Appendix A: Drilling and Blasting Management Plan

Project ref:	BAA.4008		
Project name:	Rothera Modernisation Project		
Activity plan ref:	BAA4008-BAM-ZZ-YYY-SP-WA-0007	**Revision**	Draft 04
Activity plan title:	**Drilling, Blasting and Processing Management Plan**		

Scope:

This document details management of drilling, blasting and rock processing operations in order to create a rock platform for the modernization construction works. It does not include placement of fill or other construction activities.

Authorisation:	
Prepared by (author): Jan Cordon **Position:** Drill and Blast Project Manager	**Signature:** **Date:**
Approved by Design Manager by: **Position:**	**Signature:** **Date:**
Approved by BAM QA by: **Position:**	**Signature:** **Date:**
Approved by BAM H&S by: **Position:**	**Signature:** **Date:**
Approved by BAM Env. by: **Position:**	**Signature:** **Date:**
Approved by Plant Manager by: **Position:**	**Signature:** **Date:**
Approved by General Foreman: by: **Position:**	**Signature:** **Date:**
Approved by BAM by: **Position:**	**Signature:** **Date:**
Approved for BAS by: **Position:**	**Signature:** **Date:**

Date Initial review required by:	
Carried out by (Name): **Position:**	**Signature:** **Date:**
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Carried out by (Name): **Position:**	**Signature:** **Date:**
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Carried out by (Name): **Position:**	**Signature:** **Date:**
Carried out by (Name): **Position:**	**Signature:** **Date:**

Record of amendments to this document

Date	Amendments	Signature:
06/05/19	- Quantities	JC
04/06/19	- Addition of load, haul and rock processing – s.4 - Minor changes to s.1.0 and s.2.1 - Minor changes to 3.8	JC

1. Activity plan briefing (recorded on SF204)

Contents of briefing – sections 3, 4, 5, 6, 7, 8 and 9

The following critical items must be emphasised:

- Appointments, responsibilities and control
- Explosives transport and use
- Restricted working areas
- Danger zones during blasting
- Monitoring of sensitive receptors

The following checklist items must be recognised:

- Blast Checklist for clearing the danger zone
-
-

The following verification questions are to be used:

-
-
-

Contents

1 Introduction

As part of the upgrade to the Rothera station for the British Antarctic Survey (BAS), it will be necessary to remove rock to allow the construction of new buildings. It is anticipated that prior to excavation, approximately 8,600m^3 of this rock will need to be pre-treated by blasting. After blasting, this material will then be loaded and hauled to a separate area on-station for processing and stockpiling, before being returned to the modernisation location to be used as fill material. It is anticipated that 11,200m^3 of 0-80mm rock fill will be required. During the production of this fill material it may be necessary to obtain additional blasted rock feed material from existing stockpiles sourced from the Rothera Wharf quarry.

This document describes the methods to be used to undertake these works and how the use of explosives will be controlled to prevent harm to people and the environment.

Figure 1 – Rothera Research Station showing the proposed blasting area.

2 Excavation Quantities

Figure 2 shows the cut and fill layout for the modernisation area, with the darkest green representing the fill area and all other colours representing those which potentially requiring blasting - with light green representing the shallowest areas through to brown the deepest.

