Scottish and Southern Energy Networks plc

Aultbea - Ullapool: Loch Broom Subsea Cable Installation

High-Level Navigation Risk Assessment (HLNRA)

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CONTENTS

Acronym List

Acronym	Definition
AC	Alternating Current
AIS	Automatic Identification System
ALARP	As Low as Reasonably Practicable
AtoN	Aid to Navigation
CEMP	Construciton Environmental Management Plan
CSV	Comma-Separated Values
DC	Direct Current
DWT	Deadweight Tonnage
ETV	Emergency Tow Vessel
EU	European Union
FLMAP	Fisheries Liason Mitigaiton Action Plan
FLO	Fisheries Liason Officer
FSA	Formal Safety Assessment
HLNRA	High Level Navigational Risk Assessment
IMO	International Maritime Organisation
IRPCS	International Regulations for the Prevention of Collision at Sea
KIS	Kingfisher Information Service
MCA	Maritime and Coastguard Agency
MLWS	Mean Low Water Springs
MMSI	Maritime Mobile Service Identity
MPA	Marine Protected Area
MTS	Marine Traffic Survey
NM	Nautical Mile
OD	Outside Diameter
OREI	Offshore Renewable Energy Installation
PEXA	Practice and Exercise Area
PLGR	Pre-lay Grapnel Run
RCZ	Recommended Clearance Zone
RP	Reference Point
RRM	Risk Reduciton Measure
SAR	Search and Rescue
SHEPD	Scottish Hydro Electric Power Distribution
SOLAS	Safety of Life at Sea
UKHO	United Kingdom Hydrographic Office
UTC	Universal Time Coordinated
VTS	Vessel Traffic Service

1 INTRODUCTION

This technical note contains an appraisal of the potential interaction of the installation of the Aultbea - Ullapool: Loch Broom Subsea Cable Installation, a new 33 kV (kilovolts) subsea power cable approximately 1.9 km long, which will tie-in with the existing network on the Ullapool side and a proposed extension to the overhead line network on the southern side of Loch Broom at Altnaharrie.

A targeted Marine Traffic Survey (MTS) has been undertaken to describe the relevant shipping and navigation and marine traffic baseline, as understood through desk-based review, and is presented in Section 4. This is followed by a High-Level Navigational Risk Assessment (HLNRA), which uses a Formal Safety Assessment (FSA) approach to identify and assess the risks to Navigation presented by the project activities.

This HLNRA should be read in conjunction with the following documents:

- Aultbea Ullapool: Loch Broom Subsea Cable Installation Project Description;
- Aultbea Ullapool: Loch Broom Subsea Cable Installation Marine Environmental Appraisal (MEA);
- Aultbea Ullapool: Loch Broom Subsea Cable Installation Construction Environmental Management Plan (CEMP); and
- Fishing Liaison Mitigation Action Plan (FLMAP) Aultbea and Ullapool.

2 PROJECT OVERVIEW

This section provides an overview of the proposed installation activities. The installation activities across Loch Broom are planned to be undertaken between September 2022 and January 2023. A detailed project description is provided in the Aultbea Ullapool: Loch Broom Subsea Cable Installation Project Description, which should be read in conjunction with this HLNRA.

The installation activities are expected to take 45 days. This anticipated duration includes all nearshore and offshore works as well as cable pull-in. The completion date is anticipated to be the 31st January 2023. This end date includes contingency to account for potential unforeseen operational and/or weather delays.

The cable route is located within Loch Broom on the northwest coast of Scotland. The proposed scope is to install an approximately 1.9 km long, 33 kV subsea cable which will tie-in with the existing network on the Ullapool side and a proposed extension to the overhead line network on the southern side of Loch Broom at Altnaharrie. The intention is to surface lay the cable within the installation corridor, with any obstructions and/or debris avoided where possible or removed by conducting a Pre-Lay Grapnel Run (PLGR) if required. It should be noted that there are no in or out of service cables within the installation corridor. Therefore, it is expected that this activity will be completed shortly in advance of the cable installation activities to ensure that the route remains free of debris prior to installation.

The cables within the intertidal sections at the landfall locations at Aultbea and Ullapool will be trenched by land-based excavators. Detailed route engineering has been completed based on the offshore survey data between the landing points. In order to allow sufficient flexibility for micro routing during cable installation operations, a 100 m wide installation corridor, centred on the proposed cable installation route, will be licensed and considered by this HLNRA. The location of the installation corridor is shown in Figure 3-1.

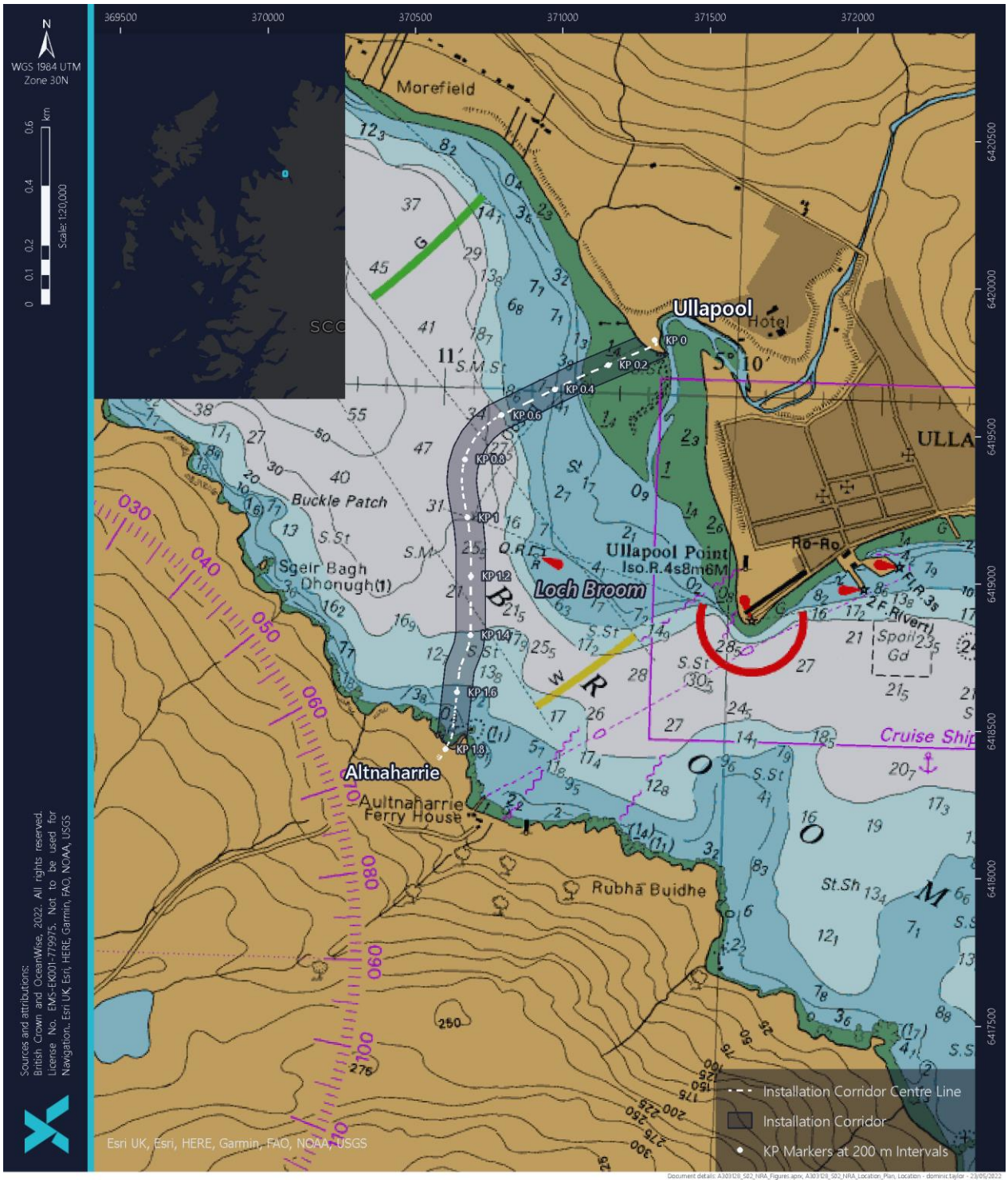


Figure 2-1 Location of the Proposed Cable Installation Corridor for Altnaharrie - Ullapool

2.1 Embedded Mitigation

Certain risk control or mitigation measures are embedded in the project design as adherence from all operators to standard industry best practices, which is fundamental to how the project will be executed. Details of the embedded mitigation which Scottish Hydro Electric Power Distribution (SHEPD) are committed to implementing, and hence has been considered by this HLNRA, are presented in Table 2-1. All embedded mitigation will be included within the CEMP.

During the assessment of impacts in the receptor specific assessment chapters, all proposed mitigation is considered when assessing the significance of an impact.

Table 2-1 Embedded Mitigation and Principal Industry Best Practices Relevant to the Proposed Activities

Measure	Details
Avoidance of Trawling and Anchoring	In line with guidance provided by the UKHO and International Convention for the Safety of Life at Sea (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. Demersal trawling is also prohibited within the Wester Ross Marine Protected Area (MPA).
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 Fisheries Liaison Mitigation Action Plan.	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 proposed Project operations.
Notice to Mariners (including local), 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 contact details for the vessels.	Promotes navigational safety and minimises the risk of equipment snagging.
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 construction, 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.

