

HYDROGRAPHY IN REMOTE AREAS

Mapping the waters of Saint Helena as part of the British Overseas Territories Seabed Mapping Programme.

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Abstract:

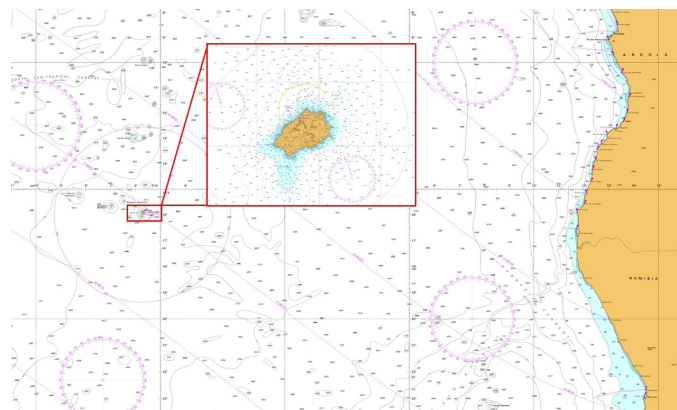
In 2018, a team of hydrographers from the United Kingdom Hydrographic Office (UKHO), supported by UK Government funding under the Overseas Territories Seabed Mapping Programme (OTSMP), undertook a bathymetric survey of the coastal waters of Saint Helena. The coastal waters of this environmentally sensitive island were substantially unsurveyed and there was a need to gather information to support Safety of Navigation along with future sustainable management and development of the island's ocean resources. This note discusses the requirements, challenges, results and wider utilisation of this geographically remote survey in the South Atlantic.

1. Introduction

In 2014, the International Maritime Organisation (IMO) introduced its Member State Audit Scheme (IMSAS). In announcing the timetable for audits, the United Kingdom and the Overseas Territories (OT's) by extension would be inspected in 2020. The Implementation of IMO Instruments Implementation Code (IIIC) Audit assesses the current level of implementation of IMO instruments by Member States in their capacity as Flag, Port and Coastal States.

The audit focuses on the 1974 Safety of Life at Sea (SOLAS) Chapter 5 Regulations 4 and 9, with specific reference to the Safety of Navigation. In UK waters, the Civil Hydrography Programme concentrates on safety of navigation surveys, but this does not extend to the Overseas Territories' (OT's). The UK Government Conflict, Security and Stability Fund (CSSF) provides funding to undertake hydrographic surveys in the OT's as part of the material preparations for the audit along with training in hydrographic governance.

One area identified with a pressing requirement for modern surveys was the island of Saint Helena, located 1,900km off the west coast of Africa in the South Atlantic.



*Figure 1 : Saint Helena - Overview of Location in South Atlantic
(BA Charts 4203 and 1771B © UKHO)*

2. Identifying Survey Requirements

Volcanic in origin, the island is fringed by perpendicular cliffs in all but a few places, with the only practical place for landings being in James Bay on the North-west side of the island. Until the recent opening of the airport, the island's only link with the outside world was by ship. Whilst the island is no longer frequented by vessels transiting around the Cape of Good Hope, over recent years visits to the island's new port by larger vessels, such as cruise liners and transiting yachts, have increased. This, along with a growing need to map the waters to assist with fisheries management and environmental monitoring, meant that modern surveys were a priority in assisting the island to meet its international SOLAS obligations.

3. Survey Planning

A number of surveys have been completed in recent years by both the Royal Navy and other UK government organisations, but the coverage was incomplete. The UKHO has developed a GIS based risk assessment tool enabling the assessment and prioritisation of the areas of highest risk to the mariner.