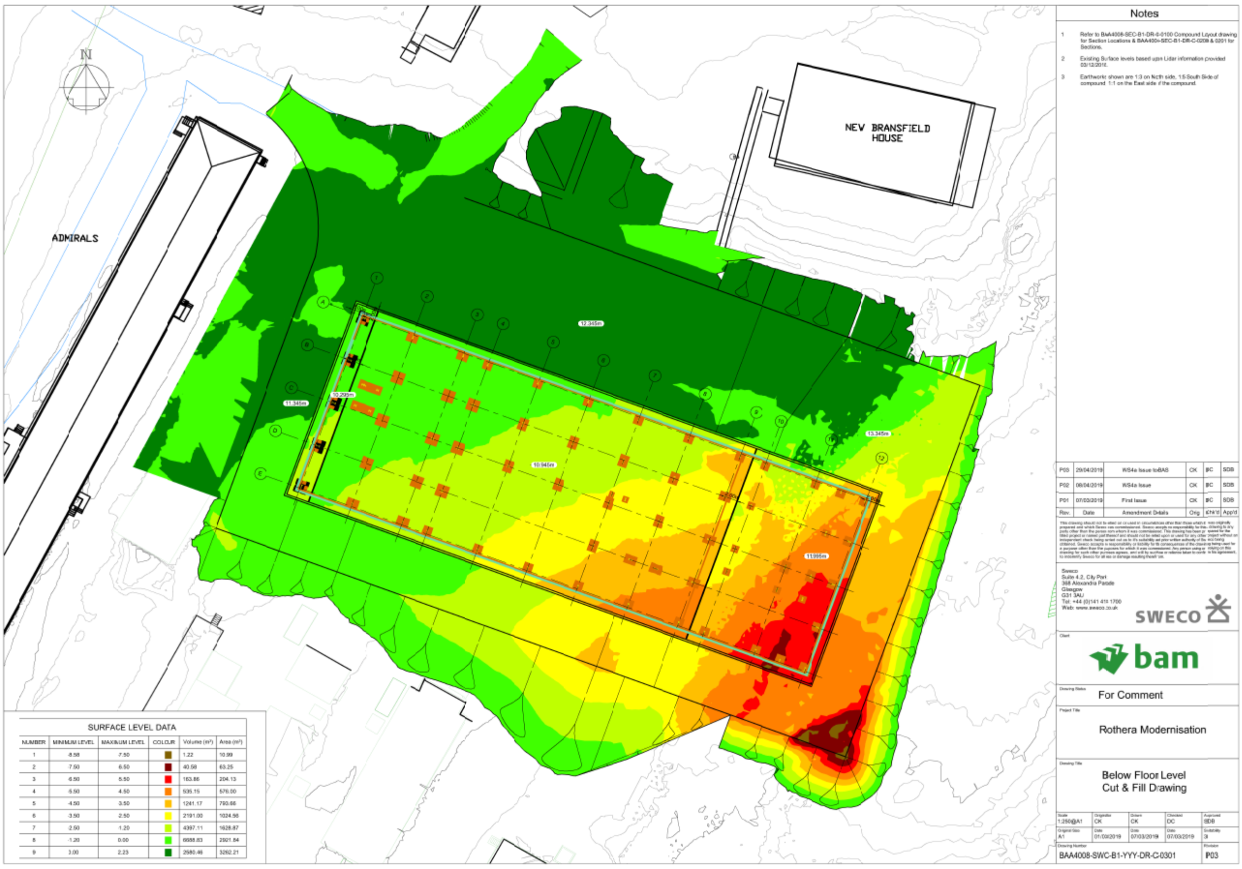


Figure 2 – Rothera Modernisation cut and fill area.

As blasting involves the removal of blocks of rock from the surface to the design depth, rather than in layers, areas and volumes of these blocks have been calculated for each coloured zone. The area and volume of each block is shown in table 1 below.

Rock thickness			visible surface	Volume M3
From (m)	To (m)	Zone		
0.6	1.2	8	1629	923
1.2	2.5	7	1025	1875
2.5	3.5	6	794	2212
3.5	4.5	5	576	2158
4.5	5.5	4	204	967
5.5	6.5	3	74	435
6.5	7.5	2		
7.5	7.91	1		
TOTAL			**4302**	**8570**

Table 1 - Total Blasting Requirement

Overview total backfill quantities			
area	materials		
	0-80mm	0-30mm	sand
	m3	m3	m3
building	4975	0	264
perimeter	4764	0	
hangar	1240	0	
bridge	100	0	
IWHF	135	0	
Total	11214	0	264

Table 2 – Total backfill quantities

A total of 11,214m3 of 0-80mm backfill material is required during the modernisation. Sand shown in table 2 will not be produced on-site.

