			Sum		
Recreational	1	2	2	3	2	0	2	3	2	5	5	3
Passenger	4	2	3	4	1	3	5	16	17	7	2	6
Other	3	7	1	1	1	2	1	14	9	7	0	0
Offshore Industry	0	0	0	0	0	0	0	0	0	2	1	1
Fishing	0	0	1	0	1	0	0	0	2	1	1	0
Cargo and Tanker	0	0	2	0	0	0	2	0	1	1	0	1

Figure 3-4 Seasonal and Monthly Summary of Vessel Types Within the Cable Corridor

AIS Data and Vessel Crossings Overview

- Sanday - North Ronaldsay Cable Corridor
- 5 NM Study Area
- Harbour Area
- AIS Vessel Tracks

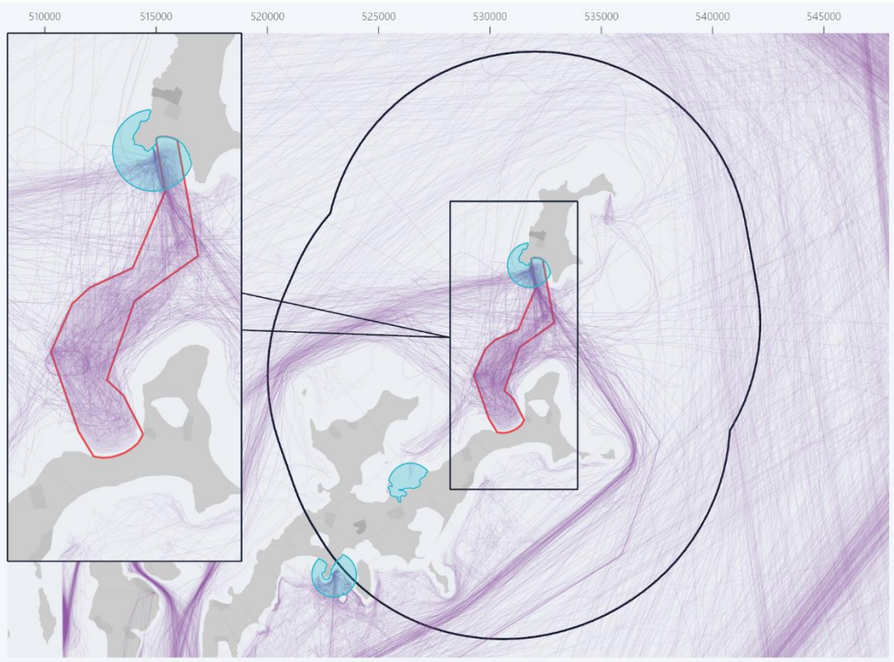
Number of Vessel Tracks per 0.1 km^2 Grid Cell

- 1 - 5
- 6 - 10
- 11 - 15
- 16 - 20
- 21 - 25
- 26 - 50
- 51 - 100
- 101 - 200
- 201 - 300
- >300