Measure	Details
Guard Vessels and Recommended Clearance Zone (RCZ) – 250 m	A guard vessel, marshalling a 250 m RCZ may be used during the installation campaign where a potential risk to the asset or danger to navigation has been identified.
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 and equipment snagging.
Aids to Navigation: cable marker beacons	Cable marker beacons (4m poles with 2.5m tall yellow flash mark diamonds) will be installed at each landfall point, subject to Statutory Sanction from Northern Lighthouse Board (NLB). These will be inspected and maintained for the life of the cable.
Proactive engagement with Ullapool Harbour Trust	Ongoing consultations with Ullapool harbour authority ensure continued awareness and communication of installation and harbour specific details relevant to minimising disruption.
Proactive engagement with regular runners including Calmac ferry operator	Engagement with regular runners and specifically Calmac ensures awareness of the installation details which minimises disruption.
Deconfliction of activity schedules with Calmac ferry schedule	Installation maintenance and decommissioning schedules arranged to minimise impact on ferry schedules. This may extend to working in night-time hours where practicable.

3 METHODOLOGY

3.1 Marine Traffic Study

Relevant baseline marine traffic conditions have been established by undertaking a review of historic AIS data for a 5 NM corridor (study area) around the proposed installation corridor. 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 marine installation corridor. AIS records were acquired for a full year between the dates 28-04-2021 00:00 and 27-04-2022 23:59 UTC, and supplied by Marine Traffic (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
- Previous port
- 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, a sequential AIS point records were connected where the intervening time or distance did not exceed 30 minutes or 5 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 misrepresenting the volume of transits or trajectories, and accurately reflecting the direction or route of a transect. Vessel density grids for the wider area were produced by overlaying a 0.05 square kilometres (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).

3.2 HLNRA Methodology

HLNRA uses the baseline shipping data from the Marine Traffic Study (MTS) to inform a high-level desk-top Formal Safety Assessment (FSA) process which identifies and assesses hazards to all relevant navigation or shipping activities, from the Loch Broom Cable Installation 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.

3.2.1 Formal Safety Assessment Approach

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 International Maritime Organisation (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.

3.2.2 Hazard/Impact Identification

Taking into account the project components and activities, baseline information provided in the MTS, 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 limited in their manoeuvrability across the installation corridor for the duration of the operations.

3.2.3 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.

3.2.4 Risk Assessment

Each impact 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 3-1 and Table 3-2. 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 3-1 Severity of Consequence of Hazard / Impact Criteria

SEVERITY / MAGNITUDE	CRITERIA DESCRIPTION
High	Loss of a crew member, or multiple serious injuries / Major/Severe damage to infrastructure or vessel / Operations / activities halted indefinitely
Medium	Serious injury to person / Notable damage to infrastructure or vessel / Protracted operational delays
Low	Minor injury(s) to person / Minor/Local damage to equipment or vessel / Minor operational delays
Negligible	No significant operational impacts

Table 3-2 Likelihood Criteria

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

The likelihood and consequence categories are combined for each hazard/impact using the risk matrix shown in Table 3-3, 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. Definitions of each risk tolerability level are provided in Table 3-4.

Table 3-3 Risk Matrix

FREQUENCY/ LIKELIHOOD					
	Likely	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 / MAGNITUDE		

Table 3-4 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 as low as reasonably practicable (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 to tolerable (ALARP).

3.2.5 Identification of Additional Mitigation Measures

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

3.2.6 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.

3.2.7 Risk Assessment Table/Hazard Log

The Risk Assessment output has been presented in a table, such that the hazards for each of the development Scheme 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 5-1.

4 MARINE TRAFFIC STUDY

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, particularly during the installation phase.

4.1 Key Navigational Features

An overview of all relevant key navigational features is provided in the following sections and presented on Figure 4-1.

4.1.1 Ports and Navigational Aids

The proposed cable and all associated works, including the study area extent are fully contained within the Ullapool Harbour limits, situated in Loch Broom. The harbour area covers 67.3 square kilometres (26 square miles), providing deep water anchorage for large vessels such as cruise liners and drill ships. Designated anchorages can be found immediately east of the pier, and to the south and southeast. The inner anchorage, southeast of the pier is used by visiting cruise ships and other medium sized vessels, whilst fishing vessels anchor in shallower water further up Loch Broom. A minimum depth of 20 metres is available within 0.3 miles of the piers.

Ullapool is the mainland port for ferry services to the Isle of Lewis in the Western Isles, with passenger vessels, particularly Ro-Ro/Passenger ships, accounting for the largest proportion of vessels within the harbour limits (almost 60% of track lines within in the AIS data – see Section 4.2). These ferry services, referred to as lifeline ferry services, provide essential supplies and access to critical services on the mainland. Calmac currently operates a twice daily service for passengers and vehicles on the 'Loch Seaforth' (MMSI 235101635) and has operated an overnight freight-only service in the past, but there is no evidence of a current service.

Ullapool is not a Competent Harbour Authority as defined in the Pilotage Act, consequently no pilots are authorised for the port. In terms of navigational aids, there are two beacons on opposite landfalls to the west of the harbour and a navigation line north of the harbour running north to south, east of Isle Martin.

4.1.2 Military Practice Areas

The entire harbour area and 5 NM study area is wholly within a military practice and exercise area (PEXA). Referred to as X5822 BROOM, it is primarily a submarine and surface fleet exercise area, with evidence of military vessels transiting through the harbour area during the study period (28-04-2021 and 27-04-2022).

4.1.3 Wrecks and Obstructions

Wreck locations were sourced from Marine Themes Vector data layers from OceanWise. Several wrecks are present within the harbour limits and 5 NM study area, with 5 wrecks categorised as being dangerous located in the immediate vicinity of the harbour pier and to the southeast. There are no wrecks present inside and within the vicinity of the cable installation corridor.

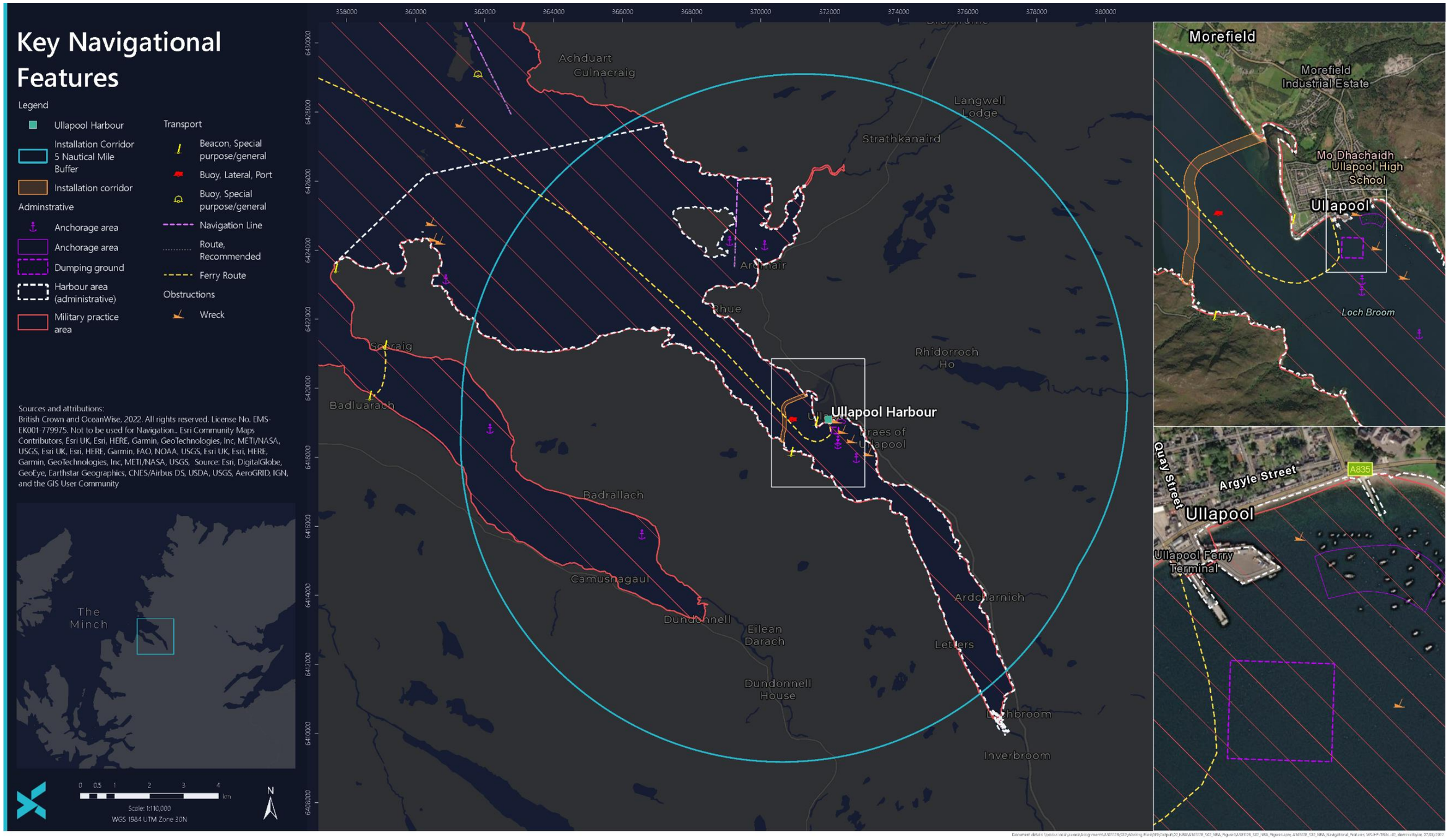


Figure 4-1 Key Navigational Features.