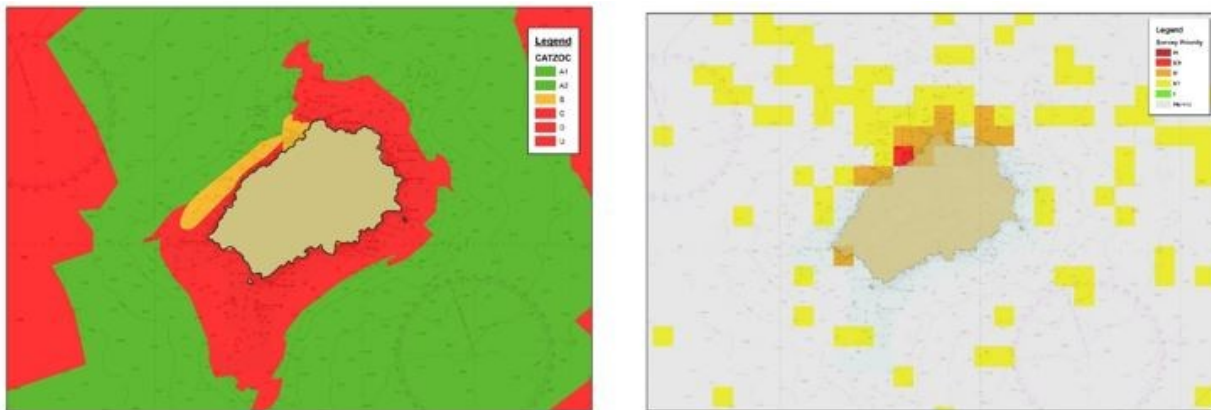


Figure 2 : UKHO CATZOC Analysis and Initial Survey Prioritisation

Left – Image shows CATZOC for area covered by BA Chart 1771B, Deep water areas have been surveyed substantially to modern standards (green) with the inshore areas (amber and red) not having systematic modern surveys.

Right – Image shows areas that are a priority for surveys based on CATZOC and AIS data. Highest priority is based around James and Rupert's Bay.

Analysis of the current data on the chart using the Category Zones of Confidence (CATZOC) revealed that the coastal waters less than 200m in depth were not surveyed to modern standards. When this was examined against AIS data showing typical transit routes to, from, and around the island, priority areas for survey were focused on the approaches to James Bay and the new port in Rupert's Bay, which lay just to the North.

The conduct of a bathymetric survey purely for safety of navigation in such a remote location may not necessarily meet all stakeholder requirements and nor fully capture wider issues impacting on the ability of the authorities to meet their maritime responsibilities. In May 2018, a technical visit was therefore undertaken to Saint Helena where meetings were held with the government and all maritime stakeholders to identify any local priorities which were not captured. What became clear during this visit was the need to ensure that any data collected was capable of being used by other UK government agencies engaged in programmes around the island (e.g. The Blue Belt Programme) and also for the data to form part of a comprehensive Spatial Data Infrastructure which was being developed by the island's GIS Office to assist in future development and coastal zone management. As a result of these meetings the following priorities were identified from key maritime stakeholders.