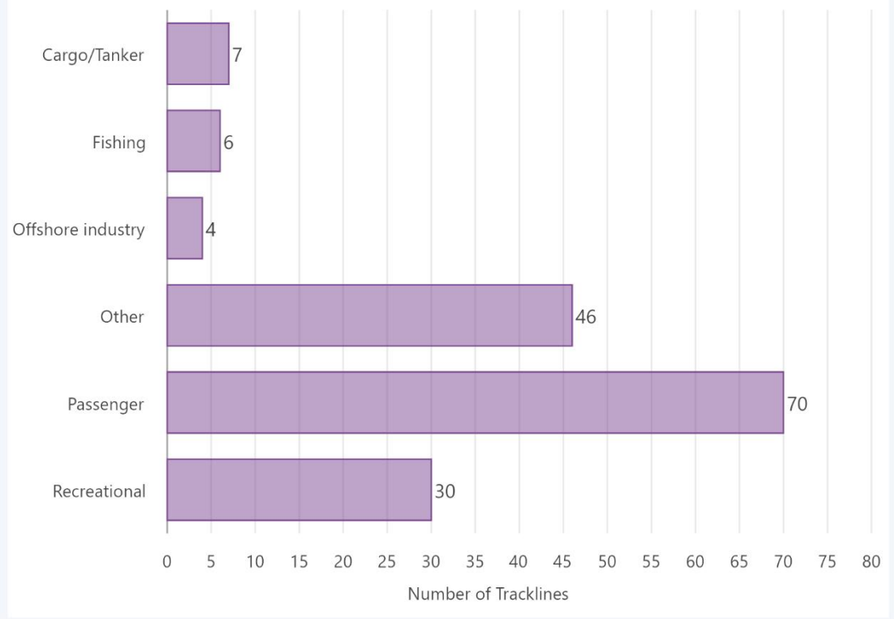
0 1.5 3 6 9 12 km

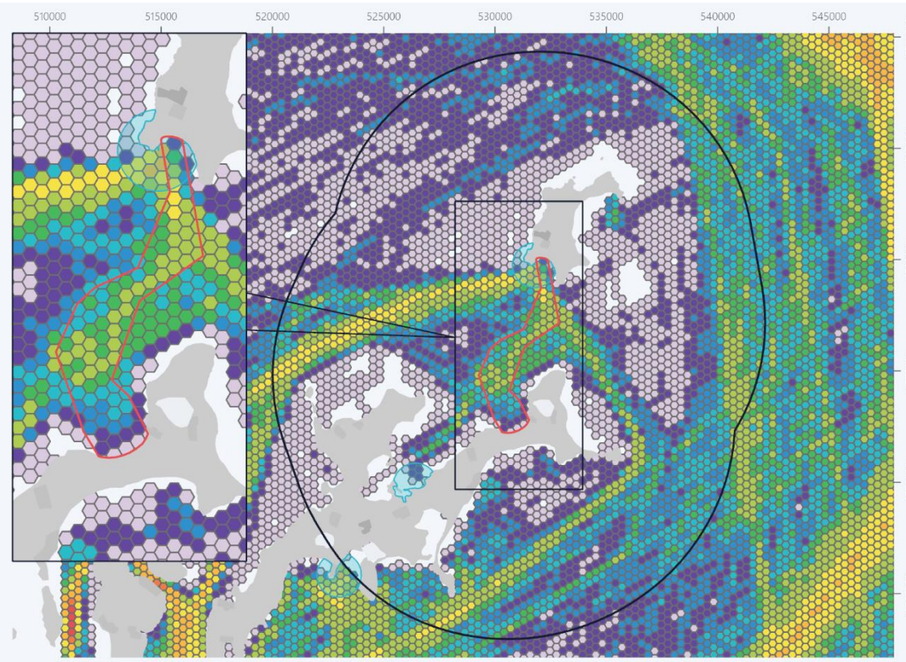
Scale: 1:275,000
WGS 1984 UTM Zone 30N

N



Number of Vessel Crossings by Vessel Type within the Cable Corridor





Passenger Vessel Crossings within the Cable Corridor

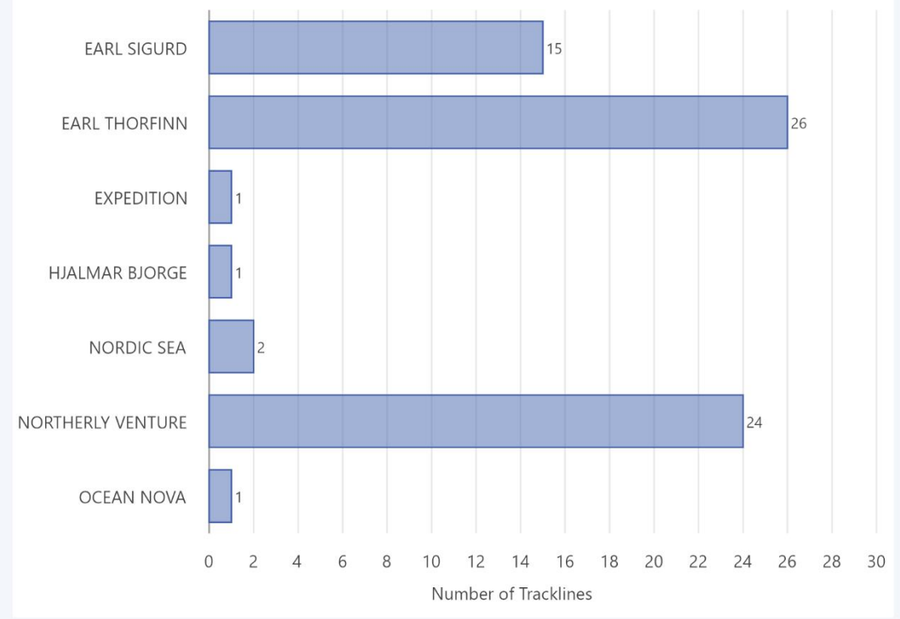


Figure 3-5 AIS Data Summary, Including Vessel Tracks, Vessel Densities, and Vessel Type Counts

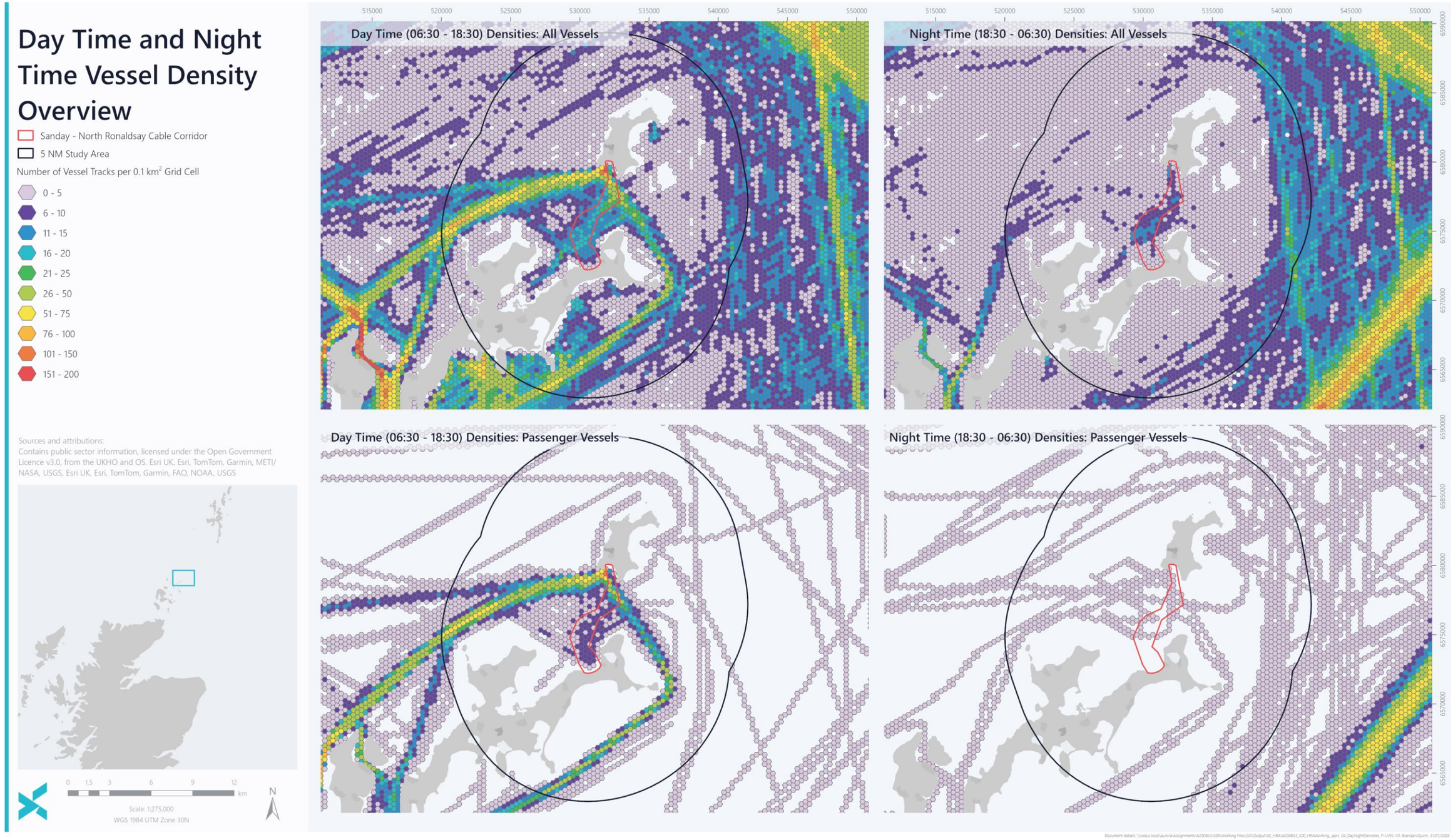


Figure 3-6 Day and Night Vessel Densities

3.2.2 Vessel Type

A breakdown of the various vessel types occurring within the study area and proposed cable corridor is provided in Table 3-2, and the track line densities of each vessel category are provided in Figure 3-7. An overview of each vessel category is provided below.

Passenger Vessels

Passenger vessels are the most frequently observed vessels within both the study area and the proposed cable corridor, accounting for 31.1% and 42.9% of total tracks across each area respectively. Roll-on/Roll-off (Ro-Ro) ferries were the most frequently occurring vessel type within the passenger vessel category. Within the study area, they accounted for 24% of all tracks observed, and the same trend is seen inside the proposed cable corridor where they account 25.2% of all tracks. Within the study area an 88.5% reduction in journeys from daytime to nighttime was observed for passenger vessels, and an 88.9% reduction from day to night was also observed for tracks that crossed the proposed cable corridor (Table 3-2).

The Earl Thorfinn Ro-Ro ferry accounted for 37.1% of the total number of tracks crossing the proposed cable which combined made a total of 70 crossings during the study period (Table 3-3). Of these 70 tracks, 64 (91.4%) occurred during the day and 6 (6.6%) during the night. Earl Thorfinn has a length of 45 m and a DWT of 231 Te.

Cargo Vessels and Tankers

Cargo vessels and tankers are the least frequently observed vessel types within the study area, accounting for 5% of vessel tracks, but it's the third least frequently observed within the proposed cable corridor accounting for 4.3% of vessel tracks. The leading sub-category during the daytime in the study area was cargo vessels, which account for 17 tracks (68%) in the study based on the total tracks in the cargo and tanker vessel category. A significant proportion of night-time tracks within this category (Table 3-2) is attributed to Ro-Ro cargo vessels, representing 10 tracks (50%) in the study area.

Fishing Vessels.

Fishing vessels accounted for 19.1% and 3.7% of vessel tracks within the study area and proposed cable corridor, respectively. More instances of these tracks were observed in the study area during the daytime with 122 tracks (18.3% of all day tracks). Whilst a decrease in tracks at night-time to 51 was observed, these tracks represent a larger percentage of all night tracks (21.1%). 0 instances of fishing vessels were observed in the proposed cable corridor during the night-time (Table 3-2).

During stakeholder consultation, both Orkney Ferries and the Orkney Islands Council Harbour Authority advised that frequent crab and lobster creel fishing takes place in the study area, which is underrepresented in this MTS, there is also very limited evidence of scallop dredging. It should be noted that AIS data often underrepresents nearshore fishing vessel activity due to their size.

