

Rothera Site Investigation
(Second season)
Initial Environmental Evaluation

BAS Environment Office
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**British
Antarctic Survey**

NATURAL ENVIRONMENT RESEARCH COUNCIL

Rothera Site Investigation Initial Environmental Evaluation

Contents

1	INTRODUCTION	5
1.1	Background to Project	5
1.2	Statutory Requirements.....	5
1.3	Purpose and Scope of Document	6
2	PROJECT DESCRIPTION	7
2.1	Rothera Wharf Investigation Works	7
2.1.1	Description of works	7
2.1.2	Location.....	7
2.1.3	Plant and equipment	8
2.1.4	Mobilisation	9
2.1.5	Personnel	9
2.1.6	Programme schedule, duration & intensity of activity.....	9
2.2	Rothera Runway Investigation Works	10
2.2.1	Description of works	10
2.2.2	Location.....	10
2.2.3	Programme schedule, duration & intensity of activity.....	10
2.3	Rothera Modernisation Investigation Works	10
2.3.1	Description of the works.....	10
2.3.2	Location.....	12
2.3.3	Plant and equipment	12
2.3.4	Mobilisation	12
2.3.5	Material testing.....	12
2.3.6	Personnel	12
2.3.7	Programme schedule, duration & intensity of activity.....	13
2.4	Relocation of the Aircraft Navigational Aids and GPS Equipment.....	16
2.4.1	Description of the works.....	17
2.4.2	Location.....	18
2.4.3	Personnel	18
2.4.4	Programme schedule, duration & intensity of activity.....	18
3	BASELINE CONDITIONS.....	21
4	ALTERNATIVES	21
4.1	Do nothing	21
4.2	Do the activity elsewhere	21
5	IMPACT IDENTIFICATION & MITIGATION	22
5.1	Importation of cargo	22
5.2	Relocation of personnel and associated luggage/cargo	23
5.3	Refuelling and use of machinery over ice free ground or water	23
5.4	Inspection of fuel tanks.....	23
5.5	Underwater rock removal.....	24
5.6	Trial hole excavation	25
5.7	Generation of dust.....	26

5.8	Generation of waste	26
5.9	Relocation of NDB, DME and DORIS	27
5.10	Transportation of personnel and cargo and operation of equipment	27
5.11	Cumulative Impacts	27
5.12	Impact Matrix.....	28
6	ENVIRONMENTAL TRAINING	31
7	CONCLUSIONS	31
8	AUTHORS OF THE IEE	31
9	ANNEX 1 - ENVIRONMENTAL BASELINE INFORMATION FOR ROTHERA POINT	32

1 INTRODUCTION

[1.1](#) Background to Project

The Natural Environment Research Council (NERC) have commissioned the construction of a new polar research vessel the RRS Sir David Attenborough (SDA), to replace the two existing British polar ships, the RRS Ernest Shackleton and the RRS James Clark Ross. Operated by the British Antarctic Survey (BAS), it is anticipated that the SDA will be ready for use in the 2019/20 season.

The SDA is a much larger research vessel than the current ships and this will have an impact on the requirements for marine infrastructure and cargo storage at all the BAS research stations in Antarctica and South Georgia.

At Rothera Research Station the SDA will require a robust wharf to be able to moor alongside. The mooring and berthing forces on the existing wharf from the SDA will be much higher than the existing ships and therefore the structural elements of the wharf will need to be more substantial. This means that the wharf has to be both upgraded and extended. To support the original site investigation works completed in March 2017 further works are proposed prior to the main construction works anticipated to commence in 2018.

As part of a larger project at Rothera namely the Antarctic Infrastructure Modernisation Programme (AIMP), site investigation works are also proposed at the southern end of the runway and around the existing station buildings. These preliminary activities will inform the overall design process for the wharf and the other infrastructure projects at Rothera. These projects will be subject to separate environmental impact assessments, which will be submitted in the near future.

BAS have contracted BAM to be the Construction Partner and undertake this site investigation work at Rothera.

[1.2](#) Statutory Requirements

To ensure the protection of the Antarctic environment, the Antarctic Treaty nations adopted the Protocol on Environmental Protection to the Antarctic Treaty in 1991 (hereafter referred to as the Environmental Protocol). The UK enforces the provisions of the Protocol through the 'Antarctic Act 1994 and Antarctic Act 2013' and 'Antarctic Regulations 1995/490 (as amended).

Annex I – Environmental Impact Assessment (EIA)

One of the guiding principles of the Environmental Protocol is that an EIA be carried out before any activity is allowed to proceed. It states that activities should be planned and conducted on the basis of *'information sufficient to allow prior assessments of, and informed judgements about, their possible impacts on the Antarctic environment'* (Article 3, Environmental Protocol).

Annex I of the Environmental Protocol sets out the detailed regulations for EIA in Antarctica, and establishes a three-stage procedure based on different levels of impact. The levels are:

- Preliminary Assessment;
- Initial Environmental Evaluation (IEE); and
- Comprehensive Environmental Evaluation (CEE).

An IEE is for activities that are likely to have a minor or transitory impact on the Antarctic environment. It is considered that an IEE is appropriate for the second season of Rothera Site Investigation works.

A best practice approach would have been to include both the first and second season site investigation works into one IEE. However due to a lack of design detail in the early stages of the project it was not possible to predict the work that was required over a two season period.

In the UK the IEE is subject to review by the Foreign and Commonwealth Office (FCO), which also makes the final decision on whether the activity should proceed.

Permits

The Environmental Protocol also states that certain activities within Antarctica require a Specialist Activity Permit before being undertaken. The activity relevant to the Rothera Site Investigation is "*mineral resource activities for scientific research*". The relevant permit application for this activity will be submitted to the FCO with this IEE.

1.3 Purpose and Scope of Document

The purpose of this IEE is to provide sufficient information on the Rothera Site Investigation for an informed judgement to be made by the FCO on the possible environmental impact of this activity on the Antarctic Environment and whether or not it should proceed.

The document has been split into the following sections:

- Section 2 provides a description of the projects;
- Section 3 provides a description of the current environment;
- Section 4 outlines the alternatives considered;
- Section 5 identifies the potential environmental impacts and mitigation measures; and
- Section 6 provides the conclusions of the IEE.

2 PROJECT DESCRIPTION

There are four separate aspects to the proposed works covered by this IEE. These are:

- Rothera Wharf Investigation Works
- Rothera Runway Investigation Works
- Rothera Modernisation Investigation Works
- Relocation of Aircraft Navigational Aids and GPS Equipment

2.1 Rothera Wharf Investigation Works

Work is currently underway to design a new wharf for Rothera Research Station, with construction due to begin in the 2018/19 season. The future proposed activities, which will be the subject of a separate EIA, involve demolishing the existing wharf and constructing a new larger wharf in the same location. The design details are yet to be finalised for the main project.

In order to advise the design process of the wharf, the following investigative works are proposed for the 2017/18 season:

- examination of the existing wharf structure, including excavation of trial holes into the existing stone fill; and
- trial removal of underwater rock obstructions.

2.1.1 Description of works

A visual examination of the tie rods in the existing wharf will be required, paying particular attention to the connections with the waler beams (these are steel beams used to transfer retained loads evenly between tie rod connection points). The results of this inspection will be critical in planning the demolition of the wharf in the following season. The inspection will also provide information on how the tie bars have fared after 25 years of being subjected to salt water conditions. This information will aid the detailed design of the new wharf.

In order to survey the tie rods, three trial holes will be excavated into the fill of the existing wharf. These will be excavated using a 49 tonne excavator (or similar machinery yet to be purchased). The trial holes will be excavated to a maximum depth of 3 m. A maximum volume of 500 m³ will be excavated.