4.2 Baseline Shipping Activity

4.2.1 Overview and Temporal Changes

A total of 5,563 and 2,859 vessel tracks were recorded within the 5 NM study area and cable corridor between the dates 28-04-2021 and 27-04-2022, respectively (Table 4-1). These tracks were associated to 227 unique vessels, and 885 unique routes based on previous and next port information captured in the AIS data. Track line densities are highest crossing the cable between reference point (RP) 0.5 and RP 1.5 and on the approach to Ullapool Harbour (Figure 4-4).

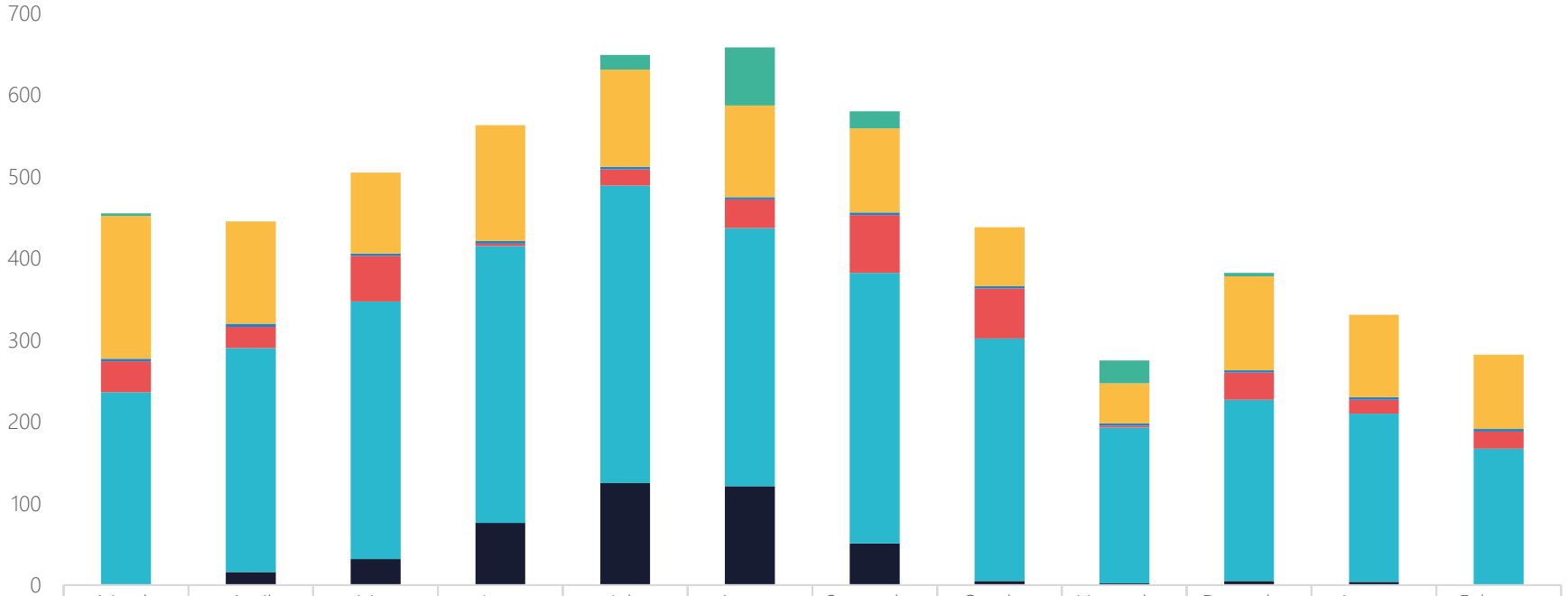
The Summer months (June, July, and August) were the busiest, accounting for 34% (1,870 tracks) and 36% (1,025 tracks) of the total number of vessels with the study year for the 5 NM Study Area and Cable Corridor, respectively. Winter observed the smallest number of vessels, accounting for 18% (995 tracks) and 17% (429 track) of the total number of tracks within the 5 NM Study Area and Cable Corridor, respectively.

A similar seasonal pattern is evident across the vessel types, with cargo and tanker, passenger, and recreational vessels all having been observed to have the highest number of tracks within the summer months (Figure 4-2 and Figure 4-3), which account for 69% and 63% of all tracks within the 5 NM study area and cable corridor, respectively. Fishing vessel presence is highest in Spring in both the 5 NM study area and cable corridor, whilst other vessel types have higher presence in Spring in the 5 NM study area, but higher presence in Autumn within the cable corridor. Presence of offshore industry vessels remained consistent across all seasons in both 5 NM study area and cable corridor. August was the busiest month in the 5 NM study area and July was the busiest month within the cable corridor. The day on which most vessels were observed in the 5 NM study area was 03-09-2021, when 33 vessel tracks were recorded. For the cable corridor this was 31-06-2021, when 17 tracks were recorded. Conversely, the quietest days were 25-12-2021 and 01-01-2022 for the 5 NM study area and 24-10-2021, 06-11-2021, 01-12-2021, 02-01-2022, 09-01-2022, 23-01-2022, 31-01-2022, 09-02-2022, and 24-02-2022 for the cable corridor when only 1 vessel track was recorded.

Table 4-1 Vessel tracks per season

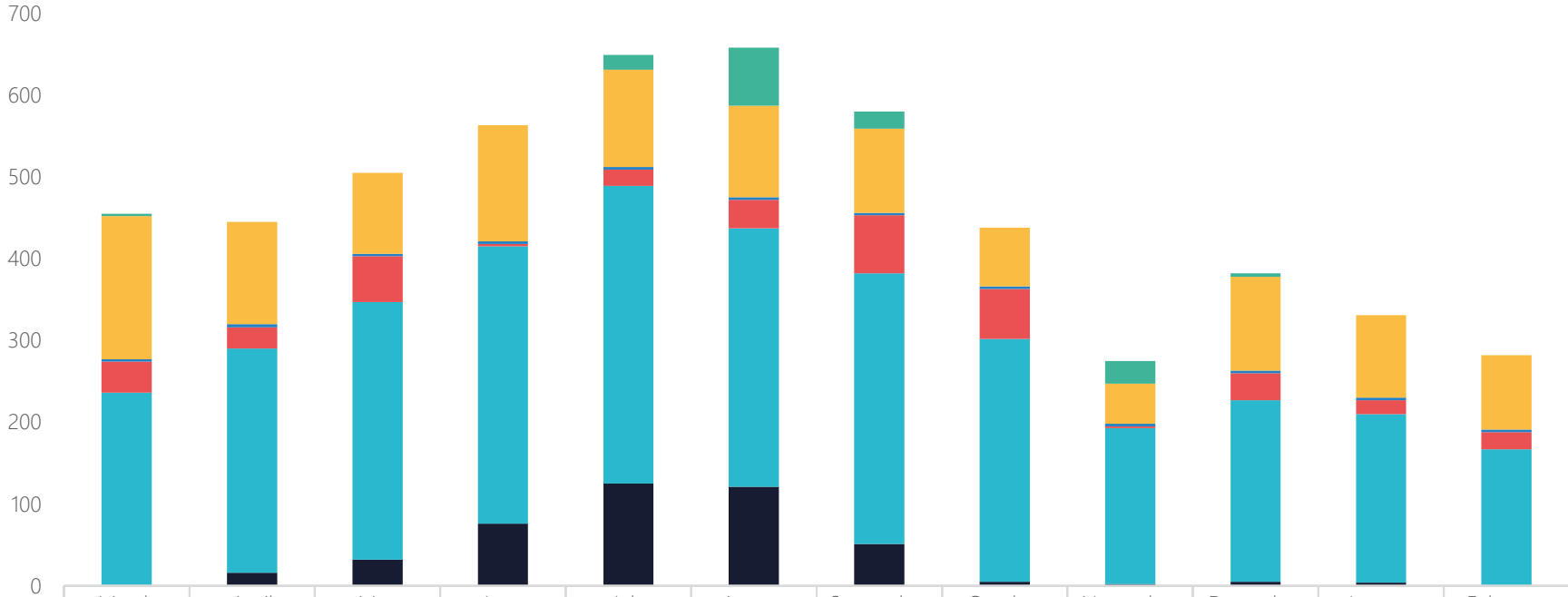
SEASON	NUMBER OF TRACK LINES	
	5 NM Study Area	Cable Corridor
Spring	1,405	705
Summer	1,870	1,025
Autumn	1,293	650
Winter	995	479
Grand Total	5,563	2,859

In total, fewer vessels are observed during the night (18:30 – 06:30), accounting for 34% and 32% of the total number of tracks within the 5 NM study area and cable corridor, respectively. Overall, this represents a 49% reduction in vessels traffic during the night within the 5 NM study area and a 53% reduction within the cable corridor (Table 4-3). All vessel types observed a reduction in tracks during the night, other than cargo vessels, which observed a marked increase of 87% for both the 5 NM study area and cable corridor.