Offshore Industry Vessels

Offshore industry vessels were the second least frequently observed vessel type within the study area, accounting for only 8.6% (78 tracks) of total tracks. Within the proposed cable corridor, it is the least prevalent vessel type, accounting for 2.5% (4 tracks) of total tracks. Within the study area, a 112% increase from day to night tracks is observed from 25 to 53, respectively. Of the 4 tracks which intersect the proposed cable corridor, 2 tracks each are observed in the day and night-time.

Whilst not observed in the data analysis of our MTS, the Orkney Islands Council Harbour Authority have advised that oil & gas vessels have been observed sheltering in the bays to the east of the study area in the surrounding bays.

Recreational Vessels

Recreational vessels represent a significant proportion of total tracks in both the study area and proposed cable corridor, 22.5% (204 tracks) and 18.4% (30 tracks) respectively. The leading sub-category was sailing vessels, which accounted for 17% and 12.9% of total tracks within the recreational category in the study area and proposed cable corridor, respectively. It's worth nothing that due to their size recreational vessels are less likely to have AIS equipment installed and therefore may be underrepresented in the data.

Furthermore, during stakeholder consultation the RYA Scotland advised that not every boat flagged as recreational is correct. There are known cases where these boats have been miscategorised from their correct vessel types of marine tourism or fishing.

Other Vessels

Other vessels represent the third most frequent AIS vessel category, accounting for 13.8% and 28.2% of vessel tracks within the study area and the proposed cable corridor, respectively. Within the study area, most of these vessels were observed during the daytime, with 86 tracks (50.3% of the total other vessel tracks). Similarly, in the proposed cable corridor, tracks were recorded mainly during the daytime, with 27 tracks (58.7% of total other vessel tracks) recorded during the day compared to 19 tracks (41.3% of total other vessel tracks) at night.

Table 3-2 Vessel Categories by Day/Night within the Study Area and Cable Corridor

VESSEL CATEGORY	VESSEL TYPE	STUDY AREA							CABLE CORRIDOR						
		Day Track Line Counts		Night Track Line Counts		Percentage Change from Day to Night	Total	Proportion of Total Track Lines	Day Track Line Counts		Night Track Line Counts		Percentage Change from Day to Night	Total	Proportion of Total Track Lines
		Track Count Day (06:30-18:30)	Proportion of Day Track Lines	Track Count Night (18:30-06:30)	Proportion of Night Track Lines				Track Count Day (06:30-18:30)	Proportion of Day Track Lines	Track Count Night (18:30-06:30)	Proportion of Night Track Lines			
Cargo/Tanker	Cargo	17	68.0%	4	20.0%	-76.5%	21	2.3%	6	100.0%	0	0.0%	-100.0%	6	3.7%
	General Cargo	3	12.0%	4	20.0%	33.3%	7	0.8%	0	0.0%	0	0.0%	0.0%	0	0.0%
	Oil/Chemical Tanker	1	4.0%	0	0.0%	-100.0%	1	0.1%	0	0.0%	0	0.0%	0.0%	0	0.0%
	Passenger/Cargo Ship	1	4.0%	2	10.0%	100.0%	3	0.3%	0	0.0%	1	100.0%	0.0%	1	0.6%
	Reefer	1	4.0%	0	0.0%	-100.0%	1	0.1%	0	0.0%	0	0.0%	0.0%	0	0.0%
	Ro-Ro Cargo	2	8.0%	10	50.0%	400.0%	12	1.3%	0	0.0%	0	0.0%	0.0%	0	0.0%
Cargo/Tanker Total		**25**	**3.8%**	**20**	**8.3%**	**-20.0%**	**45**	**5.0%**	**6**	**4.7%**	**1**	**2.8%**	**-83.3%**	**7**	**4.3%**
Fishing	Fish Carrier	16	13.1%	22	43.1%	37.5%	38	4.2%	2	33.3%	0	0.0%	-100.0%	2	1.2%
	Fish Factory	1	0.8%	1	2.0%	0.0%	2	0.2%	0	0.0%	0	0.0%	0.0%	0	0.0%
	Fishery Patrol Vessel	0	0.0%	4	7.8%	0.0%	4	0.4%	0	0.0%	0	0.0%	0.0%	0	0.0%
	Fishing	89	73.0%	7	13.7%	-92.1%	96	10.6%	3	50.0%	0	0.0%	-100.0%	3	1.8%
	Fishing Vessel	6	4.9%	13	25.5%	116.7%	19	2.1%	0	0.0%	0	0.0%	0.0%	0	0.0%
	Trawler	10	8.2%	4	7.8%	-60.0%	14	1.5%	1	16.7%	0	0.0%	-100.0%	1	0.6%
Fishing Total		**122**	**18.3%**	**51**	**21.1%**	**-58.2%**	**173**	**19.1%**	**6**	**4.7%**	**0**	**0.0%**	**-100.0%**	**6**	**3.7%**
Offshore industry	Fire Fighting Vessel	1	4.0%	0	0.0%	-100.0%	1	0.1%	0	0.0%	0	0.0%	0.0%	0	0.0%
	High Speed Craft	7	28.0%	1	1.9%	-85.7%	8	0.9%	2	100.0%	0	0.0%	-100.0%	2	1.2%
	Multi Purpose Offshore Vessel	16	64.0%	51	96.2%	218.8%	67	7.4%	0	0.0%	2	100.0%	0.0%	2	1.2%
	Offshore Supply Ship	1	4.0%	0	0.0%	-100.0%	1	0.1%	0	0.0%	0	0.0%	0.0%	0	0.0%
	Standby Safety Vessel	0	0.0%	1	1.9%	0.0%	1	0.1%	0	0.0%	0	0.0%	0.0%	0	0.0%
Offshore industry Total		**25**	**3.8%**	**53**	**21.9%**	**112.0%**	**78**	**8.6%**	**2**	**1.6%**	**2**	**5.6%**	**0.0%**	**4**	**2.5%**
Other	Buoy-Laying Vessel	1	1.2%	0	0.0%	-100.0%	1	0.1%	1	3.7%	0	0.0%	-100.0%	1	0.6%
	Cable Layer	0	0.0%	1	2.6%	0.0%	1	0.1%	0	0.0%	0	0.0%	0.0%	0	0.0%
	Dive Vessel	15	17.4%	2	5.1%	-86.7%	17	1.9%	9	33.3%	2	10.5%	-77.8%	11	6.7%
	Diving Support Vessel	4	4.7%	1	2.6%	-75.0%	5	0.6%	1	3.7%	1	5.3%	0.0%	2	1.2%
	Other	16	18.6%	16	41.0%	0.0%	32	3.5%	14	51.9%	16	84.2%	14.3%	30	18.4%
	Port Tender	7	8.1%	0	0.0%	-100.0%	7	0.8%	0	0.0%	0	0.0%	0.0%	0	0.0%
	Research/Survey Vessel	1	1.2%	6	15.4%	500.0%	7	0.8%	0	0.0%	0	0.0%	0.0%	0	0.0%
	SAR	5	5.8%	1	2.6%	-80.0%	6	0.7%	0	0.0%	0	0.0%	0.0%	0	0.0%
	Tug	6	7.0%	2	5.1%	-66.7%	8	0.9%	0	0.0%	0	0.0%	0.0%	0	0.0%
	Tug/Supply Vessel	2	2.3%	0	0.0%	-100.0%	2	0.2%	0	0.0%	0	0.0%	0.0%	0	0.0%
	Unspecified	6	7.0%	0	0.0%	-100.0%	6	0.7%	0	0.0%	0	0.0%	0.0%	0	0.0%
	Utility Vessel	6	7.0%	2	5.1%	-66.7%	8	0.9%	2	7.4%	0	0.0%	-100.0%	2	1.2%
	Work Vessel	17	19.8%	8	20.5%	-52.9%	25	2.8%	0	0.0%	0	0.0%	0.0%	0	0.0%
Other Total		**86**	**12.9%**	**39**	**16.1%**	**-54.7%**	**125**	**13.8%**	**27**	**21.3%**	**19**	**52.8%**	**-29.6%**	**46**	**28.2%**