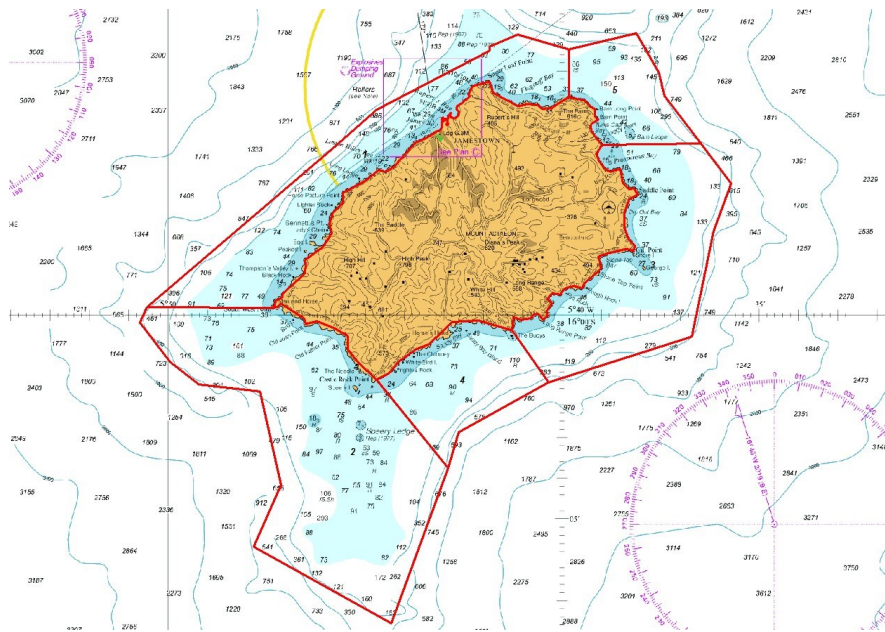


Figure 3 : Local stakeholder Priorities following technical visit.

Top Left – Land Survey and Mapping identified 3 areas, green being the highest priority and blue the lowest. **Bottom Left** – Search and Rescue identified two areas with a need to cover inshore areas on NW and E side of the island for Search and Rescue.

Top Right – Fisheries identified 3 areas driven by the need to identify new fishing grounds and potential protection of existing sites to maintain fish stocks. **Bottom Right** – Ports and Harbours main priority were areas in which increasing numbers of vessels are now visiting (cruise liners to yachts) and the areas typically used by vessels engaged in whale-watching activities. (Extract from BA Chart 1771B © UKHO)

Following a review of all requirements, a final block of prioritised survey areas was then designed based on the both UKHO’s and the local requirements with the highest priority being the north-west coast.

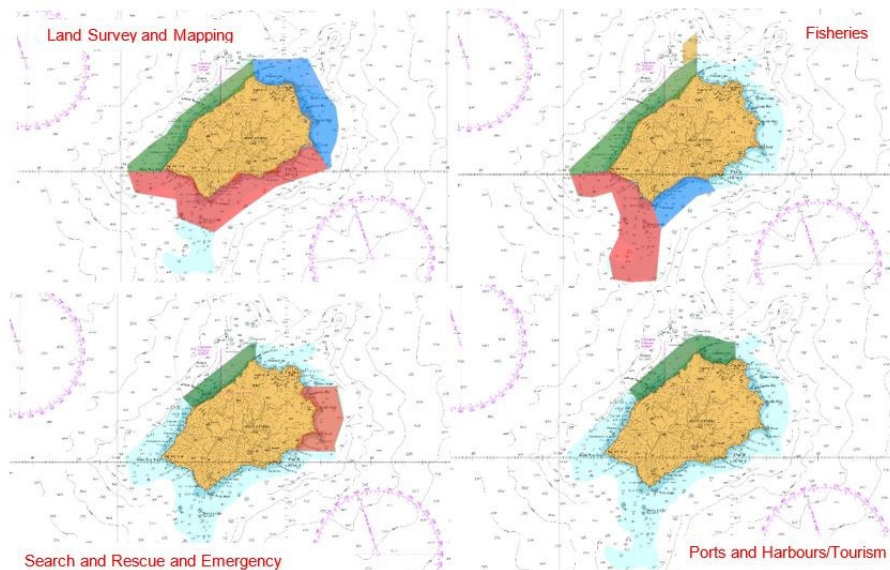


Figure 4 - Final Survey Requirements extract from BA Chart 1771B © UKHO

4. Conduct of Surveys

Having identified the areas that would benefit all marine stakeholders, the decision on how to undertake the survey was the next task. Geographically remote from the main areas of current survey activity, mobilising contractors to undertake the survey would be challenging and potentially expensive. With a number of major oil and gas and mineral exploration centres on the west coast of Africa, the decision was taken to issue an open tender for the survey work using UKHO's Acoustic Specifications for Surveys which provided amplifying information to S44 – IHO Standards for Hydrographic Surveys. Following review of the tender submissions, whilst all were technically compliant the cost of mobilising the vessel far outweighed the cost of the actual survey and was not delivering value for money. An alternative solution would need to be found.