To obtain the required under keel clearance for the SDA at the new wharf it will be necessary, during the main construction phase (outwith this IEE) to undertake some rock removal of the sea bed. Using a 49 tonne excavator with a hydraulic breaker attachment a section of the rock along the line of the new wharf will be broken out to provide information on the suitability of an excavator and breaker in performance of this operation. Less than 20 m³ of rock will be broken out during this operational trial.

2.1.2 Location

It is proposed that trial holes will be excavated into the surface of the existing wharf (see Figure 1). In addition the test of underwater rock breaking will be carried out in shallow water a few metres from the shore (at the extent of the excavator arm).

The rock will not be removed from site. The specific locations will include the area in front of the existing wharf, within Honey Bucket Cove and at the southern end of the runway. The location of the work areas are a minimum of 150 m from any skua breeding sites or beaches where penguins and seals congregate. The proposed works are a minimum of 120 m from either the Bonner or Gerritz Laboratories.

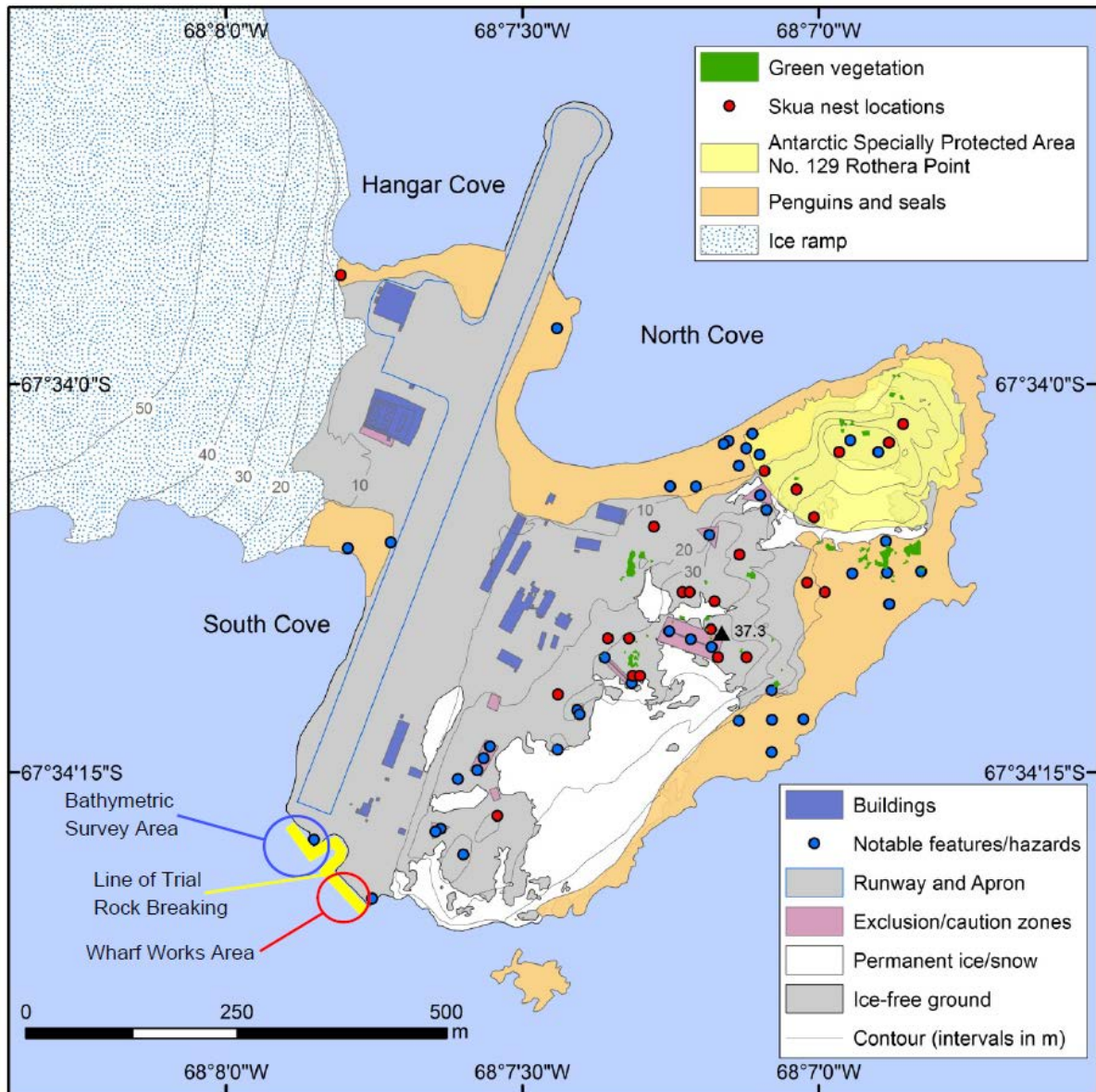


Figure 1. Location Map.

2.1.3 Plant and equipment

The following plant and equipment will be required to carry out the works.

Plant Item	Usage	Duty (hours/day)	Fuel Consumption (litres/hour)	Noise Output (dB(A) at 10 m)
CAT345 49 Tonne Excavator	Trial holes and underwater breaking	8	31-45	76
Hydraulic Breaker	Underwater breaking	as above	N/A	93 combined with Excavator
Pressure Washer	Biosecurity Cleaning in FI, Damping Down Excavations (if required)	8 h/day for 1 day (FI) Occasional (Rothera)	0.33	53
Hoover	Biosecurity Cleaning in FI	8 h/day for 1 day (FI)		

[2.1.4](#) Mobilisation

The proposed plan is to mobilise the 49 tonne excavator and breaker to the South Atlantic gateway before transporting them to Rothera. At the time of writing it is proposed that this should be on HMS *Protector*. The shipping to the Falkland Islands is still being organised and several options are being considered. Shipping option include utilisation of RRS *James Clark Ross*, RSS *Sir Ernest Shackleton* or the FIRS line.

Prior to loading the equipment in the UK, biosecurity checks will be carried out to ensure that no seeds, propagules, insects, their eggs or any other biosecurity hazards are evident.

Members of the Rothera Wharf Investigation team (BAM personnel) will be flown to the Falkland Islands to carry out a final biosecurity check before the equipment is reloaded onto HMS *Protector* for transportation to Rothera Research Station.

It is envisaged that these members of the team will then accompany the equipment to Rothera aboard HMS *Protector*.

[2.1.5](#) Personnel

Five BAM personnel will be on site and carry out the works. These are the:

- Supervisor;
- Engineering Supervisor;
- Machine Operator; and
- Fitter/Plant Marshall
- Logistics Coordinator

The BAM Project Manager, Gerard Turk, is the direct point of contact between BAS and BAM and is the overall manager responsible for Health, Safety, Environment and Security (HSES), site activities, staff, administration, Quality Assurance and control.

The BAM Site Manager for the wharf and runway site investigation works will be Billy Thursfield, who will be responsible for the completion of the works and will be onsite throughout the proposed activity.

[2.1.6](#) Programme schedule, duration & intensity of activity

The works are due to commence in February 2018 and are expected to take no longer than 16 days. The team of five, listed above, will arrive at Rothera on the 6th February and depart by the 23rd February at the latest.

Working hours on site have been agreed as 07:30-18:30 Monday - Friday and 07:30-14:00 Saturday.

It is not anticipated that any work will be conducted during the hours of darkness and no outdoor lighting will be used.

See Figure 2 for an outline programme of the works.

[2.2](#) Rothera Runway Investigation Works

Future works to stabilise the runway are currently being investigated. To support this work an initial site investigation, involving a bathymetric survey of the seabed immediately south of the runway and to the north, is proposed in the 2017/18 season.

[2.2.1](#) Description of works

Multibeam bathymetry uses pulses of high frequency sound to determine the profile of the bottom of the seabed. The pulses are emitted from a survey vessel and the reflection of these pulses from the seabed are monitored. The time it takes to receive the reflected signal indicates the distance to the seabed.