VESSEL CATEGORY	VESSEL TYPE	STUDY AREA							CABLE CORRIDOR						
		Day Track Line Counts		Night Track Line Counts		Percentage Change from Day to Night	Total	Proportion of Total Track Lines	Day Track Line Counts		Night Track Line Counts		Percentage Change from Day to Night	Total	Proportion of Total Track Lines
		Track Count Day (06:30-18:30)	Proportion of Day Track Lines	Track Count Night (18:30-06:30)	Proportion of Night Track Lines				Track Count Day (06:30-18:30)	Proportion of Day Track Lines	Track Count Night (18:30-06:30)	Proportion of Night Track Lines			
Passenger	Passenger	38	15.0%	7	24.1%	-81.6%	45	5.0%	22	34.9%	5	71.4%	-77.3%	27	16.6%
	Passenger Ship	5	2.0%	13	44.8%	160.0%	18	2.0%	0	0.0%	2	28.6%	0.0%	2	1.2%
	Ro-Ro/Passenger Ship	210	83.0%	9	31.0%	-95.7%	219	24.1%	41	65.1%	0	0.0%	-100.0%	41	25.2%
Passenger Total		253	38.0%	29	12.0%	-88.5%	282	31.1%	63	49.6%	7	19.4%	-88.9%	70	42.9%
Recreational	Pleasure Craft	37	62.7%	13	26.0%	-64.9%	50	5.5%	6	26.1%	3	42.9%	-50.0%	9	5.5%
	Sailing Vessel	117	24.0%	37	74.0%	-68.4%	154	17.0%	17	73.9%	4	57.1%	-76.5%	21	12.9%
Recreational Total		154	23.2%	50	20.7%	-67.5%	204	22.5%	23	18.1%	7	19.4%	-69.6%	30	18.4%
Grand Total		665	100.0%	242	100.0%	-63.6%	907	100.0%	127	100.0%	36	100.0%	-71.7%	163	100.0%

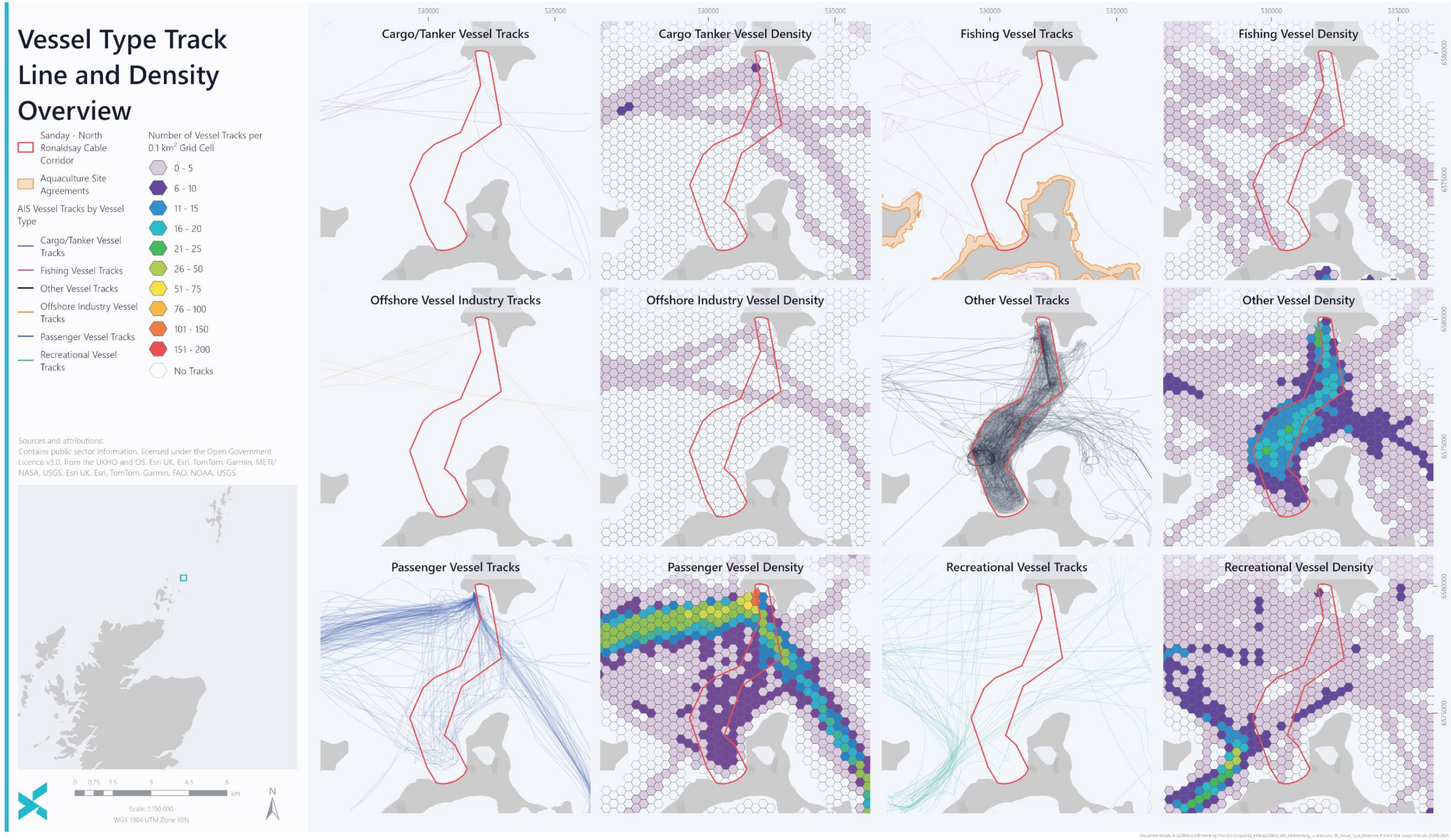


Figure 3-7 Vessel Type Tracks and Densities

Table 3-3 Track Line Summary for Passenger Vessels

VESSEL NAME	MMSI	LENGTH (m)	DWT (t)	SERVICE	NUMBER OF TRACKS WITHIN STUDY AREA			NUMBER OF TRACKS WITHIN CABLE CORRIDOR		
					Day	Night	Total	Day	Night	Total
EARL SIGURD	232000670	45.3	231.0	RAPNESS - RAPNESS	96	0	96	15	0	15
EARL THORFINN	232000760	45.0	231.0	PAPA WESTRAY - NORTH RONALDSAY	114	0	114	26	0	26
NORDIC SEA	232029607	22.0	99.8	NORTH RONALDSAY - KIRKWALL	6	0	6	2	0	2
HJALMAR BJORGE	235012833	23.0	107.7	KIRKWALL - SHAPINSAY	3	0	3	1	0	1
NIGG BAY	235022611	13.0	40.4	NORTH RONALDSAY - KIRKWALL	3	0	3	0	0	0
NORTHERLY VENTURE	235098073	16.0	57.7	NORTH RONALDSAY - NORTH RONALDSAY	26	7	33	19	5	24
HROSSEY	235448000	125.0	1563.0	KIRKWALL - LERWICK	0	3	3	0	0	0
HJALTLAND	235450000	125.0	1831.0	KIRKWALL - LERWICK	0	6	6	0	0	0
AIDASOL	247302900	253.3	7891.0	SEYDISFJORDUR - KIRKWALL	0	2	2	0	0	0
SEA SPIRIT	255806397	90.6	695.0	LERWICK - ROSYTH	0	1	1	0	0	0
EXPEDITION	255806402	100.0	1465.0	SCRABSTER - LERWICK	1	4	5	0	1	1
OCEAN NOVA	309051000	73.0	200.0	POOLE - LERWICK	0	1	1	0	1	1
HEBRIDEAN SKY	311000253	90.6	551.0	STORNOWAY - KIRKWALL	1	1	2	0	0	0
AMERA	311000840	204.0	6150.0	TORSHAVN - KIRKWALL	1	0	1	0	0	0
SYLVIA EARLE	311000867	104.4	1500.0	TROON - LERWICK	0	2	2	0	0	0
CARNIVAL LEGEND	311001094	292.5	7089.0	AKUREYRI - KIRKWALL	0	1	1	0	0	0
SEVEN SEAS NAVIGATOR	311050600	170.7	3470.0	TORSHAVN - KIRKWALL	0	1	1	0	0	0
ISLAND SKY	311743000	90.6	695.0	STORNOWAY - LERWICK	2	0	2	0	0	0