2.1 Blasting Development Plan

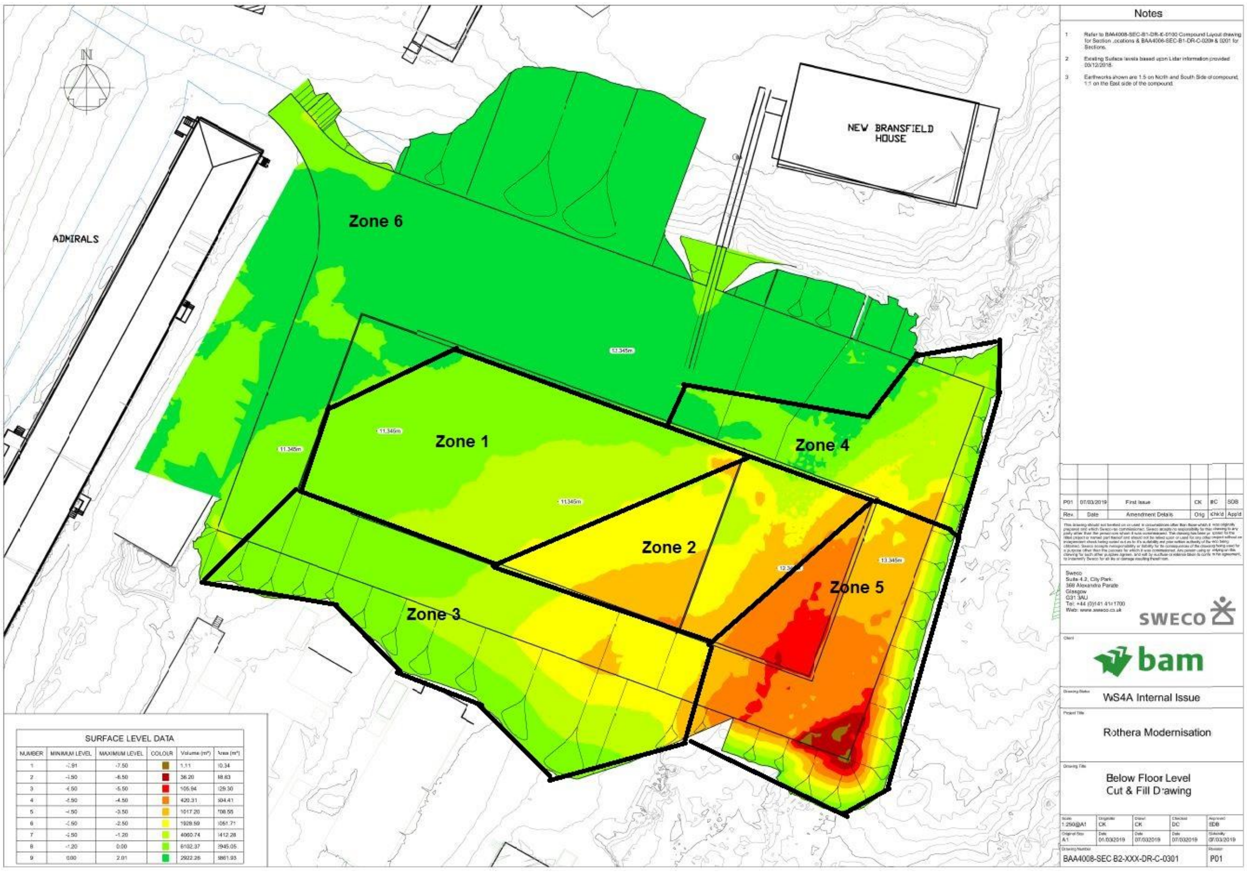


Figure 3 – Rothera Modernisation indicative blasting development.

The exact development sequence must be determined by the Explosives Supervisor on-site after the loose overburden has been removed and all the relevant information affecting blasting has been considered.

Figure 3 shows an indicative blasting sequence as follows:

- Starting in zone 1 to develop a face in the shallow rock areas furthest away from buildings. This involves the smallest charges and the maximum distances from sensitive structures.
- Development of the face then continues into zone 2 with a thicker rock layer, but still at a distance from buildings.
- Next zones 3 and 4 open up the cut created and work towards the more sensitive area. The cut allows blasting towards the existing cut and away from buildings. High spots in Zone 6 will also be removed during this period.
- Finally zone 5, the thickest rock layer is removed.

As blasting progresses towards buildings and other sensitive receptors, vibration levels will be monitored to determine peak particle velocity and frequency values. These values will be compared to BS7385-2. In the event that compliance is not possible at the closest proximity, the option is to allow exceedance with a potential for damage, or use a hydraulic breaker. It may be reasonable to accept/risk minor cosmetic damage to those industrial building marked for demolition, though this should be approved by the BAS representative.

Figures 4, 5 and 6 show 3D visualisations of the blasted area and new building.