It is proposed that the bathymetric survey will be carried out by either the HMS *Protector* Survey Motor Boat *James Caird IV* or the BAS ship, RRS *James Clark Ross*. The SMB *James Caird IV* is equipped with a Kongsberg EM3002 multibeam echo sounder. This equipment operates at a frequency of 300 kHz, which is well outside the communication frequency typically used by whales found in the locality (i.e. < 40 kHz). Alternatively, the survey may be undertaken by the RRS *James Clark Ross*.

Mitigation methods to reduce the risk of any impacts on local wildlife have been identified in Section 5.

[2.2.2](#) Location

Please see Figure 1 for the location of the proposed bathymetric survey at the southern end of the runway. The exact requirements for the bathymetry survey at the northern end of the runway have not yet been finalised.

[2.2.3](#) Programme schedule, duration & intensity of activity

The survey will be carried out by the crew of HMS *Protector* in January 2018. See Figure 2 for an outline programme of the works.

[2.3](#) Rothera Modernisation Investigation Works

In order to advise the design process for the modernisation of the Rothera Research Station the proposed site investigation works for the 2017/18 season will involve:

- digging ground investigation trial holes;
- an investigation of buried services; and
- a condition survey of the existing fuel tanks.

The investigation of buried services will also involve the excavation of trial holes, the lifting of covers on service troughs and the tracing of services from one location to another.

[2.3.1](#) Description of the works

In order to design the Rothera Modernisation works, the make-up of the ground overlying the bedrock needs to be understood in order to establish the most appropriate foundations for the new buildings. The investigation will require the mechanical excavation of a maximum of 20 trial holes using the research station's JS130 excavator. The trial holes will be dug to a maximum depth of 3 m, or until bedrock is reached.

Photographs of the excavations will be taken and the nature of the ground logged by either the Rothera Modernisation Project Lead, David Phethean, or the Environmental Lead, Neil Goulding.

Samples (c. 25 kg) will be collected from each trial hole and sent to the Bonner Laboratory (located at Rothera Research Station) for pH and particle size distribution testing. BAS staff will undertake this initial testing.

A further c. 4 kg rock sample will be sent to the BAM Nuttall Laboratory in Kilsyth, Scotland, for sulphate testing. The address of the laboratory is: BAM Nuttall Ltd, Glasgow Road, Kilsyth, Glasgow, G65 9BL. BAM have agreed that the sampling results will only be provided to BAS for the purposes of the Rothera Modernisation project and that no additional testing outside the agreed scope will take place. Once the tests are complete the samples will be disposed of at a landfill site and a waste transfer note will be issued and a copy sent to the BAS Environment Office.

Investigations into the fabric and the construction methodologies of the existing buildings that are to be demolished will also be required. This may involve exposing hidden elements of the building, such as insulation and connection details. Internal cladding may need to be temporarily removed, or small holes drilled into the internal cladding, in order to expose these elements. Use of an endoscope to visualise internal structures may be required if elements cannot be suitably exposed. All investigative works will be made good upon completion of the survey.

The buildings requiring investigation include the following:

- Fuchs House
- Old Bransfield House
- Old Bransfield House South Extension
- Old Bransfield House Phase IV Extension
- Ops Tower
- RO Building
- Garage
- Garage Extension
- Hangar
- Boat Shed
- Wet Well (RO Intake)
- Generator Shed
- Workshops Offices and Stores
- Aircraft Fuel Store
- Pump House
- Giants House
- Boiler Room / RO Plant Room
- Tech Service Office
- Sauna
- Lubrication Oil Store
- Carpenter and Electrical Workshop
- Timber Store
- Electrical Store
- Battery Store
- Power Gen Building
- Tech Service Store
- Paint Store
- Miracle Span

- Stores
- Incinerator

Further investigations are required to ascertain the condition of the fuel storage tanks that are located at the Rothera fuel farm. A visual survey will be carried out to detect any signs of corrosion of the tanks and the thickness of the steel will be measured using ultrasound. As the tanks are positioned on the ground, and there is no access to the underside, it will be necessary for the inspectors to enter the tanks in order to determine the thickness of the base using ultrasound. In order for this work to be conducted the tanks will be emptied and vented prior to access. This process of draining the fuel tanks will be undertaken by the BAS Facilities team. This activity occurs annually as part of the maintenance programme for the fuel tanks. The procedures set out in the *Rothera Fuel Storage and Distribution Facility Operation and Maintenance Manual* will be followed

[2.3.2](#) Location

The specific location of the trial holes will be confirmed by the BAM team on arrival at Rothera. The general areas where the trial holes will be dug are indicated by red circles on Figure 3. The plan shows the existing buildings at Rothera Research Station, the buildings proposed to be demolished and the proposed new buildings.

[2.3.3](#) Plant and equipment

The plant and equipment listed in the table (below) will be required to carry out the works.

Plant Item	Usage	Duty (hours/day)	Fuel Consumption (litres/hour)	Noise Output (dB(A) at 10m)
JS130 13 tonne excavator	Trial holes	8	13-17	69
Cordless Drill				
Endoscope				

[2.3.4](#) Mobilisation

The excavator required for the works is already in use at Rothera, and its operator will be provided by BAS. The BAM personnel, along with the endoscope and cordless drill, will be transported to Rothera by the BAS Dash 7 aircraft from Punta Arenas.

[2.3.5](#) Material testing

Samples weighing C. 25 kg will be taken from each trial hole excavated. A small quantity of this sample will be used to test the pH of the ground. This work will be carried out in the Bonner laboratory. A 200g sample from each trial hole will be returned to the BAM Ritchies laboratory in Kilsyth in the UK (maximum amount of 4 kg), where further testing will be used to determine the sulphate content and the particle size distribution.

[2.3.6](#) Personnel

Three BAM staff will be required to carry out the works. These will include the following roles:

- Engineering Supervisor
- Engineering Assistant

- M&E Designer

An excavator operator will be provided by the BAS team onsite.

The BAM Superintendent for the modernisation site investigation works will be David Phethean. He will be responsible for the completion of the works and will be onsite throughout the proposed activity.

The Superintendent will liaise, on a daily basis, with the Station Leader to coordinate the works with other station activities and be in control of the BAM work force for the wharf, runway and modernisation activities. He will ensure that the appropriate tool box talks (site induction talks) are undertaken and will prepare a daily report on the works completed on site. The Superintendent will act as the HSES Manager during the works and will assist the construction team with the relevant health, safety and environmental requirements.

The fuel tanks inspections will be carried out by a Liam Doris of SWECO and Jason Caldwell of SGS. During the site visit they will work under the direction of the BAS Estates team specifically the Rothera Facilities Engineer.

[2.3.7](#) Programme schedule, duration & intensity of activity

The trial hole works and building investigations are due to commence in February 2018 and are expected to take no longer than a maximum of 14 days. The team of four, listed above, will arrive at Rothera on the 6th February 2018 and depart by the 23rd February 2018 at the latest. Working hours on site have been agreed as 07:30-18:30 Monday - Friday and 07:30-14:00 Saturday.

See Figure 2 for an outline programme of the works.

The fuel tank inspection works will be undertaken between the 4th November 2017 and the 5th December 2017 prior to the main Rothera station refuelling activity.