3.2.3 Anchoring Summary

Figure 3-8 provides an overview of vessels at-anchor, including the time spent at anchor for each vessel type. Vessel track segments were classified as "at-anchor" if the vessel's status was set to 1 (at-anchor) and its speed was less than 0.5 knots. Within the study area a total of nine vessels spent an estimated 53.6 hours (2.23 days) at anchor (Table 3-4). Within the proposed cable corridor a total time of 4.4 hours (8.3% of total time observed within the study area) was spent at anchor by the Flying Dutchman sailing vessel.

Passenger vessel type category accounted for the majority of anchoring activity, spending approximately 40 hours at-anchor – 74.5% of the total anchoring time within the study area (Table 3-4). Additionally, the next closest vessel type for at-anchor time was Cargo/Tanker with 7.6 hours (14.1%) spent at-anchor (Table 3-4).

Table 3-4 Vessels at-Anchor Overview

VESSEL CATEGORY	VESSEL NAME	HOURS SPENT AT-ANCHOR	PROPORTION
Cargo/Tanker	NORDSTJERNEN	7.6	14.1%
Recreational	FLYING DUTCHMAN	4.4	8.3%
	OCEANLIFE	0.4	0.7%
Other	PAUL D	1.3	2.5%
Passenger	EXPEDITION	19.8	36.9%
	HEBRIDEAN SKY	10.0	18.6%
	ISLAND SKY	1.4	2.5%
	OCEAN NOVA	5.1	9.5%
	SEA SPIRIT	3.7	7.0%
Grand Total		53.6	100%

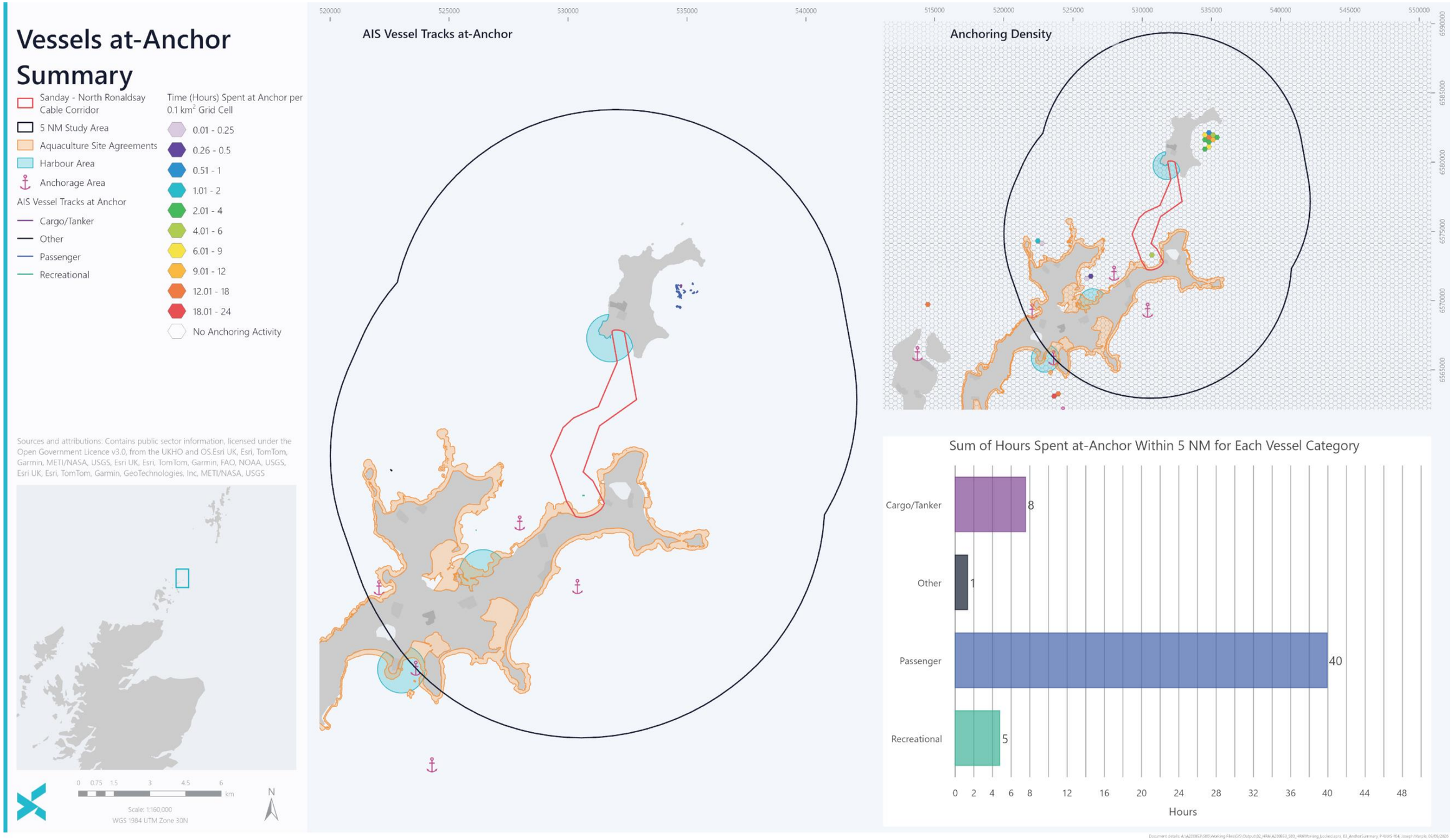


Figure 3-8 Vessels at-Anchor Summary Displayed in Vessel Tracks and Vessel Track Densities Across the Study Area

4 FORMAL SAFETY ASSESSMENT

4.1 Results

The assessment identified eight distinct hazards/risks to shipping from the Project. The individual summaries of these assessments of the identified hazards can be seen in Table 4-1 below. The eight hazards are:

- Vessel collision (third party vessel with project vessel) during installation, maintenance and decommissioning;
- Disruption to established vessel routes and areas during installation, maintenance and decommissioning;
- Interactions with vessel anchors during installation, maintenance and decommissioning;
- Interactions with vessel anchors during normal operations;
- Interactions with fishing gear during installation, maintenance and decommissioning;
- Interactions with fishing gear during normal operations;
- Reduction in under keel clearance during normal operations; and
- Electromagnetic field (EMF) effects and compass deviation.

An additional hazard of Unexploded Ordinance (UXO) is normally considered for projects in and around the Orkney archipelago, due to high military action during World War II. According to earlier survey work and ALARP assessments [Ref: H25041-REP-001 Caithness and Orkneys UXO Risk Assessment], North Ronaldsay and Sanday fall in the "Northern" region of the area, and as such cable routes are considered to be ALARP unless specifically near military wrecks. As the route does not cross near or over any such recorded wrecks, the threat of UXO is considered to be ALARP and no further risk assessment will be performed in this report.