	March	April	May	June	July	August	September	October	November	December	January	February
	Spring			Summer			Autumn			Winter		
Cargo/Tanker	3				18	71	21		28	4		
Fishing	175	125	99	142	119	112	103	72	49	115	101	91
Offshore industry	3	4	3	3	3	3	3	3	3	3	3	3
Other	38	26	56	3	20	35	71	61	2	33	17	21
Passenger	235	274	315	339	364	316	331	297	191	222	206	167
Recreational	1	16	32	76	125	121	51	5	2	5	4	

Figure 4-2 Seasonal and monthly summary of vessel types within the 5 nm study area.



	March	April	May	June	July	August	September	October	November	December	January	February
	Spring			Summer			Autumn			Winter		
Cargo/Tanker	3				18	71	21		28	4		
Fishing	175	125	99	142	119	112	103	72	49	115	101	91
Offshore industry	3	4	3	3	3	3	3	3	3	3	3	3
Other	38	26	56	3	20	35	71	61	2	33	17	21
Passenger	235	274	315	339	364	316	331	297	191	222	206	167
Recreational	1	16	32	76	125	121	51	5	2	5	4	

Figure 4-3 Seasonal and monthly summary of vessel types within the cable corridor.

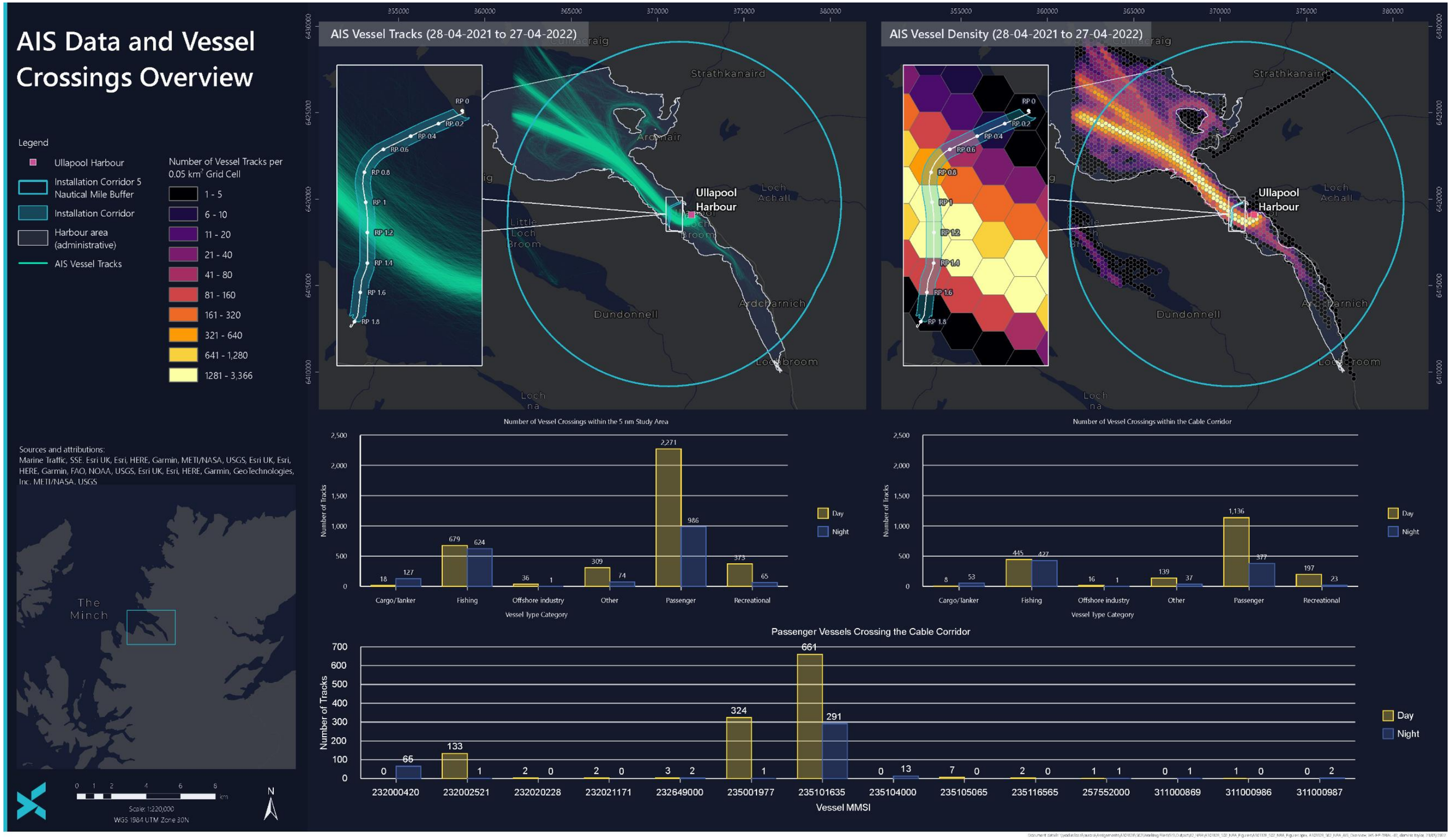


Figure 4-4 AIS data summary, including day and night vessel type counts.

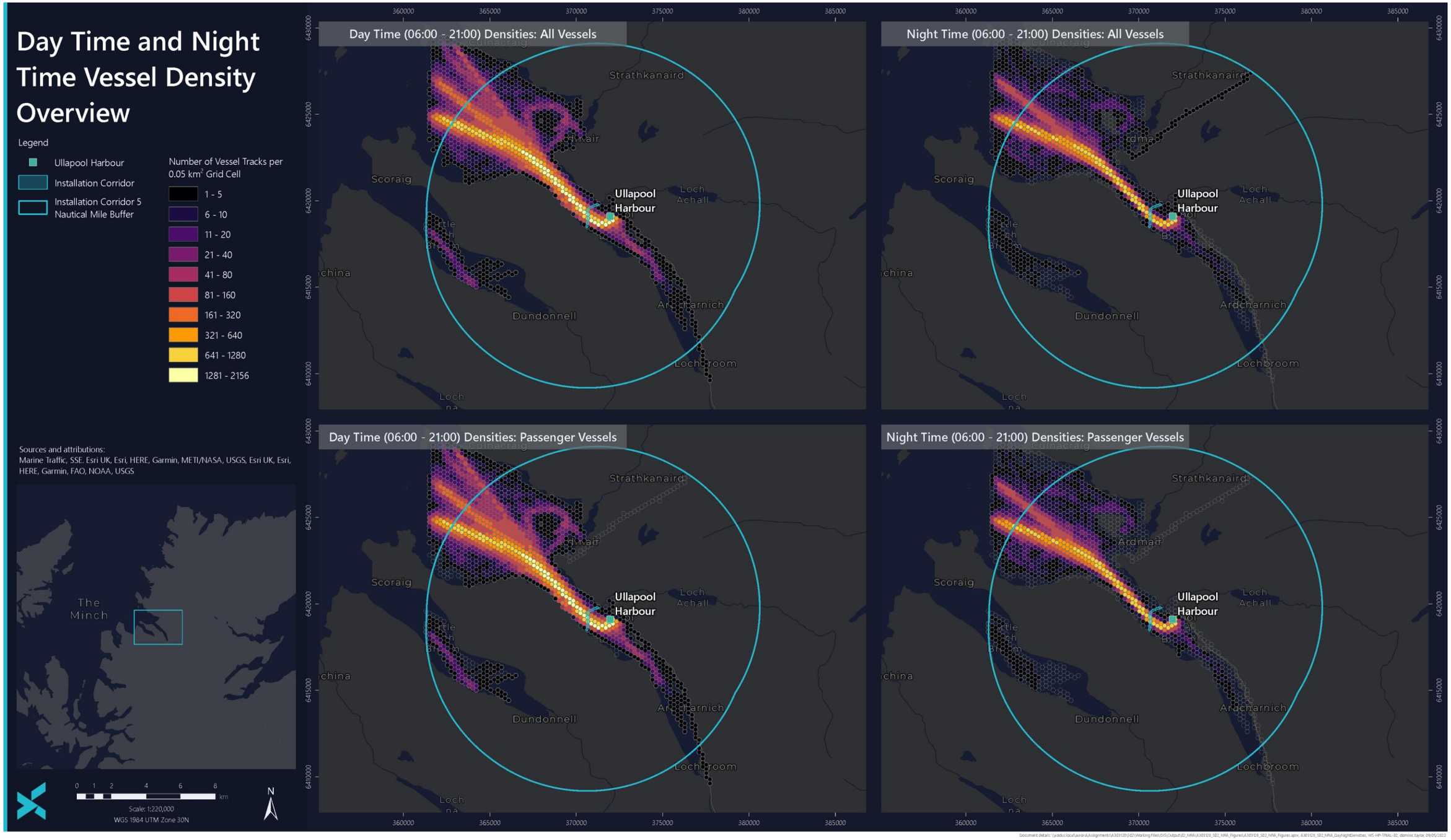


Figure 4-5 Day and night densities.