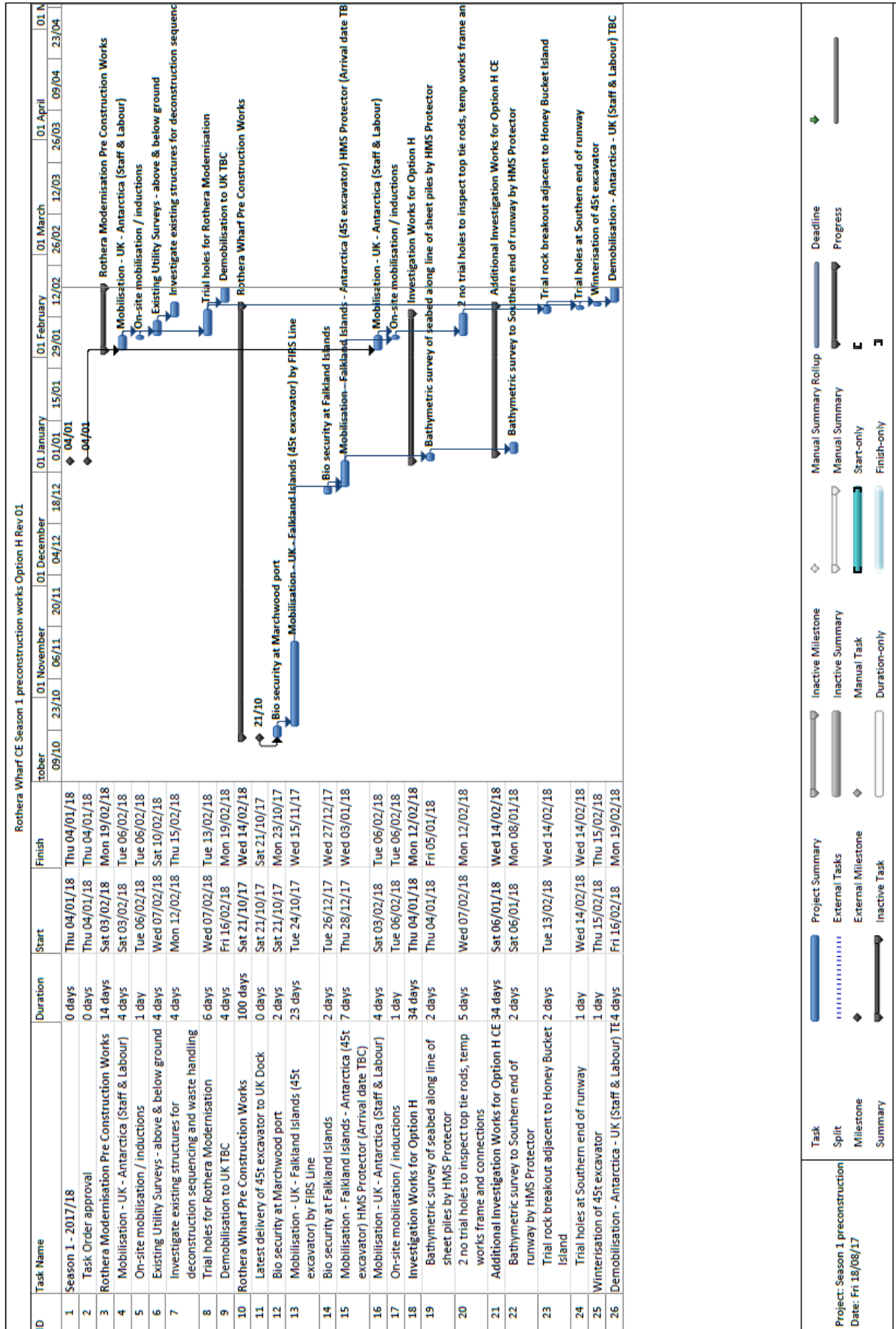


Figure 2. Outline Programme of Works

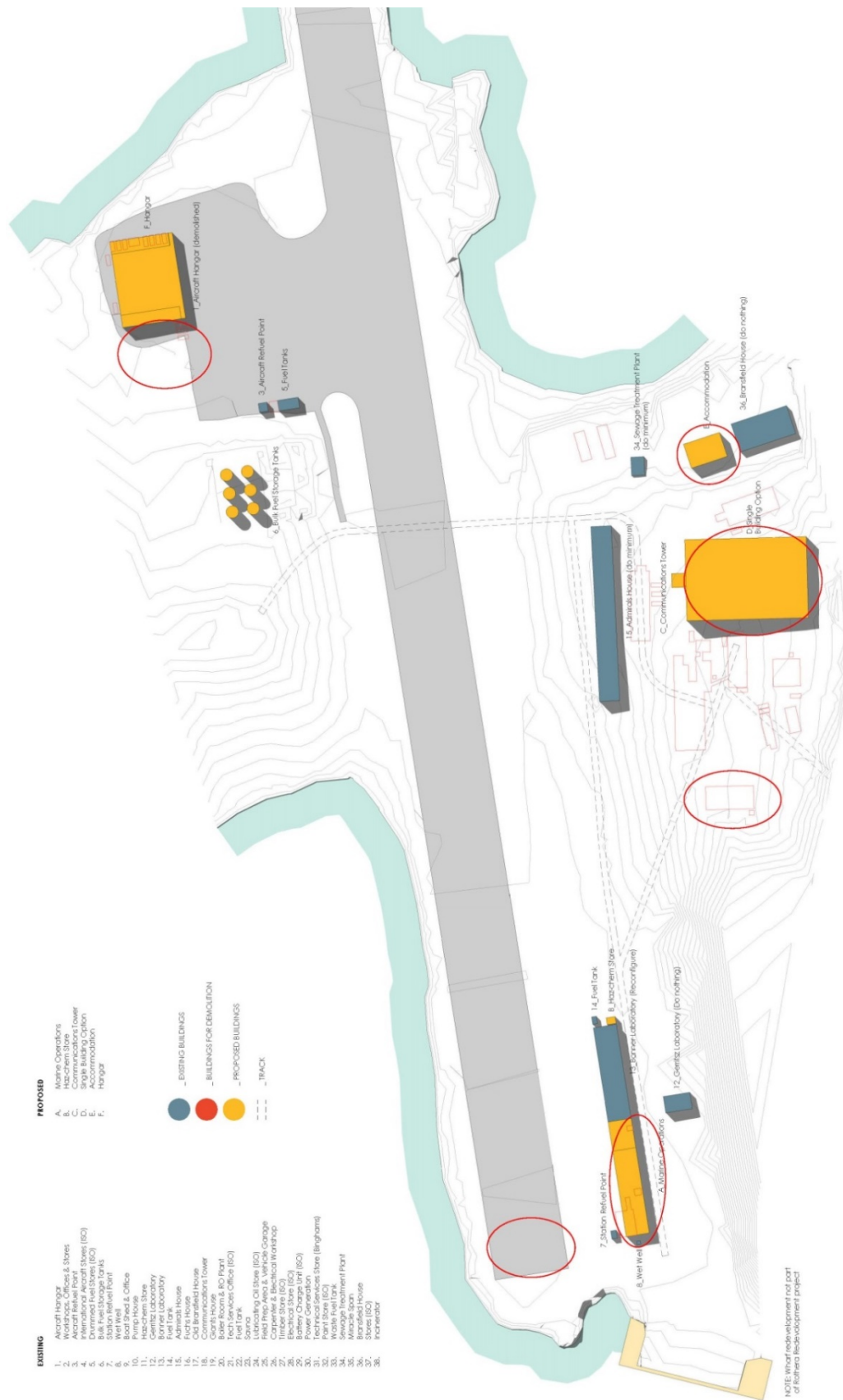
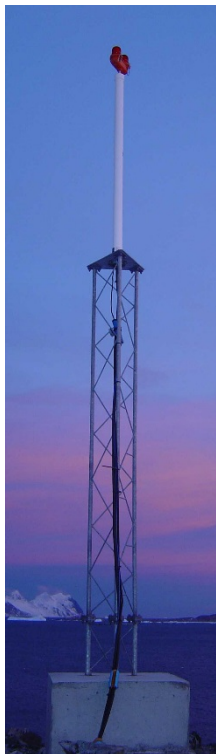


Figure 3 Rothera Modernisation Site Plan

2.4 Relocation of the Aircraft Navigational Aids and GPS Equipment

In anticipation of rock removal associated with the future proposed wharf construction, there is a requirement to relocate a number of aircraft navigational aids and some GPS equipment. These include:

- Distance Measurement Equipment (DME)
- Non Directional Beacon (NDB)
- Doppler Orbitography & Radiopositioning Integrated by Satellite unit (DORIS)



The DME is a radio navigation aid that provides safety critical information to the aircraft when coming in to land regarding the distance between the aircraft and the ground station. The DME is at the end of its effective life and is due for replacement. The unit comprises a concrete plinth on top of which sits a galvanised steel frame supporting the DME antenna, which is comprised of electrical cabling and protective plastic cover. The total height of the unit is 1.98 metres.