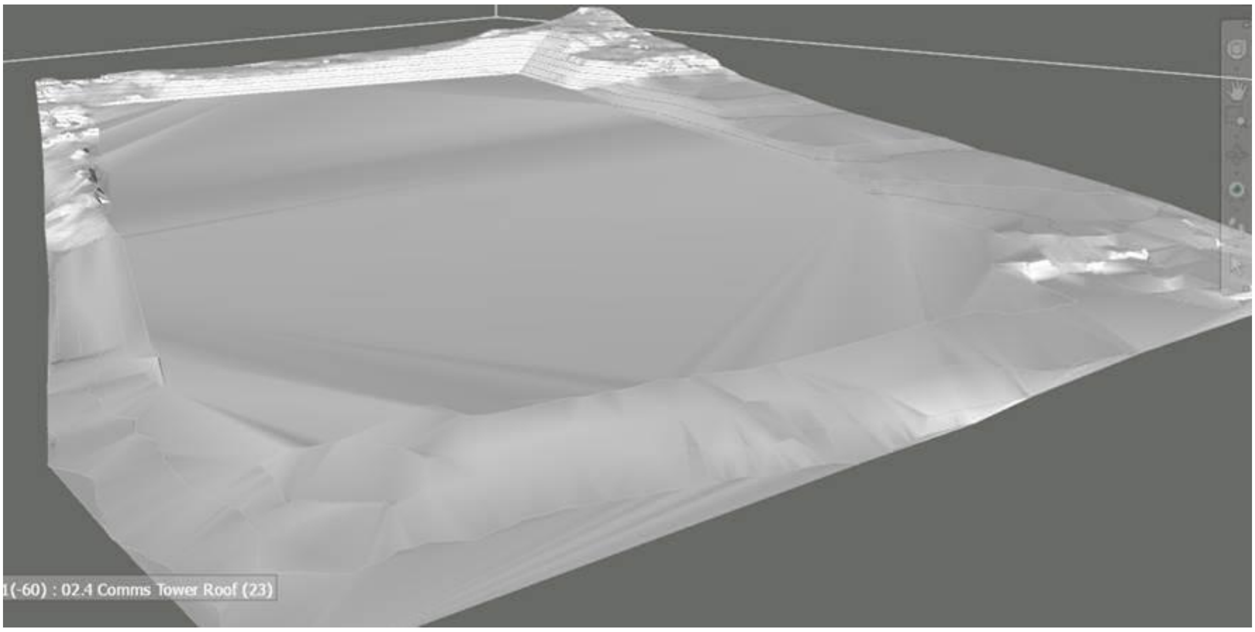


Figure 4 – 3D visualisation of the modernisation cut viewed from the north west.

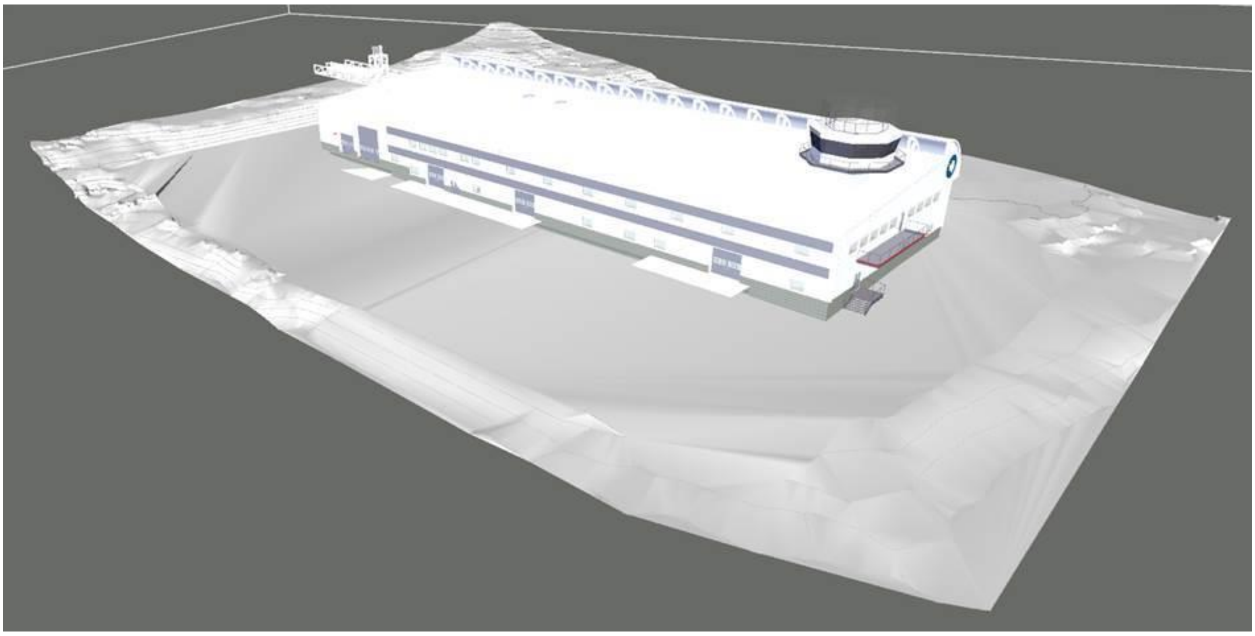


Figure 5 – 3D visualisation of the modernisation cut viewed from the north west with new building included.