From the initial assessments undertaken, one identified no risk, whilst four were assessed as being Broadly Acceptable therefore, no further consideration of Risk Reduction Measures (RRMs) is necessary for these hazards. The remaining three were assessed as Tolerable if ALARP, and therefore required further consideration. However, no additional RRMs above the embedded mitigations were considered appropriate, and no recommendations have been made following the assessment. The assessment therefore determined that all risks to navigation associated with the development are considered ALARP. A brief summary of the key considerations of each impact included in the sections following.

4.1.1 Vessel Collision – Installation, Maintenance and Decommissioning

Vessel collision risk is highest at the busiest section of the corridor nearest the landfall approach at North Ronaldsay (see Figure 3-5) and within daylight hours, see Figure 3-2. The Project includes several specific embedded mitigation measures designed to minimise vessel interactions and reduce collision risk, namely:

- Issuing of NtMs and Kingfisher Bulletins;
- The proposed implementation of a 500 m RCZ (or other agreed distance following consultation with stakeholders) for the "Kirkwall – North Ronaldsay – Papa Westray" ferry service.
- Potential provision of a guard vessel or small support vessel on standby to reduce risk of collision if vessels pass too close to the installation vessel. The requirement for a guard vessel will be considered through consultation with the ferry operator Orkney Ferries, the relevant SHA as required, and Installation Contractor;
- Compliance with IRPCS, including displaying appropriate lights and day shapes;
- Two new permanent AtoNs will be installed as part of this project, warning mariners of the presence of cables on the seabed in the area; and

- Engagement with navigational consultees (Relevant harbour authorities such as Orkney Islands Council Harbour Authority and the "Kirkwall – North Ronaldsay – Papa Westray" route ferry operators).

The vast majority of the traffic passes in the northern section of the proposed cable corridor as vessels approach the Nouster Harbour area on North Ronaldsay, and is routine traffic which will not normally interact/cross paths with the installation vessels. The Project activities are not confirmed currently but are anticipated to last for a short duration (including weather related down time) given the short cable lay. The current scheduled installation time of approximately 4 days of seabed preparation, 3 days for the cable lay itself, and a further 28 days of intertidal works including trenching, is relatively short and therefore reduces the likelihood of collisions. An additional period of 60 days will be used in Spring/Summer 2027 to add rock bags and for cable protection/stabilisation. Whilst there is a general Orkney Islands Vessel Traffic Service (VTS) operated by the statutory harbour authority in Scapa, it does not operate as far north as the operations are expected to take place. This means that the VTS is unlikely to be alerting vessels transiting through North Ronaldsay Firth, so they may not be aware of the cable installation activities. Even without VTS as an added safety measure, these considerations combine to provide considerable inherent collision safety over and above the industry standard mitigations, such as guard vessel protection (as required), NtM and weather condition limits.

Considering the limited duration of potential interaction between the installation vessel and vessels operating in the area, as well as the high efficacy of the embedded mitigation measures described above, the likelihood is considered 'Remote'. The worst-case credible outcome of a collision would be loss of life due to collision with installation or support vessels, so a consequence severity is assessed as 'High'. This results in overall assessment of 'Tolerable if ALARP'. As such consideration of additional risk reduction measures should be made.

Individual recommendations are made that the cable installation schedule be deconflicted from regular ferry runs and peak times in so far as practicable, and potentially to reduce the RCZ from 500m to 250m (or other project-acceptable distance) for vessels which are regularly present, reducing disruption especially around the harbour areas.

Given the short duration of the operations in the navigable channel and at periods of low traffic, no further measures other than the above are considered to represent justifiable or effective risk reduction. The risk is therefore considered ALARP.

4.1.2 Disruption to Established Vessel Routes and Areas – Installation, Maintenance and Decommissioning

The risk of disruption to vessels is most relevant to the "Kirkwall – North Ronaldsay – Papa Westray" lifeline ferry service from the slow moving and restricted project installation vessels. The ferries approach the ferry terminal in Nouster Harbour, primarily during daylight hours, by approaching the cable corridor from either the west or the southeast, with the southeast approach requiring a full cross of the cable corridor to reach the terminal (see Figure 3-5). The embedded mitigation measures outline in Section 1.2 will reduce the potential to significantly disrupt existing vessel activity, specifically:

- Reduction of the RCZ from 500 m to 250 m (or other agreed distance) for the Kirkwall – North Ronaldsay – Papa Westray ferries, and vessels transiting North Ronaldsay Firth, through engagement with relevant local Orkney Islands Council Harbour Authority, and the ferry operators, Orkney Ferries;
- Two new permanent AtoNs will be installed as part of this project, warning mariners of the presence of cables on the seabed in the area;
- Engagement with navigational consultees (Orkney Islands Council Harbour Authority, and the Orkney Ferries ferry operators); and

- Deconfliction with the "Kirkwall – North Ronaldsay – Papa Westray" ferry timetable where practicable, including consideration of night-time operations.

The measures combine with the limited duration of the proposed cable installation activities to provide considerable inherent mitigation to ensure disruption to existing vessel movements are minimised.

Considering the limited duration of potential interaction between the installation vessels, ferries and vessels operating in the area, as well as the high efficacy of the embedded mitigation measures described above, the likelihood is considered 'Remote'. The worst-case credible outcome would be protracted delays to ferry schedules and impact on local communities, so a consequence severity is assessed as 'Medium'. This results in overall assessment of 'Broadly Acceptable' and no further consideration of additional risk reduction measures required.

4.1.3 Interaction with Vessel Anchors – Installation, Maintenance and Decommissioning

The interaction of vessels anchors with the cable during the activities associated with installation maintenance or decommissioning of the Project is considered highly unlikely. The principal reason being that there are no charted anchorage areas in the vicinity of the proposed cable corridor with the closest approximately 2.2 km away; however, there is information within the baseline data indicative of a single recreational vessel spending approximately 4.5 hours at anchor within the corridor (see Figure 3-8). This has been taken as an outlier and not representative of the normal use of the cable corridor. This general lack of permanently moored vessels reflects the fact that the cable corridor is wholly situated within a charted subsea cables area, and crosses the navigable area through North Ronaldsay Firth. Embedded mitigation measures further reduce the risk of vessels' anchors interacting with cables during the installation, maintenance and decommissioning phases, including the issuing of NtM and navigation warnings, and potential use of a guard vessel or small support vessel to advise vessels as required.

If a vessel fouls its anchor on the subsea cable, there is the potential for the severe damage or foundering to occur if inappropriate attempts to recover the anchor are made. Injury could also occur through interactions with lines under load. Thus, the consequences are considered to be 'Medium'. This is combined with a 'Remote' assessment of likelihood, given the mitigation outlined above and the fact that vessels are not expected to anchor in the vicinity of the cable corridor. This results in an overall assessment of 'Broadly Acceptable', and no further mitigation is required.

4.1.4 Interaction with Vessel Anchors – Normal Operations

As the operations phase of the Project endures for the lifetime of the cable, the likelihood is considered to be greater. Indeed, during the operations no guard vessel patrol or recent NtM will inform vessels of the cable. Similarly, the risk of vessel breaking down and adverse weather conditions throughout the lifetime of the cable present a slightly increased possibility of a vessel requiring to drop anchor in case of emergency. In such a scenario adverse weather would potentially exacerbate the incident endangering the risk of any crew. This may have been the scenario for the brief period of anchoring observed for one vessel in the proposed cable corridor, but the occurrence is considered an outlier for the area.

Embedded mitigation measures reduce this risk, including:

- Provision of as-built survey data to the UKHO and Kingfisher for inclusion on Admiralty Charts, and KIS-ORCA charts; and
- Two new permanent AtoNs will be installed as part of this project, warning mariners of the presence of cables on the seabed in the area.