Figure 4. DME Antenna

The NDB is also a radio navigation aid, but is used to provide directional information to the aircraft. The NDB comprises a single steel frame mast at a height of 15 m, which is mounted on a concrete plinth, that is supported by three guy anchor points, which are also mounted on concrete plinths. The overall footprint of the NDB, including the anchor points, is 144m².



Figure 5. NDB base and ground plane and NDB Antenna

DORIS is a ground-based radio beacon that, in conjunction with other units located around the globe, provides satellites with their position relative to the Earth. It is comprised of a small radio antenna mounted on a concrete plinth.



Figure 6. DORIS

[2.4.1](#) Description of the works

Each of the three units will need to be relocated, which will involve the construction of new concrete plinths to provide secure foundations for the antennas. The dimensions of the plinths are detailed below.

- DME - one concrete plinth (H 1.4 m x W 0.9 m x D 0.9 m = 1.13 m³)
- NDB - either four concrete plinths; one for the mast section (H 0.5 m x W 0.9 m x D 0.9 m = 0.4 m³); and three for the guy anchor points (H 0.35 m x W 0.8 m x D 0.8 m = 0.22 m³).
- DORIS - one concrete plinth (H 1.55 m x W 0.4 m x D 0.4 m = 0.25 m³)

The intention is to construct the new plinths directly onto the exposed rock. At each location, wooden shuttering will be constructed to contain the wet concrete and a steel rebar framework placed inside to provide additional strength to the structure. The concrete will be mixed on site at Rothera in the area adjacent to the sewage treatment plant (STP), where stockpiles of sand and gravel are currently located. Good practice techniques to ensure that cement dust does not blow around the site will be followed. These include:

- restricting the mixing of concrete to calm days with little or no wind;
- minimising the handling of open cement bags through good planning and housekeeping during construction;
- containing partially used or damaged bags of concrete in order to minimise the risk of accidental spills; and
- transporting only wet concrete mixes to plinth locations.

The concrete will be poured into a hopper and transported by JCB to the relevant location. The concrete will be poured directly into the shuttered area. Once each plinth has set the shuttering will be removed and, where possible, reused. Once installed in the new locations, the cabling and supporting equipment from the DME antenna will be stored in an existing Bentham container. The

Optical Hut will house the cabling from the DORIS GPS and the calibrated tool container (located in the NW corner of the hangar) will house the cabling from the NDB antenna.

All mast work and guys will be carried out in accordance with the "*Rothera & Rock Founded Installations Mast Manual*". It has not yet been decided whether the original plinths will be demolished and removed or whether there may be use for them in the future. If demolished the concrete will be either used as construction fill or be removed from site in line with the procedures outlined in the BAS Waste Management Handbook.

[2.4.2](#) Location

All three units are currently sited on rock outcrops to the north east of the wharf. It is proposed that each unit will be relocated to a new location within the existing footprint of the Rothera station area. The current and proposed new locations are shown in Figure 7.

The NDB is proposed to be relocated to an area behind the Hangar. There are records which confirm that this area has been used as a skua nesting site but not in recent years. There is also a record of a skua nests in the vicinity of the proposed locations for the DORIS and the DME, again this has not been used in recent years.

[2.4.3](#) Personnel

The BAS Facilities team will undertake the concreting works during the 2017/2018 summer season under the supervision of Tim Jackson, the BAS Rothera Facilities Manager. The Rothera carpenter will manufacture and install the wooden shuttering and two other Facilities staff will construct the plinths for all three units. The physical relocation of the DME and NDB antenna and associated cabling will be completed by a specialist engineer. The masts will be relocated by two RAF mast erectors. The re-commissioning will be undertaken by a BAS-led team.

The DORIS will be relocated by Jerome Saunier, a specialist engineer from the Institut Géographique National (IGN). IGN is the organisation that coordinates the GPS network to which the DORIS is affiliated.

[2.4.4](#) Programme schedule, duration & intensity of activity

The programme for the relocation of the DME, NDB and DORIS will commence in mid-December 2017 and is anticipated to be complete by the end of January 2018. Whilst the actual construction and relocation work involved will only take approximately 18 days, a period of 30 days is needed for the concrete plinths to cure. Working hours on site will be the normal hours of 07:30 -17:30 Monday - Friday and 08:30 -14:00 on Saturday. See Figure 8 for a programme of works.

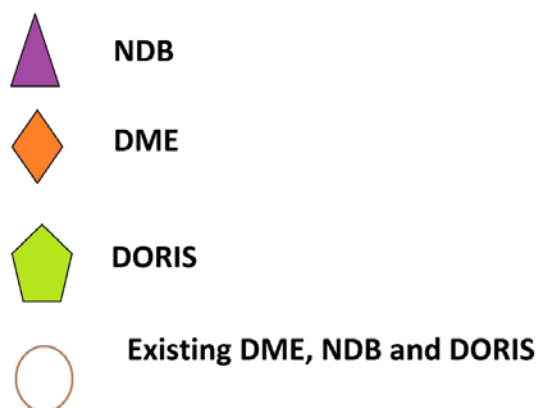
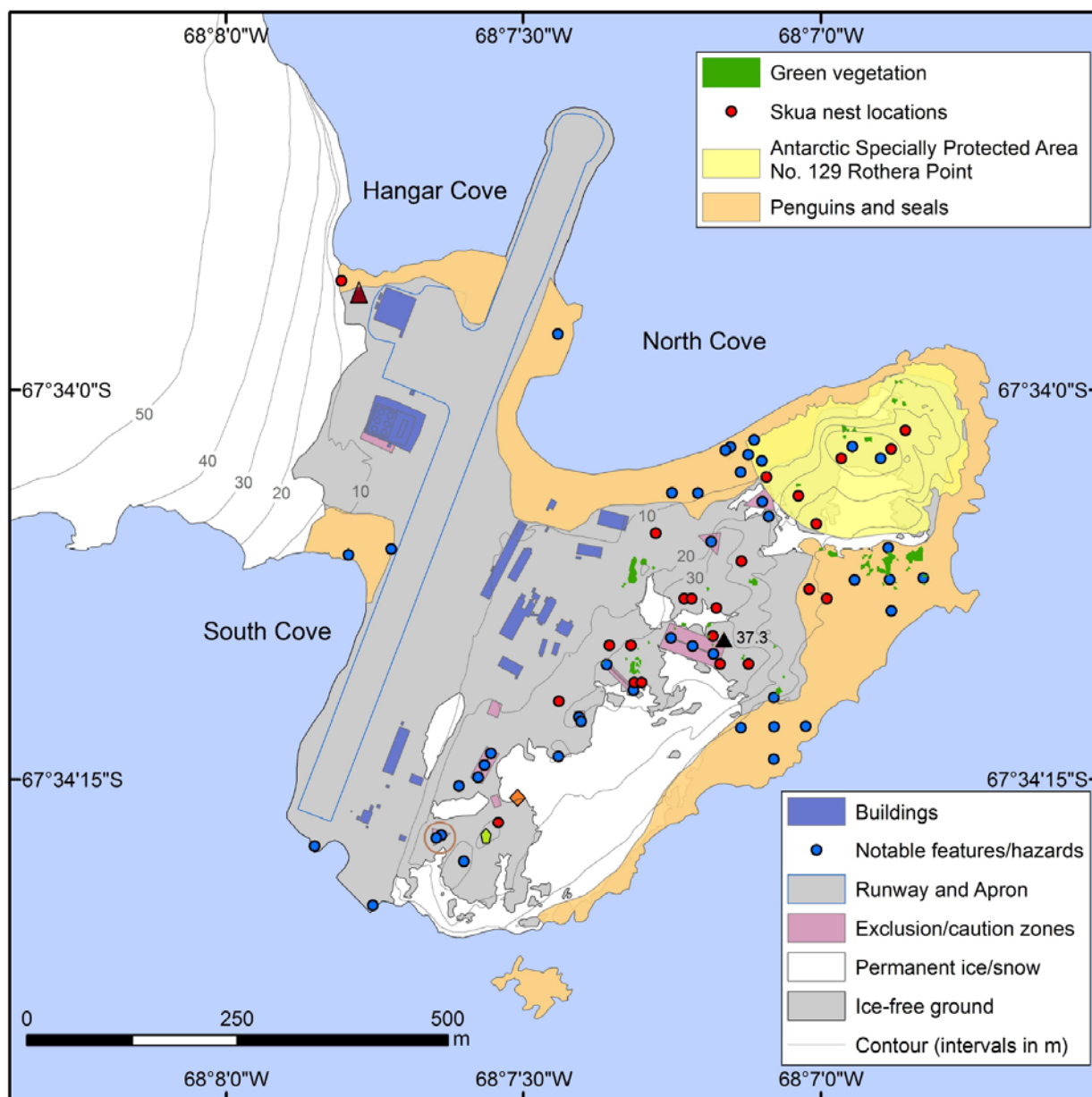