4.2.2 Vessel Type

A breakdown of the various vessel types occurring within the 5 NM study area and cable corridor is provided in Table 4-3, and the track line densities of each vessel category are provided in Figure 4-6. An overview of each vessel category is provided below.

Cargo Vessels and Tankers

Cargo Vessels and Tankers are the second least frequently occurring vessels, accounting for 2.6% and 2.1% of vessels tracks within the 5 NM study area and cable corridor. They are observed primarily at night, with 100% (51 tracks) of cable corridor crossings associated a single Ro-Ro cargo vessel called the Arrow (MMSI: 235096892). The Arrow was chartered in by Calmac to provide an overnight freight ferry service, which operated between July and November 2021, and was not present within the study area following these dates, is therefore not considered to be part of the routine vessel traffic between Ullapool and Stornoway. The large proportion of night time tracks (Table 4-3) within this vessel category can largely attributed to this vessel. Within the 5 NM study area 87.6% (145 tracks) of tracks within this vessel category occur at night, which are, in addition to the Ro-Ro cargo vessel, associated the cargo and general cargo vessel types.

Fishing Vessels

Fishing vessels are the second most frequently occurring vessel type after passenger vessels, accounting for 23.4% and 30.5% of vessel tracks within the 5 NM study area and cable corridor. The cable corridor and 5 NM study area are wholly within the Wester Ross Marine Protected Area (MPA), which has several protected benthic features including burrowed mud, circalittoral muddy sand communities, flame shell beds, and Kelp and seaweed communities. Therefore, demersal fishing activities such as trawling, and dredging are prohibited, and presence of fishing vessels are assumed to be transiting to and from Ullapool Harbour, or engaged in static gear fishing. The presence of fish carrier vessels in the study area are associated to aquaculture sites present throughout Ullapool Harbour limits and beyond, which are primarily related to Fin Fish and Shellfish species (Figure 4-6).

Offshore Industry Vessels

Offshore industry vessels are the least frequently occurring vessels, accounting for 0.7% and 0.6% of vessel tracks within the 5 NM study area and cable corridor, and are associated to only two individual vessels, the Ievoli Black (MMSI: 247332100) and the Artabro (MMSI: 224866000). The former is a multi-purpose offshore vessel with a length of 70 m and DWT value of 2,063 and was observed exclusively during the day. Whilst listed as a multi-purpose offshore vessel in AIS, it was chartered to provide the emergency towing vessel (ETV) service for the west coast, as organised by the MCA. The latter is a supply vessel with a length a 90.7 m and a DWT value of 3,000 and was observed exclusively at night and only once in the study year.

Other Vessels

Other vessels are observed in the AIS infrequently, accounting for 6.9% and 6.2% of vessels tracks within the 5 NM study area and cable corridor. 80.7% of tracks within the 5 NM study area occur during the day, with a similar proportion of vessels crossing the cable corridor also during the day (79%). Several individual vessel types make up the vessel tracks within this category, however Tug vessels account for the largest proportion

Military vessels are also observed, accounting for 7% of vessel tracks within this category with only 4 crossing the cable corridor. Military vessel activity is likely to be associated to the military practice and exercise area present within the 5 NM study area.

Passenger Vessels

Passenger vessels are the most frequently observed vessels within both the 5 NM study area and the cable corridor, accounting for 58.5% and 52.9% of total tracks across each area. Ro-Ro/Passenger vessels were the most frequently occurring vessel type within the passenger vessel category. Within the 5 NM study area they accounted for 87.9% of passenger vessel tracks and 51.4% of the total number tracks. Within the cable corridor, they accounted for 76.9% of passenger vessel tracks and 40.7% of the total number of tracks. Within the 5 NM study area a 56.6% reduction in journeys during the night, compared to the day was observed for passenger vessels, and a 66.8% reduction in journeys was also observed for tracks that crossed the cable corridor (Table 4-3).

Three passenger vessels accounted for almost half (49.3%) the total number of tracks crossing the cable corridor. These include the Loch Seaforth (MMSI: 235101635), Isle of Lewis (MMSI: 232002521), and Shearwater (MMSI: 235001977), which combined made a total of 1,411 crossings during the study period (Figure 4-4 and Table 4-2). Of these 1,411 tracks, 293 (20.7%) occurred during the night (18:30 – 06:30). However, 99% (291 tracks) night crossings were exclusively associated to the Loch Seaforth. Both the Loch Seaforth and Isle of Lewis vessels are part of the CalMac Ferries fleet, are Ro-Ro/Passenger Ships with lengths of 116.16 m and 101.25 m and DWT values 1,442 and 867, respectively, and whose primary route is between Ullapool and Stornoway. The Isle of Lewis service was brought in as a replacement vessel following the breakdown of the Loch Seaforth in Spring 2021 and provided continuity of service until Winter 2021, when Loch Seaforth was operational again. Vessel Shearwater is operated by Shearwater cruises and is a passenger vessel only with a length of 15 m and a DWT value of 19.4, whose primary route is circular, leaving and returning to Ullapool.

Table 4-2 Track line summary for the 3 most frequently occurring passenger vessels

VESSEL NAME	MMSI	VESSEL LENGTH	VESSEL DWT	5 NM STUDY AREA TRACK LINE COUNTS			CABLE CORRIDOR TRACK LINE COUNTS		
				Day	Night	Total	Day	Night	Total
CalMac Ferries									
Isle of Lewis	232002521	101.25	867	301	17	318	133	1	134
Loch Seaforth	235101635	116.16	1,442	1587	759	2,346	661	291	952
Shearwater Cruises									
Shearwater	235001977	15	19.4	337	1	338	324	1	325

Recreational Vessels

Recreational vessels are observed infrequently, accounting for 7.9% and 7.7% of vessels tracks within the 5 NM study area and cable corridor, respectively. In the 5 NM study area, sailing vessels account for the largest proportion of tracks lines (65%) which include 49 unique vessels, whilst Yachts account for the smallest proportion (<1%)., with only a single yacht observed during the study period. Recreational vessels follow the same day/night patterns of overall vessel traffic with 85% of vessel tracks occurring during the day within the 5 NM study area and 90% occurring during the day within the cable corridor. It's worth noting that due to their size recreational vessels are less likely to have AIS equipment installed and therefore may be under-represented in the data.

Table 4-3 Summary of vessel tracks recorded in the 5 NM buffer and cable corridor.

VESSEL CATEGORY	VESSEL TYPE	5NM STUDY AREA						CABLE CORRIDOR					
		Track Count Day (06:30 - 18:30)	Proportion of Track Lines	Track Count Night (18:30 - 06:30)	Proportion of Track Lines	Percentage Change from Day to Night	Total	Track Count Day (06:30 - 18:30)	Proportion of Track Lines	Track Count Night (18:30 - 06:30)	Proportion of Track Lines	Percentage Change from Day to Night	Total
Cargo/Tanker	Cargo	8	72.7%	3	27.3%	-62.5%	11	5	83.3%	1	16.7%	-80.0%	6
	General Cargo	8	88.9%	1	11.1%	-87.5%	9	3	75.0%	1	25.0%	-66.7%	4
	Ro-Ro Cargo	2	1.6%	123	98.4%	6050.0%[1]	125	0	0.0%	51	100.0%	N/A	51
	Cargo/Tanker Total	**18**	**12.4%**	**127**	**87.6%**	**605.6%**	**145**	**8**	**13.1%**	**53**	**86.9%**	**562.5%**	**61**
Fishing	Fish Carrier	133	48.5%	141	51.5%	6.0%	274	80	44.0%	102	56.0%	27.5%	182
	Fishing	219	40.5%	322	59.5%	47.0%	541	146	41.4%	207	58.6%	41.8%	353
	Fishing Vessel	166	67.2%	81	32.8%	-51.2%	247	112	65.9%	58	34.1%	-48.2%	170
	Trawler	161	66.8%	80	33.2%	-50.3%	241	107	64.1%	60	35.9%	-43.9%	167
	Fishing Total	**679**	**52.1%**	**624**	**47.9%**	**-8.1%**	**1,303**	**445**	**51.0%**	**427**	**49.0%**	**-4.0%**	**872**
Offshore Industry	Multi Purpose Offshore Vessel	36	100.0%	0	0.0%	-100.0%	36	16	100.0%	0	0.0%	-100.0%	16
	Supply Vessel	0	0.0%	1	100.0%	N/A	1	0	0.0%	1	100.0%	N/A	1
	Offshore Industry Total	**36**	**97.3%**	**1**	**2.7%**	**-97.2%**	**37**	**16**	**94.1%**	**1**	**5.9%**	**-93.8%**	**17**
Other	Anchor Handling Vessel	3	100.0%	0	0.0%	-100.0%	3	2	100.0%	0	0.0%	-100.0%	2
	Buoy-Laying Vessel	4	100.0%	0	0.0%	-100.0%	4	3	100.0%	0	0.0%	-100.0%	3
	Dive Vessel	7	100.0%	0	0.0%	-100.0%	7	1	100.0%	0	0.0%	-100.0%	1
	Dredger	20	90.9%	2	9.1%	-90.0%	22	7	87.5%	1	12.5%	-85.7%	8
	Law Enforce	4	100.0%	0	0.0%	-100.0%	4	4	100.0%	0	0.0%	-100.0%	4
	Local Vessel	25	89.3%	3	10.7%	-88.0%	28	20	95.2%	1	4.8%	-95.0%	21
	Military Ops	20	71.4%	8	28.6%	-60.0%	28	4	100.0%	0	0.0%	-100.0%	4
	Naval Patrol Vessel	2	100.0%	0	0.0%	-100.0%	2	0	N/A	0	0.0%	N/A	N/A
	Other	7	77.8%	2	22.2%	-71.4%	9	1	50.0%	1	50.0%	0.0%	2
	Patrol Vessel	1	33.3%	2	66.7%	100.0%	3	0	0.0%	1	100.0%	N/A	1
	Port Tender	2	66.7%	1	33.3%	-50.0%	3	1	50.0%	1	50.0%	0.0%	2
	Research/Survey Vessel	2	66.7%	1	33.3%	-50.0%	3	1	100.0%	0	0.0%	-100.0%	1
	SAR	4	80.0%	1	20.0%	-75.0%	5	1	100.0%	0	0.0%	-100.0%	1
	Training Ship	18	78.3%	5	21.7%	-72.2%	23	16	76.2%	5	23.8%	-68.8%	21
	Tug	116	81.7%	26	18.3%	-77.6%	142	56	81.2%	13	18.8%	-76.8%	69