Having already identified costs as a challenge, the alternate solution was to deploy a team from UKHO to undertake the survey. UKHO employs a number of qualified hydrographers, both in the Scientific Advisory Group, who undertake data validation, and within the Hydrographic Programmes team, who lead a number of data collection and capacity building activities. In recent years, this team of hydrographers have deployed on vessels of opportunity to undertake a number of surveys in the Caribbean and SW Pacific in support of UK Government funded programmes being led by UKHO.

In order to ensure the smooth running of the project, a reconnaissance was undertaken to establish any potential problems or risks for a team deployed so remotely and to also establish potential challenges with chartering vessels, import of equipment and how the local infrastructure could support a deployed team during survey operations.

The survey areas were defined prior to the survey reconnaissance to allow any last-minute changes to be incorporated into planning when liaising with local government officials. Critically, during the reconnaissance the opportunity was taken to check existing information held at UKHO for survey geodesy, particularly benchmarks for the tidal observations which were over 30 years old. Two existing radar tide gauges were operating but there have been reliability issues, so the decision was taken to establish an independent station to provide redundancy during operations.

5. Unique Challenges of Remote Area Surveys

A number of challenges are always present in any detached survey where there may be limited local resources or access problems, therefore proper planning based on reconnaissance is essential. Potential challenges include issues with permitting, authorisation for personnel to work, local support facilities, weather conditions, communications and most importantly support from manufacturers in the event of a defect.

- i. Accessibility - Saint Helena has one or two flights per week (dependent upon the time of year) and a single vessel visit (delivering containerised cargo) every 4 weeks and so preparation and shipping of equipment and flights to meet its arrival are critically important to avoid undue delays. Due to its location and the siting of the airport, flights are subject to last minute cancellation and the potential for this had to be factored in for scheduling and costing purposes.
- ii. Personnel – Sufficient personnel need to be available to operate the vessel during daylight hours and also process the data to ensure that any data gaps or poor-quality data is re surveyed at the time. At the outset, the need for a Survey Engineer to be on site for the entire duration of the survey was also identified as a key requirement which would mean any equipment faults or defects could be addressed immediately.
- iii. Vessels – During the technical assessment visit, several potential vessels were identified that could be chartered for operations. Deconflicting activities would be critical as these vessels are limited in number and used for multiple purposes already, for example: tenders for

visiting ships, support for local environment departments work, and other local activity. As equipment would need to be deployed over the side of the boat during survey operations it was important to ensure the chosen vessel could support this and have sufficient power onboard to operate all hardware. During the reconnaissance it became clear that facilities to manufacture a suitable mount locally in the short time frame of the survey were not available. As a result, detailed measurements were taken to allow the pole to be fabricated in the UK and shipped with all of the other equipment. This would speed up mobilisation once the equipment was on site.

iv. Equipment Requirements – All goods are imported by ship, as the aircraft supplying the island have limited cargo capacity due to fuel restrictions on the inbound flight to Saint Helena. As a result, all equipment for the survey would need to be shipped in several weeks in advance to allow for it to be unloaded and transported from the port to Jamestown where it would be cleared by Customs prior to the survey team arriving. In total, 7 pallets of equipment were sent, and the decision was made to duplicate all equipment to provide sufficient spares on site in the event of failures.

vi. Environmental Conditions – Lying in the tropics, weather conditions are generally stable, however significant sea and swell conditions can build up at any time of the year. Following local advice, the planned dates for survey were adjusted to conduct operations in what was expected to be the best conditions around the whole island.