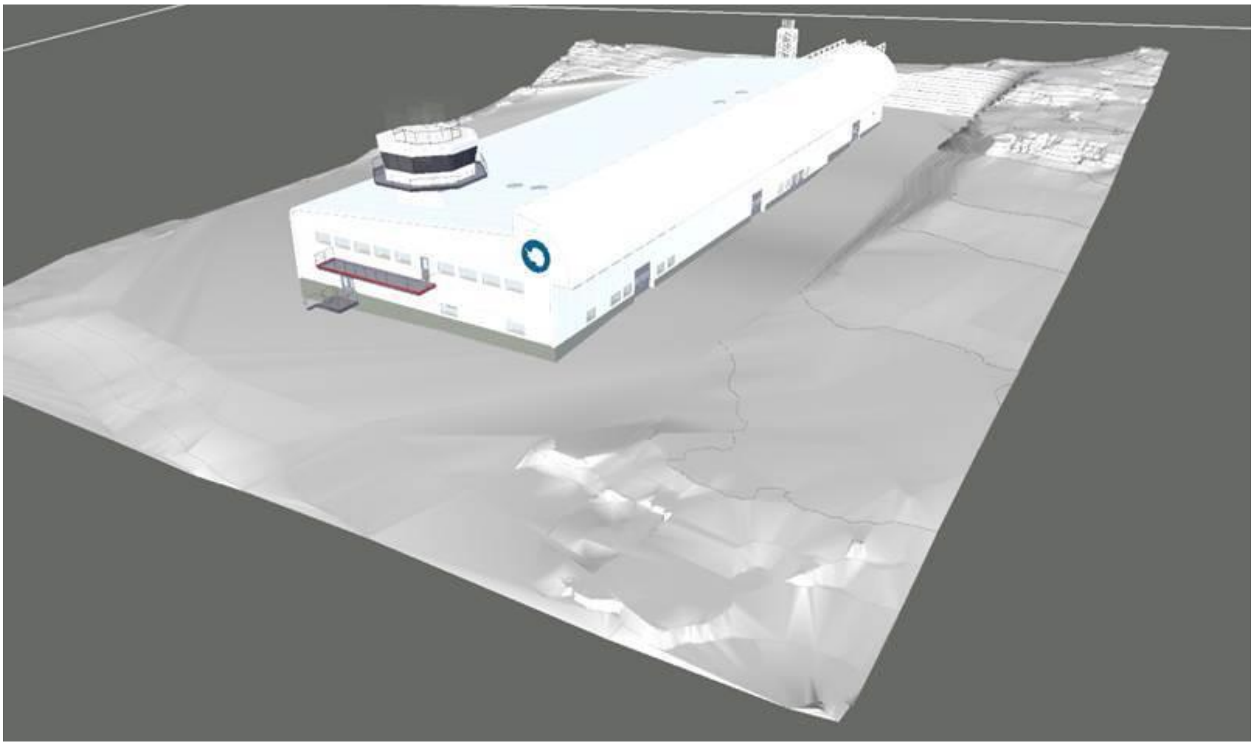


Figure 6 – 3D visualisation of the modernisation cut viewed from the south west with new building included.

2.2 Access and Egress to the Drill and Blast Area

The drilling and blasting area is located in the central open area of the Rothera Station. Access to the area for drilling and blasting operations can be made from either the west or the south. Access for explosives transport is shown on the plan below with access routes both from the apron (for explosives transport from the glacier storage area) and station magazines.

Access to existing station facilities must be strictly controlled during blasting operations, immediately around the blasting area during drilling and charging and additionally at the time of firing.