[1]. *Significant increase related to vessel Arrow (MMSI: 235096892), which was chartered in by Calmac to provide an overnight freight ferry service operating between July and November 2021. Not typical of the long-term vessel traffic baseline.*

VESSEL CATEGORY	VESSEL TYPE	5NM STUDY AREA						CABLE CORRIDOR					
		Track Count Day (06:30 - 18:30)	Proportion of Track Lines	Track Count Night (18:30 - 06:30)	Proportion of Track Lines	Percentage Change from Day to Night	Total	Track Count Day (06:30 - 18:30)	Proportion of Track Lines	Track Count Night (18:30 - 06:30)	Proportion of Track Lines	Percentage Change from Day to Night	Total
	Unspecified	45	84.9%	8	15.1%	-82.2%	53	14	66.7%	7	33.3%	-50.0%	21
	Utility Vessel	5	71.4%	2	28.6%	-60.0%	7	3	60.0%	2	40.0%	-33.3%	5
	Work Vessel	24	64.9%	13	35.1%	-45.8%	37	5	50.0%	5	50.0%	0.0%	10
	Other Total	**309**	**80.7%**	**74**	**19.3%**	**-76.1%**	**383**	**139**	**79.0%**	**37**	**21.0%**	**-73.4%**	**176**
Passenger	Passenger	365	99.5%	2	0.5%	-99.5%	367	335	99.7%	1	0.3%	-99.7%	336
	Passenger Ship	18	64.3%	10	35.7%	-44.4%	28	7	53.8%	6	46.2%	-14.3%	13
	Ro-Ro/Passenger Ship	1,888	66.0%	974	34.0%	-48.4%	2,862	794	68.2%	370	31.8%	-53.4%	1,164
	Passenger Total	**2,271**	**69.7%**	**986**	**30.3%**	**-56.6%**	**3,257**	**1,136**	**75.1%**	**377**	**24.9%**	**-66.8%**	**1,513**
Recreational	Pleasure Craft	138	92.6%	11	7.4%	-92.0%	149	93	94.9%	5	5.1%	-94.6%	98
	Sailing Vessel	232	81.1%	54	18.9%	-76.7%	286	102	85.0%	18	15.0%	-82.4%	120
	Yacht	3	100.0%	0	0.0%	-100.0%	3	2	100.0%	0	0.0%	-100.0%	2
	Recreational Total	**373**	**85.2%**	**65**	**14.8%**	**-82.6%**	**438**	**197**	**89.5%**	**23**	**10.5%**	**-88.3%**	**220**
	Grand Total	3,686	66.3%	1,877	33.7%	-49.1%	5,563	1,941	67.9%	918	32.1%	-52.7%	2,859

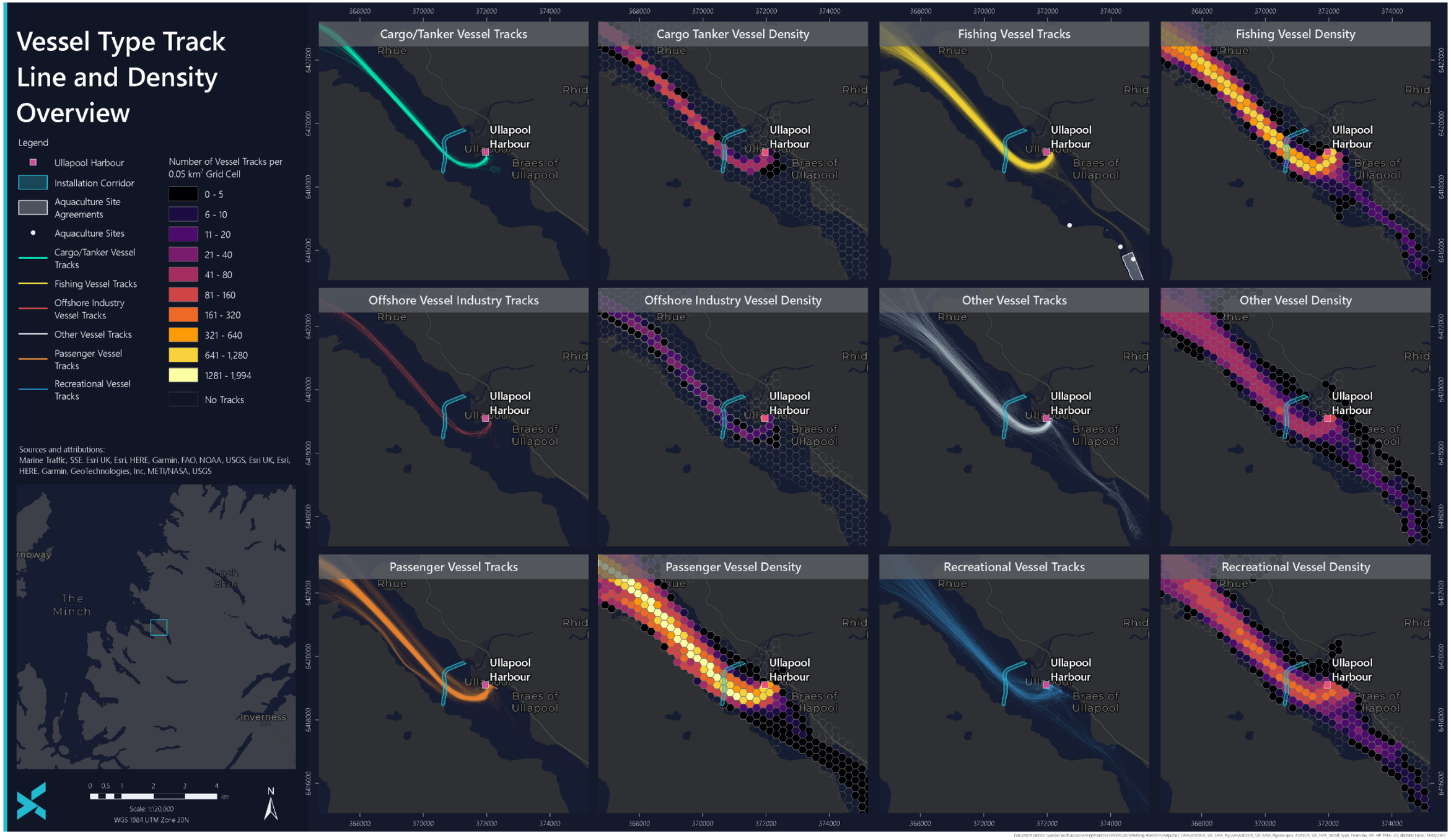


Figure 4-6 Vessel type tracks and densities.

4.2.3 Anchoring Summary

An overview of vessels at anchor is provided in Figure 4-7, which includes time spent at anchor for each vessel type. Segments of vessel tracks were determined to be at-anchor if vessel status was set to 1 (at-anchor) and were travelling at speeds of less than 0.5 knots. In total, vessels spent an estimated 619 hours at-anchor within the 5 NM study area. Anchored vessels were distributed throughout the harbour limits, but were most concentrated directly south of Ullapool Harbour, within designated anchorage areas, which observed densities between 50.3 and 84.3 hours per 0.05 km^2 grid cell. There were no vessels at-anchor within the cable corridor during the study, according to the AIS data.