vi. Environmental Protection – Saint Helena's entire Exclusive Economic Zone (EEZ) was declared a Marine Protected Area (MPA) in 2016 (St Helena's Marine Protected Area, 2016). Saint Helena's waters are feeding grounds for commercially important tuna species, sharks and billfish and provide seasonally important habitats for whale sharks and humpback whales. Survey operations represent a potential threat to whale sharks and cetaceans, therefore ensuring that appropriate permitting and deconfliction measures were in place was a key requirement identified by the Environmental Management Division.

vii. Communications – Saint Helena has internet access, but is limited to dial-up speeds and is relatively expensive to use. Identification of this constraint enabled the team to take all documentation and materials they may need to minimise requirements for large downloads.

6. Data Capture

Equipment was deployed and arrived in Jamestown in early November. After leaving the UK on Thursday 15th November, the UKHO survey team finally arrived in St Helena on Friday 23rd November to commence seabed mapping operations having been delayed by poor weather on St Helena (poor visibility and high winds), impacting on the safe operation of the new airport.



Survey operations commenced on the 26th November following the rapid mobilisation of the MV Enchanted Isle and completion of the shore-based observations. Due to the delay in arrival, survey operations for the first four days took place over 19 hrs a day to catch up the lost time which was made possible by the additional personnel deployed for the survey.

Figure 5 : Kongsberg 2040 mobilised to MV Enchanted Isle prior to lifting back in the water

Prevailing sea states focussed operations around the west side of the island until day 5 when it was possible to run a series of lines along the east coast. The survey areas had been designed with a number of areas to minimise downtime and allowed survey operations to continue during planning. Operations continued until the 10th December when a partial planned demobilisation took place to allow the vessel to be used for a previously arranged contract.

Following remobilisation, survey operations continued until the 14th December, with a total of 155km² of the planned 243km² area being surveyed. The difference in the areas surveyed was down to only operating into 4m of water, reaching the extinction depth of the sensor (>200m) and the unseasonably poor conditions experienced on the east side of the island.