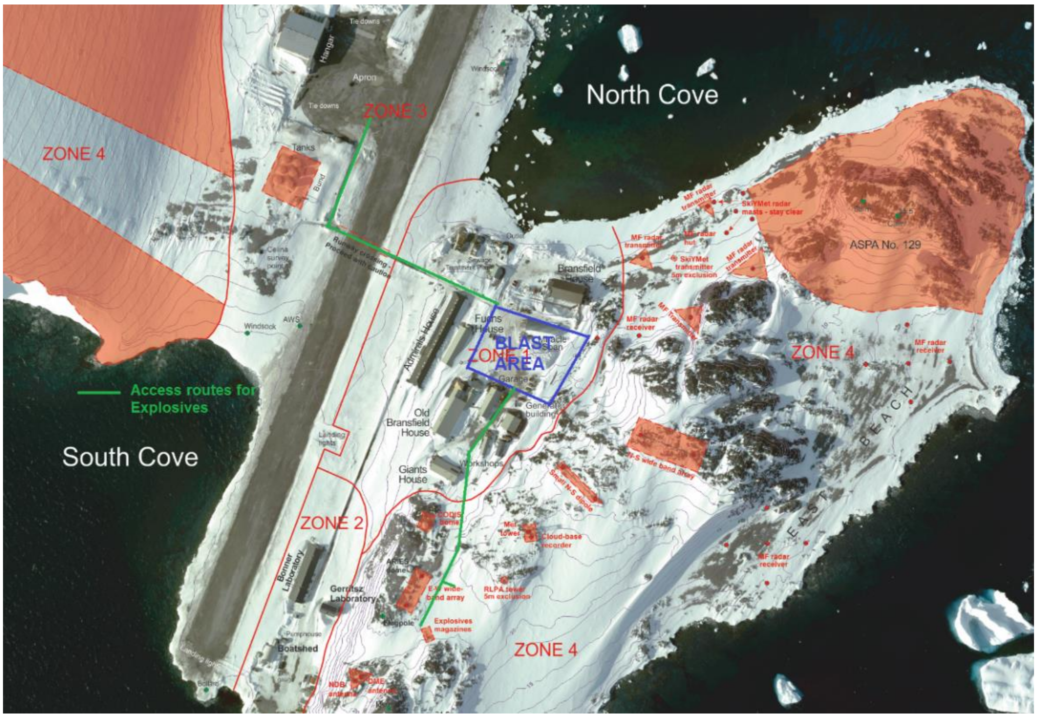


Figure 7 - Access route to the quarry shown in green.

3 Drilling and Blasting

Primary rock extraction from the modernisation development area will be undertaken using drilling and blasting with explosives. This will involve the drilling of vertical, or near vertical holes, in the range of 64mm to 76mm diameter, with a tracked hydraulic drill rig. These holes will be drilled in rows parallel and adjacent to an open face, or in a pattern to develop an open face. These holes will then be charged with explosives and stemmed with angular aggregates.

It is anticipated that the majority of blasting will be undertaken during the 2019-2020 austral summer, with approximately 20 – 30 individual blasts. The duration of each blast will typically be less than 0.5 seconds. Drilling will continue during working hours on most of the working days during the drilling and blasting period.

This drilling and blasting process will be strictly controlled following BAM Ritchies blasting procedures and following the requirements of the UK Quarries Regulations 1999. The Quarries Regulations 1999 provide the strictest requirements currently in place and also ensure compliance with BS5607:1998 Code of practice for the safe use of explosives in the construction industry. In addition the use of explosives will comply with British Antarctic Survey Code of Practice: Explosives, 3rd edition, 2007. This management plan also forms the shotfiring rules as described in the legislation.

Figure 8 – Atlas Copco D7 tracked drill rig at Rothera.