Figure 7. Location of existing and proposed DME, NDB and DORIS

3 BASELINE CONDITIONS

A baseline report for the current environmental conditions at Rothera Point has been included in Annex 1 - Environmental Baseline Information for Rothera Point, Adelaide Island, Antarctica.

4 ALTERNATIVES

4.1 Do nothing

The proposed Rothera site investigation works and the relocation of the aircraft navigational aids and GPS equipment are all preliminary activities required for the Rothera Wharf and Rothera Modernisation projects. These infrastructure development projects will be subject to a separate Environmental Impact Assessment.

The 'do nothing' alternative has been considered and rejected on the grounds that there are significant benefits gained from carrying out these works at this stage. These benefits include informing BAM of the existing ground and bathymetric conditions, which will assist in identifying the most appropriate construction methods for the Rothera Wharf and Rothera Modernisation. In addition, the completion of the site investigation this season could help to avoid unnecessary works in the future that may have a negative environmental impact.

Relocating sensitive navigational equipment is essential to ensure the safe operation of aircraft during future construction periods.

4.2 Do the activity elsewhere

The locations for the proposed activities have been chosen specifically to inform BAM of the local ground and building conditions that may impact design requirements or construction methodologies.

Conducting the proposed site investigation works elsewhere would not provide the relevant information required and, as such, has been rejected as an option.

The locations that have been proposed for the relocation of the Aircraft Navigational Aids & GPS Equipment have been discussed with relevant experts. This was undertaken in order to ascertain the operational requirements and to ensure optimal use once relocated. The three proposed locations are considered to be the most suitable, but other sites could be proposed if there were any environmental constraints identified.

5 IMPACT IDENTIFICATION & MITIGATION

The environmental impacts associated with the Rothera wharf, runway and modernisation site investigations and the relocation of navigational equipment have been identified in this section. Mitigation measures to minimise or avoid these impacts have been suggested beneath each impact.

Table 1. provides a summary of those impacts and provides a qualitative measure of the probability of the impact occurring and the severity of the impact if it were to occur.

All personnel will receive an environmental briefing from a member of the BAS Environment Office prior to departure from the UK. On arrival at Rothera Research Station, the Station Leader will outline waste management procedures on site, energy and water usage, wildlife watching procedures and local biosecurity requirements.

5.1 Importation of cargo

Potential Impact: Non-native species may be imported unintentionally to Rothera Research Station and the local vicinity in association with transported equipment and general cargo. Introduced species may become established in ice-free areas with negative impacts upon local ecosystem structure and function and associated scientific research.

Mitigation: All equipment and materials required for the proposed activity will be thoroughly cleaned before dispatch to Antarctica, in accordance with the BAS Biosecurity Handbook.

This includes all the following items of equipment:

- CAT345 49 tonne excavator
- Hydraulic Breaker
- Pressure Washer
- Small hand tools and equipment to be used in the building survey work

BAM will identify a suitable Manager to inspect all plant, equipment, materials and personal belongings prior to loading onto the vessel and on disembarkation/offloading at Rothera. This will include the following checks:

- All re-usable containers have been thoroughly cleaned and lined with plastic sheeting.
- No polystyrene or organic packaging material including hay straw or wood shavings has been used.
- All wood packaging is new and has complied with ISPM 15.
- No corrugated cardboard packaging material has been used.
- Openings in structural members have been sealed.
- Containers have been cleaned and fumigated.

All personnel being deployed to Rothera will have received a pre-deployment briefing from a member of the BAS Environment Office, which will cover biosecurity, waste management, oil spill response and wildlife interactions.

Should soil, seeds or propagules be imported accidentally, they must be carefully collected and removed. Rodents must be exterminated immediately. Disposal may include incineration at Rothera or removal from Antarctica. The Rothera Station Leader should be informed immediately and the

incident reported to the BAS Environment Office.

[5.2](#) Relocation of personnel and associated luggage/cargo

Potential Impact: Impacts upon Antarctic ecosystems as described above.

Mitigation: All personnel being deployed to Rothera will have read, and must comply with, the BAS Biosecurity Handbook before departing their home country. All personal items of clothing and cargo should be thoroughly cleaned and checked for soils, plants, propagules or insects.

[5.3](#) Refuelling and use of machinery over ice free ground or water

Potential Impact: Minor spills and fuel leaks could occur during refuelling of the excavators, leading to contamination of the local area. A range of activities, from a minor fuel leak from hoses through to or catastrophic failure of the fuel tank, could result in contamination of the terrestrial or marine environments.

Mitigation:

- Spill kits containing floating booms and floating oil absorbent pads will be kept with both excavators throughout the works.
- All plant will be well maintained and inspected daily ensuring good fuel economy and reducing the risk of oil and hydraulic leaks. Daily plant inspections will be recorded on BAM Nuttall form PC04
- The Rothera Oil Spill Contingency Plan (OSCP) is to be followed in the event of a spill.
- All refuelling will be carried out by trained BAS personnel in accordance with the station's refuelling procedures. This has been coordinated and confirmed with Rothera Station Management.
- The equipment to be used on site only requires the use of small quantities of fuel.
- All BAM staff will have received training on emergency spill procedures.
- All spills will be reported to the Station Leader at the time of occurrence.
- As described in the Rothera OSCP, Tier 1 spills will be dealt with by BAM staff.
- Tier 2 or 3 spills will be coordinated by Rothera Station Leader
- Any spills over water will be considered as Tier 2 spills and will be reported to the Rothera Station Leader immediately.
- BAM staff will assist with any spill response under the co-ordination of the Rothera Station Leader.
- All spills are to be reported to the BAS Environment Office.

[5.4](#) Inspection of fuel tanks

Potential Impact: Risk of fuel spill during the drain down process prior to inspection.

Mitigation:

- The activity will be undertaken by the BAS Estates Team as part of the three yearly maintenance programme. This activity occurs on an annual basis as a number of tanks are inspected each year.
- The tank cleaning procedures outlined in the Rothera "*Fuel Storage and Distribution Facility Operation and Maintenance Manual*" will be followed at all times.