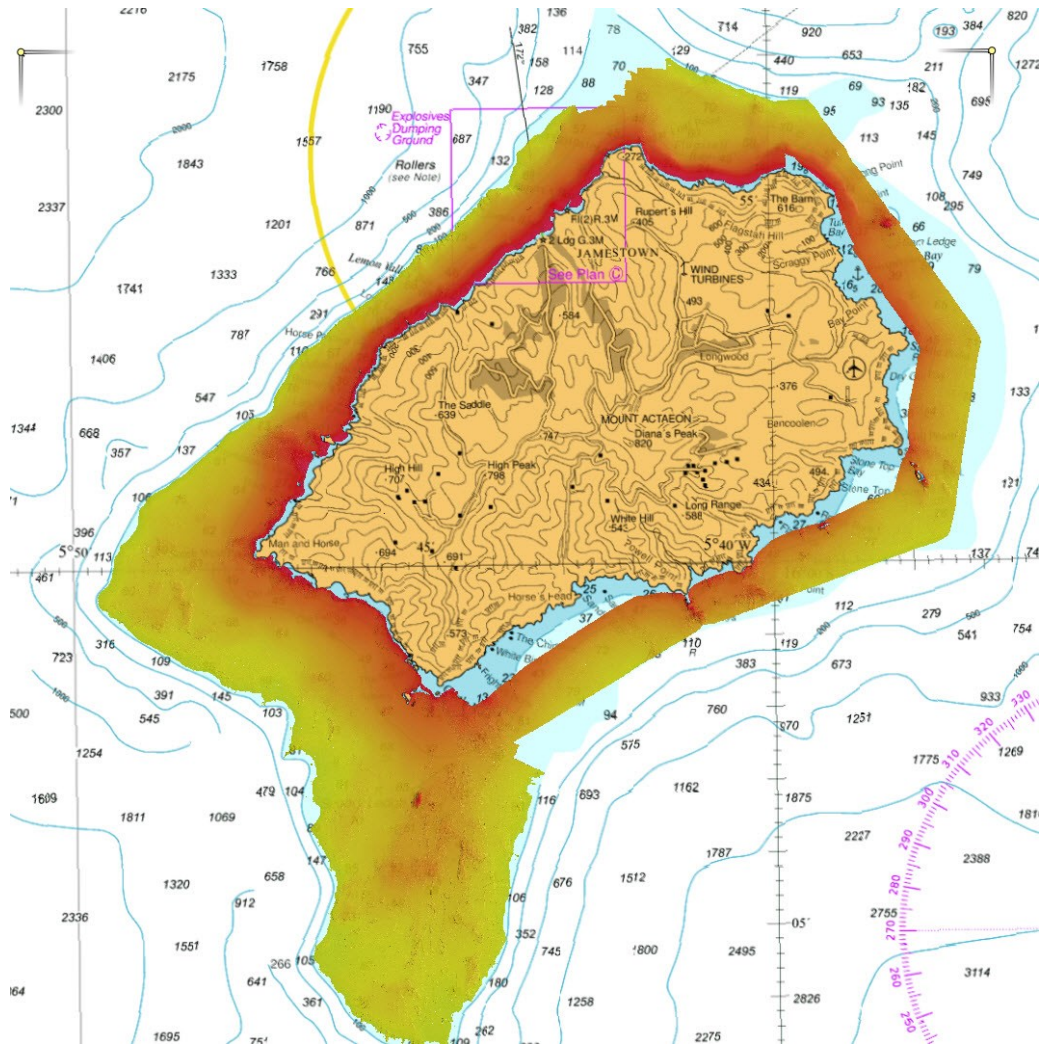


Figure 6 : Wreck of the Papanui, James Bay, Saint Helena

During the course of the survey, 8 hydrographic notes were raised covering uncharted wrecks and shoals. 7 existing wrecks and 6 new wrecks were located and investigated during the survey. A characterisation of the seabed was undertaken using the results of ROV dives and backscatter analysis, and 32 Conductivity, Temperature and Depth (CTD) observations were completed around the island.