Fishing vessels spent more time at anchor than any other vessel type, anchoring for an estimated 482 hours during the study period, accounting for 78% of total anchoring within the 5 NM study area. Fishing vessels at-anchor are exclusively fish carriers (Table 4-4), which are distributed throughout the study area and their locations, generally, are adjacent to aquaculture sites.

Table 4-4 Vessels at-anchor Overview

VESSEL CATEGORY	VESSEL TYPE	HOURS SPENT AT-ANCHOR	PROPORTION
Cargo/Tanker	*General Cargo*	19.3	3.11%
Fishing	*Fish Carrier*	481.6	77.84%
Offshore industry	*Multi Purpose Offshore Vessel*	8.5	1.38%
Other	*Buoy-Laying Vessel*	18.4	2.97%
	Work Vessel	13.1	2.12%
Passenger	*Passenger Ship*	20.5	3.31%
Recreational	*Sailing Vessel*	39.1	6.32%
	Yacht	18.3	2.96%
Grand Total		618.7	100%

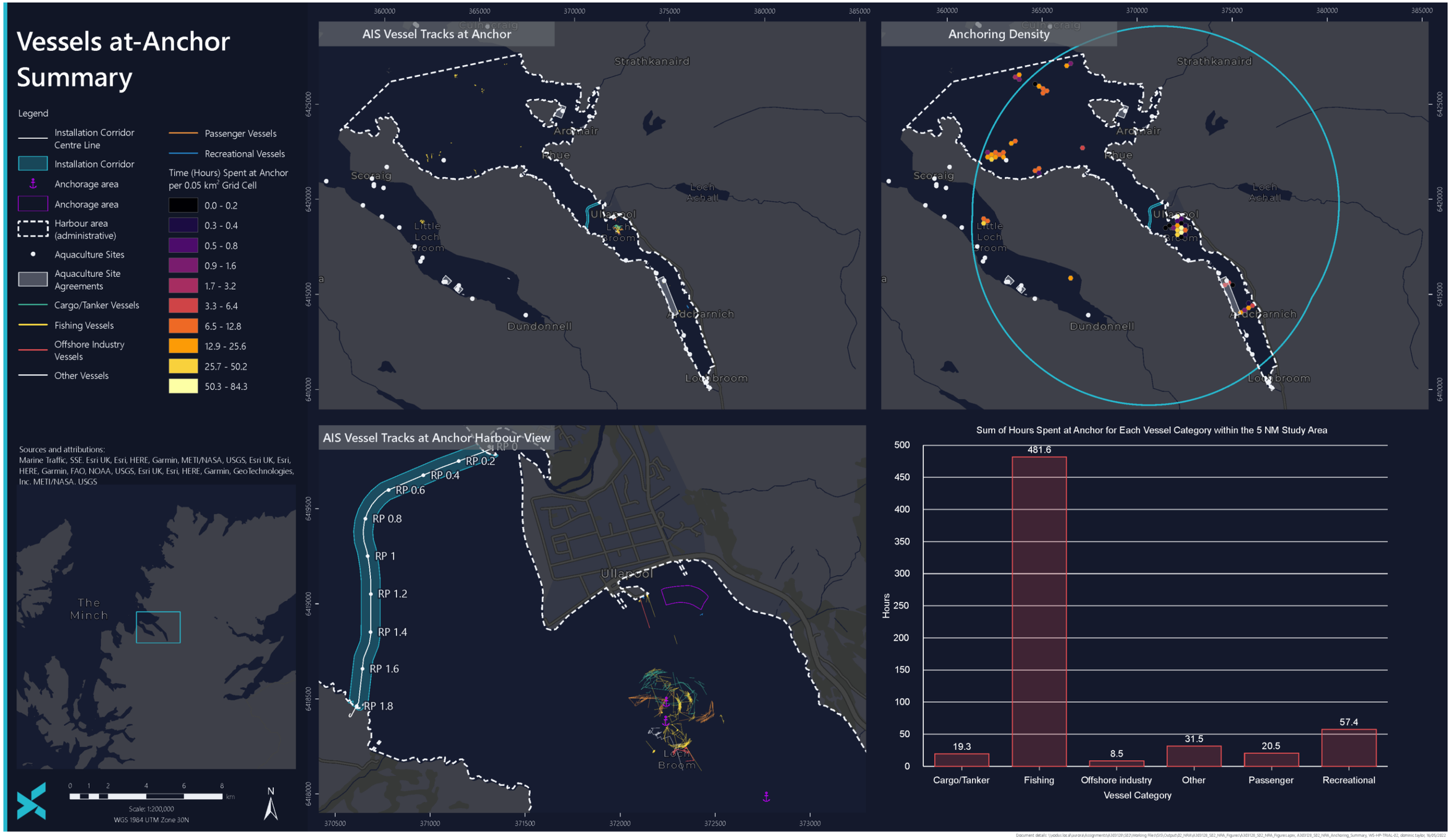


Figure 4-7 Vessels at-anchor summary.

5 FSA

5.1 Results

The Aultbea to Ullapool Cable Installation passes through a well trafficked and marked navigation channel, predominantly carrying vessels in and out of Ullapool Harbour. 33 vessels were recorded on the busiest day in the MTS study period. Therefore, the slow-moving cable installation vessels, which will be limited in their ability to manoeuvre, crossing perpendicular to the channel represents a hazard or potential impact to shipping in the area.

The assessment identified six distinct hazards / impacts to shipping from the development resulting in eight individual assessments across the installation maintenance and decommissioning phases. The eight individual assessments can be seen below and in Table 5-1 below. The six hazards are shown here:

- Vessel collision (Third party vessel with project vessel)
- Disruption to established vessel routes and areas
- Interactions with vessel anchors
- Interactions with fishing gear
- Reduction in under keel clearance
- Electromagnetic field (EMF) effects and compass deviation

Of the eight assessments, six were assessed as being 'Broadly Acceptable' therefore, no further consideration of risk reduction measures is necessary for these hazards. The remaining two were assessed as Tolerable if ALARP and therefore required further consideration. However, no additional risk reduction measures 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 section below.

Vessel collision – Installation Maintenance and Decommissioning

Vessel collision risk is highest at the busiest section of the navigable channel (around reference point 0.6 to 1.4 See Figure 4-4) and within the busiest hours (generally daylight hours See Table 4-3). The project includes several project specific embedded mitigation measures designed to minimise vessel interactions and reduce collision risk, namely: scheduling of works to avoid peak vessel traffic activity periods and the Calmac ferry schedule and, where practical, extension of working to night time hours. The vast majority of the traffic passes through a narrow section of the cable corridor between RP 0.6 to 1.4 (under 1 km). Assuming a standard cable installation progression speed of around walking pace, works within this section will be extremely limited in duration. These considerations combine to provide considerable inherent collision safety over and above the industry standard mitigations, such as guard vessel protection (as required), notice to mariners and weather condition limits.

Considering the extremely 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 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. However, given the very short duration of the

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

Disruption to established vessel routes and areas – Installation Maintenance and Decommissioning

The risk of disruption to vessels is most relevant to the potential occlusion of the ferry passage in and out of Ullapool harbour from the slow moving and restricted installation vessels. In addition, similar to the risk of collision, the risk of disruption potential is highest at the busiest section of the navigable channel (around RP 0.6 to 1.4 (see Figure 4-4)) and within the busiest hours (generally daylight hours See Table 4-3). Therefore, the embedded project specific mitigation measure, to deconflict the development activity schedules with the Calmac ferry schedule and peak traffic hours combined with ongoing engagement with Ullapool Harbour Trust minimises this risk of disruption by minimising vessel interactions.

Again, the standard cable installation progression speed of around walking pace presents a very short duration in the sections of the channel with substantial traffic. These considerations combine to provide considerable inherent collision avoidance over and above the industry standard mitigations, such as guard vessel protection (as required) and notices to mariners.

Considering the extremely limited duration of potential interaction between the installation vessel and ferries 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, 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'.

Interaction with vessel anchors – Installation Maintenance Decommissioning

The interaction of vessels anchors with the cable during the activities associated with installation maintenance or decommissioning is considered highly unlikely. The principal reason being that no anchoring is seen in the baseline data (See Figure 4-7). This reflects the fact that the cable installation corridor passes through a navigable channel thus vessels are unlikely to drop anchor in this area for safety reasons. Moreover, the cable corridor lies within the jurisdiction of Ullapool harbour authority, providing additional prevention of anchoring outside designated areas. Embedded mitigations covering notification to mariners, guard vessel protection (as required) and so on, further reduce the potential for interactions to an appreciable minimum.

Any interaction with vessel anchors during installation maintenance and decommissioning activities would occur at conditions within normal operational wave and wind limits relating to these activities, as such operations will not be conducted during severe weather events. Thus, the consequences are considered to be limited to serious injury or notable damage ('Medium'). This is combined with a 'Remote' assessment of likelihood to result in an overall 'Broadly Acceptable' outcome, requiring no further consideration of risk reduction.