- In the event of a spill the Rothera Oil Spill Contingency Plan will be followed.
- Spill response equipment will be located at the fuel tanks throughout the maintenance works.

5.5 Underwater rock removal

(i) Potential Impact: Noise impacts may cause disturbance, avoidance behaviour or hearing damage to marine mammals.

In practice it is difficult to assess the risk of injury on animals as a result of underwater noise. There has been little research conducted on specific impacts to Antarctic marine animals.

In order to predict the effects of underwater noise from rock breaking at Rothera, BAM have used the dBSea Underwater Acoustic Modelling Software. Whilst this software provides data for several regularly used underwater noise sources, there is no data available for the exact scenario of breaking rock underwater with a hydraulic breaker, as proposed at Rothera. Therefore, a number of assumptions have been made using BS5228, the British Standard code of practice for noise and vibration control on construction and open sites. Subsequently, the preliminary noise predictions are based on similar equipment for which noise data do exist. Further verification of the modelling results is currently being sought from an expert third party.

The dBSea software modelled the noise generated by the hydraulic breaker at the wharf, Honey Bucket Cove, and the southern end of the runway, which comprise the three locations proposed for rock breaking. The model utilises the National Oceanic and Atmospheric Administration (NOAA) sound levels for temporary threshold shift (TTS) for cetaceans at 179 dB re 1 μ Pa (a Temporary Threshold shift (TTS) is an upward shift in the threshold of hearing usually caused by being subjected to a loud sound. When the noise abates, the hearing returns to normal.)

Using the TTS level for cetaceans, the dBSea model is able to provide a recommended exclusion zone around the noise source. Taking a precautionary approach, it is suggested that a 1000 m exclusion zone for cetaceans is appropriate for the underwater rock removal at Rothera. Once the third party information has been received the suggested exclusion zone will be reviewed.

Mitigation: Assuming the initial assessment is correct the following mitigation will be followed:

- As identified by the dBSea model a 1000 m exclusion zone has been recommended by BAM as an appropriate area that needs to be clear of cetaceans during the rock breaking activity.
- BAM are committed to following the best practice guidance sourced from The Irish Whale and Dolphin Group. This includes:
 - Marine Mammal Observers (MMO) will survey the area for presence of cetaceans 30 minutes before the onset of the soft start. At least one observer will be positioned on high ground to ensure good visual coverage of the exclusion zone. Key landmarks will be identified to help demarcate the 1000 m boundary and binoculars will be used.
 - If cetaceans are sighted within the 1000 m area works cannot commence.
 - Soft starts of machinery will follow JNCC guidelines with maximum sound output being achieved 20 minutes after soft start has commenced in waters less than 200 m depth.
 - Once the sound source has achieved maximum output, the activity need not be halted should cetaceans approach the noise source.
- BAM have committed to deploying at least two trained MMOs to undertake the observations.

(ii) Potential Impact: Potential noise impact experienced on land as a result of underwater rock removal activities.

There are no sensitive environmental noise receptors within the area that the rock breaking will occur. The nearest human receptors are located within the Bonner Laboratory, which is approximately 120 m from the wharf.

The Rothera Wharf investigation works will use a single 49 tonne excavator with a hydraulic breaker attachment and no other mechanical plant. BS5228 gives the following sound pressures for similar plant.

Equipment	Sound Pressure Level (dB(A) at 10 m re. 20 µPa)	Reference
40 Tonne Excavator Ground excavation/earthworks	79	BS5228 Table C.2
29 Tonne Excavator with Hydraulic Breaker Breaking boulders/oversized material	93	BS5228 Table C.9

Whilst these figures do not refer to the exact size of machine to be used in Rothera, they do refer to the works that will be undertaken e.g. breaking rock, making these figures more applicable than manufacturers' noise emissions data.

Over the 120 metres between the wharf and the Bonner Laboratory, BAM have predicted that the noise will attenuate by 22 dB and therefore the sound pressure at the Bonner Laboratory as a result of the excavator at the wharf would be 56 dB(A).

BS5228 the code of practice for noise and vibration control on construction and open sites states "Noise from construction and demolition sites should not exceed the level at which conversation in the nearest building would be difficult with the windows shut. Noise levels, between 07.00 and 19.00 hours, outside the nearest window of the occupied room closest to the site boundary should not exceed:

- 70 decibels (dBA) in rural, suburban and urban areas away from main road traffic and industrial noise;
- 75 decibels (dBA) in urban areas near main roads in heavy industrial areas.

The noise produced as a result of the excavator at the wharf is well below these limits and therefore no mitigation is considered to be required.

[5.6](#) Trial hole excavation

(i) Potential Impact: Terrestrial Noise

The Rothera Modernisation investigation works will use a single 13 tonne excavator and no other mechanical plant. BS5228 gives the following sound pressures for similar plant.

Equipment	Sound Pressure Level (dB(A) at 10m re. 20µPa)	Reference
14 Tonne Excavator Ground excavation/earthworks	69	BS5228 Table C.2

The trial holes are required in various locations around the site with some being adjacent to existing buildings.

BS5228 the code of practice for noise and vibration control on construction and open sites states that noise from construction and demolition sites should not exceed the level at which conversation in the nearest building would be difficult with the windows shut. Noise levels, between 07.00 and 19.00 hours, outside the nearest window of the occupied room closest to the site boundary should not exceed:

- 70 decibels (dBA) in rural, suburban and urban areas away from main road traffic and industrial noise;
- 75 decibels (dBA) in urban areas near main roads in heavy industrial areas.

Mitigation: The noise from the 13 tonne excavator is below the advised limits and therefore no mitigation is considered to be required.

[5.7](#) Generation of dust

(i) Potential Impact: Potential damage to soil organisms and vegetation due to high alkalinity of cementitious liquids and cement dust.

Mitigation: The BAS facilities teams are committed to the following procedures to minimise the possibility of cement dust polluting the locality, i.e. by:

- restricting the mixing of concrete to calm days with little or no wind;
- mixing all cement in one location (identified as the area adjacent to the STP);
- minimising the handling of open cement bags through good planning and housekeeping during construction;
- containing partially used or damaged bags of concrete in order to minimise the risk of accidental spills; and
- only transporting wet concrete mixes to plinth locations.
-

(ii) Potential Impact: The excavation of trial holes has the potential to create large amounts of dust. Potential damage to soil organisms and vegetation.

Mitigation:

- BAM will arrange with BAS station staff to damp down the ground adjacent to the trial holes to prevent dust from rising.
- The arisings from each trial hole will be placed next to the holes and backfilled with the material as soon as examinations of each trial hole are complete. This will minimise the movement of material and dust creation.

[5.8](#) Generation of waste

Potential Impact: Inappropriate disposal of waste materials

Mitigation:

- All personnel will receive an environmental briefing from the Station Leader on arrival at Rothera that will outline waste management systems on site.
- All waste must be segregated and incorporated into the existing waste management procedures at Rothera.

- The rock samples cores will be disposed of in landfill in Scotland once all sample testing has been completed. Waste transfer notes or equivalent certification will be provided to BAS as confirmation.
- Daily checks of the site by the Superintendent will ensure that all equipment and packaging is appropriately weighed down to avoid dispersal of waste by wind blow.

[5.9](#) Relocation of NDB, DME and DORIS

(i) Potential Impact: Potential disturbance of a skua nest.

Past monitoring has shown that skuas have previously nested in the vicinity of the proposed relocation sites for the NDB, DME and DORIS. However none of the identified nest sites have been used in the past couple of seasons so the potential risk of impact is considered to be low.

Mitigation:

- BAS staff will monitor the site as part of the annual skua monitoring programme at Rothera.
- Initial site preparation works are scheduled to begin before the nesting season.
- Regular human activity in this area is likely to discourage the birds from nesting at these particular sites.
- BAS staff to report if a nest becomes established.