As detailed above, the consequence of fouling an anchor is considered to be 'Medium'. The mitigation detailed above, combined with the low probability of a vessel either anchoring intentionally or requiring to emergency anchor in the proposed cable corridor means that the likelihood is 'Remote' is assigned. Although there was one instance over the one year that AIS data was acquired for of a singular vessel anchoring in the cable corridor for several hours, this does not constitute a trend that will raise that likelihood. Overall, this results in an assessment of 'Broadly Acceptable', and no further mitigation is required.

4.1.5 Interactions with Fishing Gear – Installation, Maintenance and Decommissioning

The interaction of fishing gear with the cable during the activities associated with installation maintenance or decommissioning is considered highly unlikely. The principal reason being that no clear fishing behaviour is seen in the AIS data; fishing vessels are recorded only transiting the area (See Figure 3-7). This reflects the fact that the cable corridor crosses the navigable channels through North Ronaldsay Firth, and is within a charted subsea cables area, thus demersal trawling in this area is unlikely for safety reasons. Embedded project mitigation includes:

- Use of a FLO during the cable installation activities;
- Issuing of NtM, including Kingfisher Bulletins;
- Potential use of a guard vessel or small support vessel to advise vessels, as required; and
- Adherence to the North Coast and Orkney Fisheries Liaison Mitigation Action Plan (FLMAP).

If a vessel fouls its fishing gear on the subsea cable, there is the potential for the severe damage or foundering to occur if inappropriate attempts to recover the gear are made. Injury and loss of life could also occur through interactions with lines under load. Thus, the consequences are considered to be 'High'. This is combined with a 'Remote' assessment of likelihood, given the mitigation outlined above and the fact that vessels are not expected to engage in demersal fishing in the vicinity of the cable corridor. This results in an overall assessment of 'Tolerable if ALARP', however given the presence of an existing subsea cable in the wider study area, as well as the existing cable Sanday-North Ronaldsay power cable, which will be replaced by this operation, there is no material change from baseline conditions, and no further mitigation is required.

4.1.6 Interactions with Fishing Gear – Normal Operations

The proposed cable will be surface laid in the subtidal area. Specific conduiting or coverage of the cable with a pipe system will be discussed further in consultation, and so has not been considered as a mitigation measure here at this stage. The operational impact from the cable is likely to be low due to the brief laying and trenching works and during the operations no FLO, guard vessel patrol or recent NtMs will be present to inform fishers of the presence of the cable. This notwithstanding, demersal trawling activity is not expected to occur in the vicinity of the proposed cable corridor, given the existing subsea cable, and the very low level of fishing vessel transit activity in the corridor (Figure 3-7). Embedded mitigation further reduces the risk of interactions with fishing gear during the operation phase:

- SHEPD advise fishers to follow the advice provided by SOLAS, UKHO, and the Mariner's Handbook, and avoid demersal trawling over subsea cables;
- Provision of as-built survey data to the UKHO and Kingfisher for inclusion on Admiralty Charts, and KIS-ORCA charts; and
- Two new permanent AtoNs will be installed as part of this project, warning mariners of the presence of cables on the seabed in the area.

As detailed above, the consequence of fouling fishing gear is considered to be 'High'. The mitigation detailed above, combined with the low probability of a vessel engaging in demersal trawling in the proposed cable corridor means that the likelihood is 'Remote' is assigned. This results in an overall assessment of 'Tolerable if ALARP', however given the presence of the existing subsea cable area, there is no material change from baseline conditions, and no further mitigation is required.

4.1.7 Reduction in Under Keel Clearance – Normal Operations

The cable will be surface laid and trenched between Mean Low Water Springs (MLWS) at Sanday and MLWS at North Ronaldsay, where depths increase towards the open channel. SHEPD have in place design criteria for mitigating this in accordance with MCA guidance, keeping depth reductions below 5% from the existing charted water depth, unless otherwise agreed with MCA (at shallow areas). Additionally, the provision of as-built survey data of the laid cable and the presence of AtoNs also reduce this risk. As the RYA have advised that the water depth (6-8 m LAT) where the Open Cut Trench (OCT) transitions to surface laid should not be an issue for recreation sail vessel anchoring, there is no concern for under keel clearance for these recreational vessels. The majority of vessel tracks are concentrated in shallower water, with no presence of large draught vessels identified, in which the likelihood of any related issues is considered to be 'Remote' with a consequence outcome of 'Low' (Minor damage to equipment). This impact is therefore assessed to be 'Broadly Acceptable' and warrants no further consideration.

4.1.8 Electromagnetic field (EMF) and compass deviation effects – Normal Operations

Magnetic compasses are designed to work with the earth's stationary geomagnetic fields and can therefore be affected by other stationary magnetic fields such as ones generated by cables. Alternating current (AC) cables such as the 11 kV cable proposed for this Project generate an oscillating sinusoidal EMF with respect to time, which fluctuates in polarity with frequency of 50 hertz (Hz). The average EMF strength is therefore 0 microteslas (μT), meaning that the deviation effect on ships' compasses will in turn be 0 degrees. There is therefore 'No Risk' from EMFs from the Project on compass deviation, and this hazard is therefore not considered further in this HLNRA.

4.2 Risk Assessment Output Summary

The following table captures the results of the FSA process and results of the HLNRA.

Table 4-1 Navigational Risk Assessment output /Hazard Log

PHASE/ACTIVITY	HAZARD/ IMPACT	EMBEDDED MITIGATION		WORSE CASE OUTCOME	LIKELIHOOD	CONSEQUENCE	INITIAL RISK	ADDITIONAL RRMS	RESIDUAL RISK	COST/ BENEFIT	NOTES
		MANDATORY/ INDUSTRY PRACTICE	PROJECT SPECIFIC MEASURES								
Installation / Maintenance / Decommissioning	Vessel Collision Passing vessel collides with installation vessel (restricted in its manoeuvrability)	IRPCS Port Bylaws and General Directions Guard Vessels (as required) and RCZ AIS Broadcast NtM Notification of Regular Runners Wave / Wind limits	Short operational duration Installation schedule deconflicted with ferry schedule and peak times in so far as practicable Reduced RCZ for vessels which are regularly present, reducing disruption	Operations halted indefinitely Loss of a crew member, or multiple serious injuries Major/Severe damage to vessel	Remote	High	Tolerable	None Identified	ALARP	NA	Short installation duration across navigable area including deconflicting with the ferry sailings where possible, in addition to embedded mitigation represents substantial inherent risk reduction which brings the likelihood to remote. No further risk reduction measures have been considered necessary / effective due to the associated existing inherent safety. Reduced RCZ is recommended to account for ferries and pleasure vessels likely to be present during installation works under which will reduce disruption where the cable corridor intersects with busy routes and would restrict vessel passage with the normal 500m recommendation. (Maintenance Inspection and Decommissioning activities assumed to be similarly short and outwith busy hours).
Installation/ Maintenance/ Decommissioning	Disruption to established vessel routes and areas	IRPCS Port Bylaws and General Directions Guard Vessels (as required) and RCZ AIS Broadcast NtM Notification of Regular Runners Wave / Wind limits	Short operational duration Installation schedule deconflicted with Ferry schedule and peak times in so far as practicable Engagement with the relevant Harbour Authority Reduced RCZ for vessels which are regularly present, reducing disruption.	Protracted operational delays	Remote	Medium	Broadly Acceptable	NA	ALARP	NA	Short installation duration across navigable area including deconflicting with the ferry sailings where possible, is considered to limit disruption risk to broadly acceptable levels. Reduced RCZ is recommended to account for ferries and vessels near North Ronaldsay which will reduce disruption where the increased harbour traffic and cable lay would potentially restrict vessel passage with the normal 500 m recommendation. (Maintenance Inspection and Decommissioning activities assumed to be similarly short and outwith busy hours).