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 notification to mariners will inform vessels of the hazard. Similarly, adverse weather conditions throughout the lifetime of the cable present an increase in the possibility of a vessel dragging anchor across the cable from a starting location within designated anchoring areas (See Figure

4-7) despite the inherent anchoring restrictions. In such a scenario adverse weather would exacerbate the incident endangering the risk of any crew. Therefore, a raised likelihood of 'Unlikely' and a raised consequence outcome of 'High' compared to the installation, maintenance and decommissioning phases, are selected. This results in a Tolerable if ALARP assessment and the need to consider additional risk reduction measures.

Cable marker beacons will be installed at each landfall point, raising awareness among mariners of its location, in addition to UKHO and KIS-ORCA charting. The risk of interaction with anchors during the operation phase, posed to shipping from the presence of the seabed cable is therefore considered to be ALARP given the implementation of the embedded measures.

Interactions with fishing gear - Installation Maintenance 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 fishing behaviour is seen in the baseline data; fishing vessels are recorded only transiting the area (See Figure 4-6). This reflects the fact that the cable installation corridor passes through a Marine Protected Area (MPA) where demersal trawling is not permitted, and a navigable channel thus vessels are further unlikely to fish in this area for safety reasons. Moreover, the cable corridor lies within the jurisdiction of Ullapool harbour authority, providing additional prevention of trawling within the MPA. It is noted however that some limited static gear fishing which is permitted within the MPA is known to occur in the area. Embedded project mitigation of the appointment of a Fisheries Liaison Officer (FLO) is in place to further reduce the potential for interactions to an appreciable minimum via Fisheries Liaison Mitigation Action Plan (FLMAP), which includes the issuing of notices to mariners in advance of works taking place.

Any interaction with fishing gear during installation maintenance and decommissioning activities would occur at conditions within normal operational wave and wind limits. Thus, the consequences are considered to be limited to serious injury or notable damage ('Medium'). This is combined with a 'Remote' assessment of likelihood to result in 'Broadly Acceptable' outcome, requiring no further consideration of risk reduction.

Interactions with fishing gear – Normal Operations

As the operations phase of the project endures for the lifetime of the surface laid cable, the likelihood in the operational phase is raised. Indeed, during the operations no FLO, guard vessel patrol or recent notification to mariners will inform vessels of the hazard. However, as-built drawings of the location will have been supplied to the UKHO and KIS-ORCA to inform fishermen of the location and cable marker beacons will be installed at each landfall. Industry guidance on avoiding trawling in the vicinity of cables and MPAs will also be in place to reduce the likelihood of interactions. Therefore, a likelihood of 'Remote' is retained and a consequence outcome of 'Medium' is also selected. This results in a 'Broadly Acceptable' assessment and overall ALARP position with no requirement to consider additional risk reduction measures.

Reduction in Under-keel clearance – Normal Operations

The cable will be surface laid between each landfall and MLWS where depths increase steeply towards the open channel. The cable itself, at 127mm OD, represents a very minor reduction of under-keel clearance which is well within the standard limit of no more than 5% reduction of navigable depth, including protection measures. As the vast majority of vessel tracks are concentrated in deeper water 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.

Electromagnetic field 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 direct current (DC) cables. Alternating current (AC) cables such as the 33KV cable in this project generate an oscillating sinusoidal EMF with respect to time within the same period. In this case, the resulting EMF fluctuates with a period of 20ms (f= 50Hz), and the average value is zero micro Tesla (the average value is the one which may influence magnetic compasses). The deviation effect on ships' compasses will therefore be zero. EMF and compass deviation are not therefore considered further in this HLNRA.

5.1.1 Risk Assessment Output

The following table captures the results of the FSA process and results of the HLNRA. All hazards are ultimately assessed as being ALARP with no recommendations for additional risk reduction measures or further action beyond continual monitoring of the risks for changes to the project / assessment basis.

Table 5-1 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 VTS Communication (From Port) Guard Vessels (as required) and RCZ AIS Broadcast Notice to Mariners Notification of Regular Runners Wave / Wind limits	Very short operational duration Installation schedule deconflicted with Ferry schedule and peak times in so far as practicable	Operations halted indefinitely Loss of a crew member, or multiple serious injuries Major/Severe damage to vessel	Remote	High	Tolerable	None Identified	ALARP	NA	Very short installation duration across navigable channel (busy area) including deconflicting with the ferry sailings if 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. (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	Disruption to established vessel routes and areas	IRPCS Port Bylaws and General Directions VTS Communication (From Port) Guard Vessels (as required) and RCZ AIS Broadcast Notice to Mariners Notification of Regular Runners Wave / Wind limits	Very short operational duration Installation schedule deconflicted with Ferry schedule and peak times in so far as practicable Engagement with Ullapool Harbour Trust	Protracted operational delays	Remote	Medium	Broadly Acceptable	NA	ALARP	NA	Very short installation duration across navigable channel (busy area) including deconflicting with ferry sailings if possible, is considered to limit disruption risk to broadly acceptable levels. (Maintenance Inspection and Decommissioning activities assumed to be similarly short and outwith busy hours)
Installation / Maintenance / Decommissioning	Interactions with vessel anchors Vessel drags anchor across exposed cable	Notice to Mariners Guard Vessels (as required) and RCZ Wave / Wind limits	Vessel anchoring within the jurisdiction of Ullapool Harbour Trust	Protracted operational delays Serious injury to person Notable damage to infrastructure or vessel	Remote	Medium	Broadly Acceptable	NA	ALARP	NA	Very short installation duration across navigable channel (busy area) limits the likelihood of anchoring to remote. Installation only in safe conditions and under the jurisdiction of the Harbour Trust limits the potential consequences to medium. (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 fishing gear Fishing activity conducted in vicinity of cable and installation activities	Notice to Mariners Guard Vessels (as required) and RCZ Wave / Wind limits	FLMAP, including CFLO and regular engagement with fisheries representatives Cable laid in MPA (no trawling in area)	Serious injury to person Notable damage to infrastructure or vessel	Remote	Medium	Broadly Acceptable	None Identified	ALARP	NA	Negotiations with static gear fishing operators to arrange a clearance corridor for the duration of the installation campaign. (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 Cable Marker beacons (AtoNs) at each landfall, marking cable presence 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)	Loss of a crew member, or multiple serious injuries Major/Severe damage to infrastructure or vessel	Unlikely	High	Tolerable	None Identified	ALARP	Measure Justified	

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) Cable Marker beacons (AtoNs) at each landfall, marking cable presence Industry guidance on avoidance of fishing within MPA / in the vicinity of Subsea cables	Cable laid in MPA (no trawling in area) Cable protection measures	Loss of a crew member, or multiple serious injuries Major/Severe damage to infrastructure or vessel	Remote	Medium	Broadly Acceptable	NA	ALARP	NA	Given that the cable is within a MPA (where demersal fishing is prohibited), under Harbour Authority jurisdiction, the cable landfalls will be marked with beacons and the position charted by UKHO and KIS-ORCA, the risk is considered to be broadly acceptable 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) Cable Marker beacons (AtoNs) at each landfall, marking cable presence	Cable external diameter only 127mm Navigable water depths not reduced by more than 5% Cable buried (as a minimum) from landfalls to MLWS where depth increases steeply	Minor injury to person minor damage to vessel	Remote	Low	Broadly Acceptable	NA	ALARP	NA	It is also noted that the vast majority of vessel movements are concentrated away from landfall in deeper water
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	

6 CONCLUSION

The Aultbea to Ullapool Cable Installation passes through a well trafficked and marked navigation channel, predominantly carrying vessels in and out of Ullapool Harbour. The slow-moving cable installation vessels, which will be limited in their ability to manoeuvre, crossing perpendicular to the channel represents an obvious hazard or potential impact to shipping in the area.

However, the operation is an appreciably minor activity given its very short expected duration in the busiest parts of the channel, providing considerable inherent safety. The approach taken by the development to deconflict the installation schedule with the peak vessel traffic and critically, the Calmac ferry schedule, represents the principal risk management measure to limit impact. Indeed, the MTS shows a 53% reduction in vessel traffic during night-time hours. In particular the passenger vessel category, which represents the majority of vessel traffic, is reduced by almost 67%. Therefore, this measure reduces the risk substantially. Ongoing awareness of the installation operation through the necessary involvement of Ullapool harbour and promulgation of the operation details to Calmac 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 surface activities are ALARP.

The cable will be surface laid up to Mean Low Water Spring (MLWS) at both landfalls. An exposed cable represents an obvious hazard to trawlers and anchoring. However, the cable itself will be laid within the jurisdiction of the harbour authority, well outside any designated anchoring areas, and in a Marine Protected Area (MPA). No demersal trawling activities are permitted in the vicinity of the cable, and there are no anchorages in the immediate vicinity of the installation corridor; this is reflected within the MTS (See Figure 4-7 and Figure 4-6). 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 at leach landfall point by cable marker beacons (Aids to Navigation) which will be inspected and maintained for the life of the cable. Industry guidance on avoidance of trawling within an MPA / in the vicinity of subsea cables is in place to further reduce the potential for interactions with fishing gear.

Given the inherent safety associated with the MPA and the Harbour Authority jurisdiction, and industry standard practice, the risks posed to navigation from the presence of the seabed cable are therefore all considered to be ALARP.