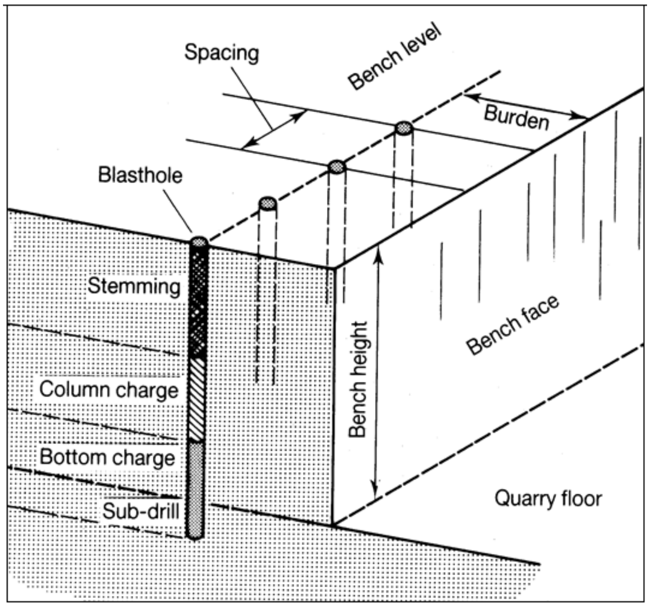


Figure 9 – Drilling and blasting terminology

Term	Definition
Burden	The rock thickness between a hole and the rock face, or hole in front (metres).
Spacing	The distance between holes within the same row (metres)
Sub-grade drilling	The distance shot-holes are drilled below the design floor level to ensure the floor breaks to design (metres)
Stemming	Non-explosive material placed in the top of the hole to confine the explosive and prevent ejection. For surface blasting this is normally aggregate chippings of approx 0.1 to 0.15x the hole diameter
Powder factor or blast ratio	The quantity of explosive used to blast a unit volume of rock kg/m^3 (sometimes expressed as a ratio - tonnes of rock per kg of explosive)
MIC	Maximum Instantaneous Charge – the charge weight fired in any one delay period, separated from other charges typically by a minimum of 8 milliseconds (ms)

3.1 Drilling and Blasting Management

Within the drill and blast department, BAM Ritchies control blasting activities at a number of levels, as follows:

- At an overall company level, operations are controlled by the Manager, Drill & Blast, supported by Contracts Managers, Project Managers and Engineers. The main documents detailing this are the ‘Operational Management Plan’, ‘Drill and Blast Procedures’ and ‘Drill and Blast Guidance’.

- At a quarry / site / project level, operations are controlled by the Site Supervisor, Explosives Supervisor and site management following this ‘Drilling and Blasting Management Plan’, ‘Drill and Blast Procedures’ and ‘Drill and Blast Guidance’, along with site documents – Site Rules, this Drill and Blast Management Plan and ‘Risk Assessments’.

- At an individual blast level, controlled by the Explosives Supervisor and Shotfirer, using the ‘Blasting Specification’ and any blast specific risk assessments.

Above all, by following this system of control meets the requirements of legislation, in particular the Quarries Regulations 1999.

The following sections provide more detail of the overall system of control and the role of this document.

3.1.1 Control at the Company level - BAM Ritchies

The 'Drilling and Blasting Operational Management Plan' describes how the company manages health & safety and environment activities within the drill and blast department. This overriding management plan can used at site level in conjunction with site specific documents to form a complete site drilling and blasting management folder.

In addition, a number of other company standard documents provide instruction, or guidance, on more specific tasks. These are BAM Nuttall procedures and guidance, and BAM Ritchies procedures and guidance.

3.1.2 Control at a Quarry / Project level.

At each site, quarry or project, the supervisor in charge will prepare and maintain a 'Site Drilling and Blasting Management Folder' which should detail how drilling and blasting operations are managed at that site. A minimum contents is set out below, but additional information relevant to drilling and blasting operations should be included where relevant.

'Drilling and Blasting Management Folder' Contents:

1. Site emergency procedures.
2. Site drill and blast organisation chart and contact details.
3. Drilling and Blasting Operational Management Plan.
4. This Drill and Blast Management Plan.
5. Other site rules.
6. Site specific environmental requirements if not included in this plan.
7. Departmental and Operational Procedures (BAM Ritchies).
8. Site Specific Risk Assessment.
9. Copy of appointments (including Explosive Supervisor Register if not displayed elsewhere).
10. COSHH assessments.
11. Guidance:
    - BAM Ritchies Drill & Blast Guidance Series.
    - Other legislation and guidance eg Quarries Regulations 1999, British Standards, BAS Explosives ACOP.
    - Product information - Material Safety Data Sheets, Technical Data Sheets.

Site drilling and blasting activities will be carried out following the 'Drill and Blast Management Plan, 'Risk Assessment', 'Drill and Blast Procedures' and 'Drill and Blast Guidance'.

Generally, one site specific risk assessment will be prepared to assess the risks involved when undertaking work following the 'Drill and Blast Management Plan, the 'Operational Management Plan' and BAM Ritchies standard procedures. This should be prepared by the Supervisor, in conjunction with other members of the team, but always including the Explosives Supervisor and Shotfirer. It should be reviewed at a minimum every six months, or sooner if conditions change. Other additional task specific risk assessments may be required.

3.1.3 Control at the blast level

This is principally controlled by the 'Blasting Specification' as defined in the Quarries Regulations 1999. Further documents may be required eg. additional risk assessments for blast specific conditions - for weather conditions, or working under faces.

3.2 Appointments and Responsibilities

Drilling and blasting operations are carried out by BAM Ritchies, a division of BAM Nuttall Ltd, for The British Antarctic Survey (BAS) as part of a construction partnership between BAM and BAS. In order to safely control blasting operations a number key appointments are required as a minimum. Full duties of each role are described below and in individual appointments.