(ii) Potential Impact: There is past evidence at Rothera that indicates that birds do not easily see guy lines which are attached to antenna or other aerial constructions. Fatalities have been recorded when birds have flown into these lines. The NDB will have three guy lines that pose a risk to birds.

Mitigation:

- NDB will be located in a position away from the main skua nesting area reducing the risk of impact.
- Reflectors to be attached to NDB guy lines to increase visibility to birds.

[5.10](#) Transportation of personnel and cargo and operation of equipment

Potential Impact: Minor cumulative contribution to regional and global atmospheric pollution and heavy metal and particulate fallout.

Mitigation

- Unavoidable impact of transporting personnel and cargo to site.
- Carbon footprint of flights and vehicle use will be included in BAS Annual Environmental Report
- Regular maintenance and daily checks to maintain vehicles to highest standards
- Staff are instructed to turn off vehicles when not in use

[5.11](#) Cumulative Impacts

A cumulative impact is the combined impact of past, present and future activities over time or space. The proposed second season of Rothera Site Investigation works is the first stage in the larger project to upgrade Rothera Wharf, the runway and Rothera station. The full impact of the overall project will be considered in an Environmental Impact Assessment which will be submitted to the FCO prior to construction activities.

5.12 Impact Matrix

Table 1. Probability and Severity of Impacts

Activity	Effect	Possible Impact	Probability of impact occurring	Severity of impact	Preventative or mitigating measures
Rothera Site Investigation					
1. Importation of cargo	<ul style="list-style-type: none"> Possible importation of non-native species 	<ul style="list-style-type: none"> Potential ecosystem alteration. Impact on future science. 	Low	Medium (High if species become established)	<ul style="list-style-type: none"> All equipment and materials will be thoroughly cleaned before dispatch to Antarctica. BAM will inspect all plant, equipment, materials and personal belongings prior to loading onto the vessel and prior to disembarkation at Rothera. If accidental importation of a non-native species occurs it will be exterminated, and disposed of appropriately. All non-native species incursions will be reported to the Rothera Station Leader immediately and the BAS Environment office.
2. Relocation of personnel and associated luggage/cargo	<ul style="list-style-type: none"> Possible importation of non-native species 	<ul style="list-style-type: none"> Potential ecosystem alteration. Impact on future science. 	Low	Medium (High if species become established)	<ul style="list-style-type: none"> All personnel being deployed to Rothera will have received a redeployment briefing from the BAS Environment Office. All personnel must read and comply with the BAS Biosecurity Handbook before departing their home country. All personal items of clothing and cargo should be thoroughly cleaned and checked for soils, plants, propagules or insects.
3. Refuelling and use of machinery over ice-free ground and water	<ul style="list-style-type: none"> Fuel spills and leaks 	<ul style="list-style-type: none"> Contamination of local environment (terrestrial and marine) 	Low	Low	<ul style="list-style-type: none"> All refuelling will be carried out by trained BAS personnel in accordance with the station's refuelling procedures. All BAM staff will have received training on emergency spill procedures. All spills will be reported to the Station Leader Tier 1 spills will be dealt with by BAM staff; Tier 2 or 3 spills will be coordinated by Rothera Station Leader Any spills over water will be considered as Tier 2 spills and will be reported to the Rothera Station Leader immediately. BAM staff will assist with any spill response under the coordination of the Rothera Station Leader. Rothera Oil Spill Contingency Plan to be followed in the event of a spill over water. All spills will be reported to the BAS Environment Office.

4. Inspection of fuel tanks	<ul style="list-style-type: none"> Fuel spills and leaks 	<ul style="list-style-type: none"> Contamination of local environment 	Low	Medium	<ul style="list-style-type: none"> Undertaken by the BAS Estates Team as part of the three yearly maintenance programme. This activity occurs on an annual basis as a number of tanks are inspected each year. The tank cleaning procedures outlined in the Rothera "<i>Fuel Storage and Distribution Facility Operation and Maintenance Manual</i>" will be followed at all times. In the event of a spill the Rothera Oil Spill Contingency Plan will be followed. Spill response equipment will be located at the fuel tanks throughout the maintenance works.
5. Underwater rock removal	<ul style="list-style-type: none"> Change in underwater noise levels 	<ul style="list-style-type: none"> Disturbance, avoidance behaviour or hearing damage to marine mammals 	Medium	Medium	<ul style="list-style-type: none"> Marine Mammal Observers (MMOs) to monitor exclusion zone for 30 min prior to works starting No works to commence until water clear of marine mammals for 30 min 1000 m exclusion zone Soft starts to be employed
6. Generation of cement dust	<ul style="list-style-type: none"> Increase in alkalinity in local environment 	<ul style="list-style-type: none"> Soil organisms and vegetation die back 	Low	Medium	<ul style="list-style-type: none"> Good practices to be followed during the mixing and transportation of cement including: <ul style="list-style-type: none"> restricting the mixing of concrete to calm days with little or no wind; mixing all cement in one location (identified as the area adjacent to the STP); minimising the handling of open cement bags through good planning and housekeeping during construction; containing partially used or damaged bags of concrete in order to minimise the risk of accidental spills; and only transporting wet concrete mixes to plinth locations.
7. Generation of Waste	<ul style="list-style-type: none"> Inappropriate disposal of waste 	<ul style="list-style-type: none"> Contamination of site 	Low	Low	<ul style="list-style-type: none"> All personnel must adhere to waste management procedures on site. All waste must be segregated and incorporated into the existing waste management systems at Rothera. The rock cores will be disposed of in landfill in Scotland. Daily checks will ensure that all equipment and packaging is appropriately weighed down to avoid wind blow

8.Relocation of NDB, DME, NDB	<ul style="list-style-type: none"> • Possible disturbance of nesting skua • Bird strikes 	<ul style="list-style-type: none"> • Nest abandonment • Bird injury or fatality 	Low	Medium	<ul style="list-style-type: none"> • BAS staff will monitor the site as part of the annual skua monitoring programme at Rothera. • Initial site preparation works are scheduled to begin before the nesting season. • Regular human activity in this area is likely to discourage the birds from nesting at this particular site. • BAS staff to report if a nest becomes established • Reflectors to be attached to guy lines of NDB
Transportation of personnel and cargo and operation of equipment	<ul style="list-style-type: none"> • Contribution to atmospheric emissions 	<ul style="list-style-type: none"> • Minor cumulative contribution to regional and global atmospheric pollution • Heavy metal and particulate fallout. 	High	Low	<ul style="list-style-type: none"> • Unavoidable impact of transporting personnel and cargo to site. • Carbon footprint of flights and vehicle use will be included in BAS Annual Environmental Report • Regular maintenance and daily checks to maintain vehicles to highest standards • Staff are instructed to turn off vehicles when not in use

6 ENVIRONMENTAL TRAINING

It is BAS policy to brief all new recruits on environmental management before they travel to Antarctica. An environmental briefing will be given by the BAS Environment Office to all BAM personnel involved in the project as part of the pre-deployment training.

7 CONCLUSIONS

This IEE indicates that the proposed Rothera Site Investigation is likely to have no more than a minor and transitory impact on the Antarctic environment, provided the recommended mitigation measures identified in the report are carried out. It is concluded, therefore, that this activity should be allowed to proceed, and that a Comprehensive Environmental Evaluation (CEE) is not required.

8 AUTHORS OF THE IEE

This Initial Environmental Evaluation was prepared by Clare Fothergill, British Antarctic Survey with input from BAM Environmental Manager Neil Goulding.

Annex 1 Environmental Baseline Information for Rothera Point was produced by Kevin A. Hughes

Further information or copies of this IEE can be obtained from:

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9 Annex 1 - Environmental Baseline Information for Rothera Point