PHASE/ACTIVITY	HAZARD/ IMPACT	EMBEDDED MITIGATION		WORSE CASE OUTCOME	LIKELIHOOD	CONSEQUENCE	INITIAL RISK	ADDITIONAL RRMS	RESIDUAL RISK	COST/ BENEFIT	NOTES
		MANDATORY/ INDUSTRY PRACTICE	PROJECT SPECIFIC MEASURES								
Installation/ Maintenance/ Decommissioning	Interactions with vessel anchors Vessel drags anchor across exposed cable	NtM Guard Vessels (as required) and RCZ Wave / Wind limits	Vessel anchoring within the jurisdiction of the local Harbour Authority Rock bag stabilisation reduced area for anchor interactions with the cable itself	Protracted operational delays Serious injury to person Notable damage to infrastructure or vessel	Remote	Medium	Broadly Acceptable	NA	ALARP	NA	Short installation duration across navigable channel limits the likelihood of anchoring to remote. Installation only in safe conditions and under the jurisdiction of the Harbour Authority limits the potential consequences to medium. The additional planned measure of cable rock bag stabilisation will provide further protection, lowering the likelihood of an anchor drag as the cable will be intentionally obstructed via the bags' presence. (Maintenance Inspection and Decommissioning activities assumed to be similarly short and outwith busy hours).
Installation/ Maintenance/ Decommissioning	Interactions with fishing gear Fishing activity conducted in vicinity of cable and installation activities	NtM Guard Vessels (as required) and RCZ Wave / Wind limits	FLMAP	Serious injury to person Notable damage to infrastructure or vessel	Remote	High	Tolerable	None Identified	ALARP	NA	Maintenance, Inspection and Decommissioning activities assumed to be similarly short and outwith busy hours.
Normal Operations	Interactions with vessel anchors Vessel drags anchor across cable	Promulgation of information on the installation and locations Two new AtoNs to be installed, marking cable presence at each landfall As-built Locations of cable and protections supplied to UKHO (Admiralty) Industry guidance on avoidance of anchoring in the vicinity of subsea cables	Route Selection (Avoids designated anchorage areas) Rock bag stabilisation reduced area for anchor interactions with the cable itself	Loss of a crew member, or multiple serious injuries Major/Severe damage to infrastructure or vessel	Medium	Remote	Broadly Acceptable	NA	ALARP	Measure Justified	In line with guidance provided by the UKHO and International Convention for the SOLAS, SHEPD recommend that fishing vessels should avoid trawling over installed seabed infrastructure. Vessels are also advised in the Mariners Handbook (NP100) not to anchor or fish (trawl) within 500 m of the cable. The additional planned measure of cable rock bag stabilisation will provide further protection, lowering the likelihood of an anchor drag as the cable will be intentionally obstructed via the bags' presence.

PHASE/ACTIVITY	HAZARD/ IMPACT	EMBEDDED MITIGATION		WORSE CASE OUTCOME	LIKELIHOOD	CONSEQUENCE	INITIAL RISK	ADDITIONAL RRMS	RESIDUAL RISK	COST/ BENEFIT	NOTES
		MANDATORY/ INDUSTRY PRACTICE	PROJECT SPECIFIC MEASURES								
Normal Operations	Interactions with fishing gear Fishing vessel drags gear across cable	Promulgation of information on the installation and locations As-built locations of cable and protections supplied to UKHO (Admiralty) and Kingfisher (KIS-ORCA) Two new AtoNs to be installed, marking cable presence at each landfall	Cable protection measures Rock bag stabilisation reduced area for anchor interactions with the cable itself	Loss of a crew member, or multiple serious injuries Major/Severe damage to infrastructure or vessel	Remote	High	Tolerable	None Identified	ALARP	NA	Given that trawling within 500m of a laid subsea cable is advised against in the Mariners Handbook (NP100), and the cable will be marked with two AtoN with the position charted by UKHO and KIS-ORCA, the risk is considered to be tolerable and ALARP.
Normal Operations	Reduction in Under Keel Clearance	As-built Locations of cable and external protections supplied to UKHO (Admiralty) and Kingfisher (KIS-ORCA) Two new Aids to Navigation (AtoNs) to be installed, marking cable presence at each landfall	Cable external diameter only 127 mm Navigable water depths not reduced by more than 5% Cable trenched (as a minimum) from MHWS to MLWS where depth increases steeply	Minor injury to person Minor damage to vessel	Remote	Low	Broadly Acceptable	NA	ALARP	NA	Given charted water depths will not be reduced by more than 5% (unless otherwise agreed with the MCA) and as-built data will be provided to the UKHO for inclusion on Admiralty charts, the risk is considered to be broadly acceptable.
Normal Operations	Electromagnetic field effects disturb magnetic compass navigation	NA	EMFs from AC cables do not affect magnetic compasses	No significant operational impacts	NA	NA	No Risk	NA	No Risk	NA	N/A

5 CONCLUSION

The proposed Sanday to North Ronaldsay replacement cable passes through a regularly trafficked navigational area, predominantly vessels in the North Ronaldsay Firth area to and from Kirkwall and North Ronaldsay. The slow-moving cable installation vessels, which will be restricted in their ability to manoeuvre, crosses the main ferry route and represent a potential hazard or impact to shipping in the area during the installation process.

However, the operation is an appreciably minor activity given the Project's short cable length and short expected duration of installation activities in the busiest parts of the North Ronaldsay Firth, providing considerable inherent safety. Additionally, as the cable represents a like-for-like replacement of the existing power cable (faulted), there is significantly less unknown risk in the routing and installation procedure than would normally be seen in a new cable route. This is because there is already a general awareness of a cable at this location which is a major risk reduction factor, as there is no introduction of a new cable at a location where there was no cable previously.

The approach taken by the Project is to continue to facilitate good communication between the installation contractor, SHEPD, Orkney Ferries and Orkney Islands Council Harbour Authority to deconflict issues with ferries as much as possible, in addition to keeping a small support vessel on standby which can rapidly intervene if vessels pass too close to the installation vessels. Finally, a plan may be implemented which will deconflict the RCZ of 500 m to account for potential interactions at the harbour area in North Ronaldsay that the vessel will start and end operations in, in relation to regular vessel traffic including ferries. Ongoing awareness of the installation operation through the necessary involvement of relevant harbour authorities and promulgation of the operation details to Orkney Islands Council Harbour Authority and mariners in general completes a very low risk profile for the activities. This is reflected in the assessment of the installation, maintenance and decommissioning phases of the project, which determined the risks associated with the activities are ALARP.

The cable will be surface laid and trenched in the subtidal area between MLWS on Sanday and MLWS on North Ronaldsay, and eventually being protected/stabilised with rock bags. An exposed cable represents an obvious hazard to trawlers and anchoring before being stabilised with rock bags and further protection from that operation is achieved in Spring/Summer 2027. However, the cable itself will make landfall within the jurisdiction of the harbour authority, well outside any designated anchoring areas. No demersal trawling activities are permitted in the vicinity of the cable, and there are no chartered or regular anchorages in the immediate vicinity of the installation corridor; this is reflected within the MTS (See Figure 3-7 and Figure 3-8). In addition, as-built locations of the cable and any external protection measures will be supplied to UKHO (Admiralty) and Kingfisher (KIS-ORCA) and the cable will be marked by two new permanent AtoNs which will be inspected and maintained for the life of the cable.

Given the inherent safety associated with the statutory harbour jurisdiction area, and industry standard practice, the risks posed to navigation from the presence of the replacement cable are therefore all considered to be ALARP.

6 REFERENCES

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