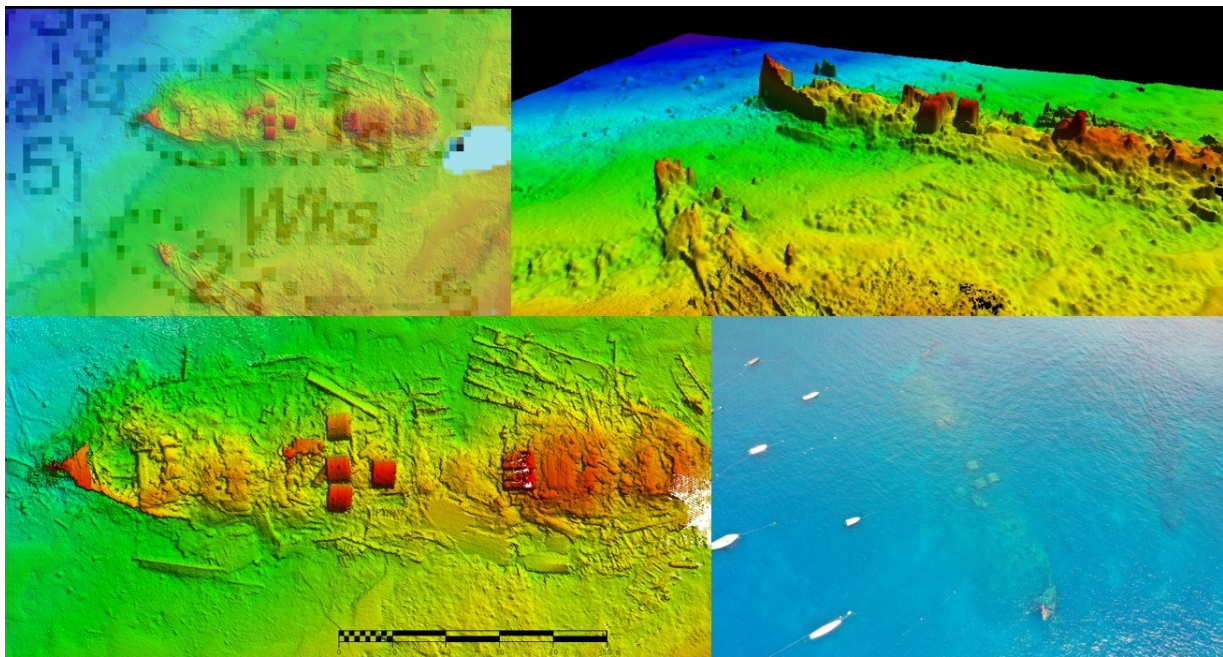


Figure 7 : Final Survey Coverage (BA Chart 1771B © UKHO)

A number of faults and failures of cables, tide gauges, and remotely operated vehicle occurred during the survey, but resulted in very little lost time and justified the additional equipment carried.

7. Utilisation of Data

New navigational products have already been produced and have resulted in much improved charting around the island, particularly around Speery Ledge. All of the data has also been provided to the government of Saint Helena for use in their Spatial Data Infrastructure. Initially this will be used in ongoing coastal zone management which will be used to sustainably manage sewage, pollution and sand extraction which are threats to the nearshore marine environment. This data will also be used by the Blue Belt programme to undertake habitat mapping to improve knowledge and sustainable management of currently exploited inshore fish species such as Grouper.

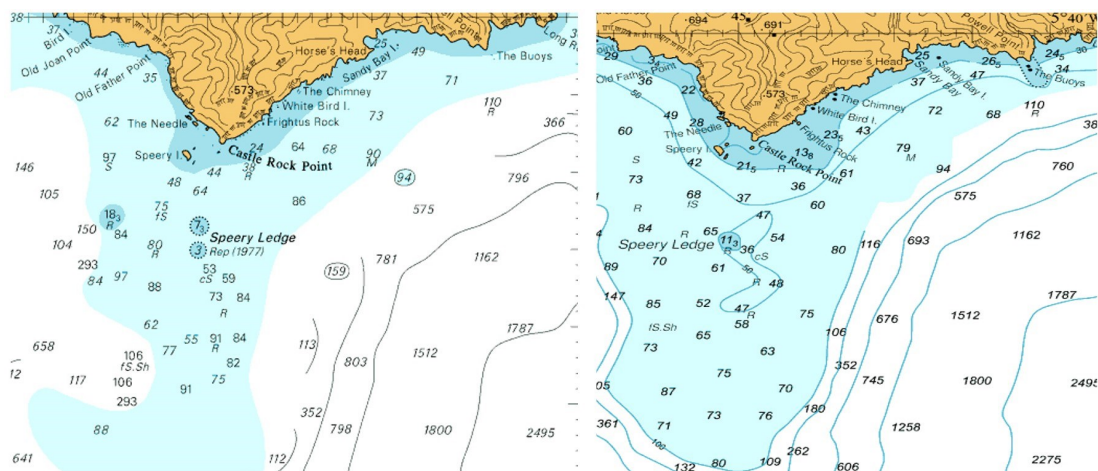


Figure 8 : Comparison of old and new standard nautical charts extract from BA Chart 1771B © UKHO

8. Conclusion

Comprehensive planning, risk management and data collection has delivered a high-resolution multi-use dataset in a remote area with minimal support. This project has not only enabled Saint Helena to meet its International Obligations under the United Nations Convention on Law of the Sea and the Safety of Life at Sea Convention, but will also enable the island to sustainably manage and develop its economy through tourism and exploitation of marine resources whilst also protecting the marine environment through increased knowledge of coastal resources and fisheries.