The person appointed to organise and supervise all work at the quarry involving the use of explosives is the Explosives Supervisor. The Explosive Supervisor will be appointed in writing by the Project Manager.

All other appointments listed below will be appointed in writing by the Explosives Supervisor:
- Shotfirer
- Explosives Storekeeper
- Blast Controller
- Sentries
- Laser Surveyor
- Driller

Written appointment records will be kept during the term of the appointment and for 3 years after completion of the project.

It is the responsibility of the appointor to ensure that the appointees have suitable training, qualifications and experience to competently undertake that role and check that they are not a prohibited person.

Records of these checks must be kept with the appointment – these may be in the form of training records, competency assessment forms, or copies of a CV and certificates.

The duties and responsibilities of each role must be included in the written appointment. Individuals may be appointed to several roles, but must follow the rules relating to the role they are undertaking irrespective of their employment job title.

3.2.1 Explosives Supervisor (ES)

The person appointed to organise and supervise all work at the quarry involving the use of explosives.

Although more than one person may be appointed as Explosives Supervisor, only one may act in this role at any time. This is controlled by completion of the ‘Explosives Supervisor Register’ which will be on display in the project office. This must be completed and then signed by the acting Explosives Supervisor and Project Manager. On transfer to another Explosive Supervisor the end date must be completed for the outgoing ES and a new line completed for the incoming ES. The Explosives Supervisor should ensure that a handover is undertaken to pass any new relevant information or changes.

Key Responsibilities:

- To ensure that explosives are handled and used in a manner that is without risk to the health and safety of personnel in the vicinity, and bring anything which may adversely affect this to the Project Manager’s attention immediately.
- The Quarries Regulations 1999, Part V Explosives are complied with as far as possible at this location.
- An adequate written blast specification is produced for each blast - prepared by themselves or the Shotfirer. This is evidenced by the Explosive Supervisor signing at least the cover sheet and proposed explosives loading sheets prior to charging operations commencing.
- Making all explosives appointments on site (except Explosives Supervisors).
- Equipment used for shotfiring is suitable and safe.
- Site conditions are in line with the blast specification before work with explosives begins.
- Explosives are only kept in the approved storage areas unless they are being transported or are being used and accurate records are maintained.
- Implementation of the misfire procedure in conjunction with the Shotfirer.
- Defining the danger zone required. This may be a standard danger zone for blasting, but must be reconsidered for every blast when approving the blasting specification, or if notified of any change during charging notified by the Shotfirer. The extent of the danger zone and position of any safe areas must be notified to the Blast Controller before charging commences and prior to clearing the danger zone in the event of changes in conditions as a result of actual charging.
- Ensuring that all personnel upon which this ‘Drilling and Blasting Management Plan’ imposes duties have received the latest copy and have understood, accepted and signed their copy. A copy of the signed acceptance should be kept.
- Ensuring that risk assessments are in place for all blasting activities, even though they may be assessed by others.

3.2.2 Shotfirers

Key Responsibilities:

- Marking out shots prior to drilling.
- Surveying shots, or ensuring information provided by a separate surveyor is adequate for use preparing the blasting specification.
- Preparing an adequate blast specification as defined in the Quarries Regulations 1999.
- To prepare, or mix explosives for immediate use.
- Supervising transport of explosives on-site.
- Prepare primers with detonators.
- Charge and stem holes as per the blasting specification, or within the allowable variation shown on the specification. They must notify the Explosives Supervisor of any changes outside the allowable variation, or changes to any conditions since the approval of the specification.
- Link, connect or otherwise prepare the initiation system ready for firing.
- Inspect and test the initiation system as appropriate for the type being used.

- Liaise with the Blast Controller to ensure that the danger zone is clear before testing any live initiation system.
- Fire the shot from a safe designated location.
- Carryout post-blast inspections to check for misfires.
- Comply with The Quarries Regulations 1999, Part V Explosives, and this management plan relating to the storage, handling & use of explosives and instructions from the Explosives Supervisor.
- Check that equipment used for shotfiring is suitable and safe and site conditions are in line with the blasting specification before work with explosives begin.
- Maintaining security of explosives and control of the blast site as a restricted area.

3.2.3 Explosives Storekeeper

The Shotfirer will act in this role. Key responsibilities:
- The security and safe storage of explosives, including detonators.
- Keys to the store are kept in a secure location at all times.
- Check and maintain the field storage location and ensure that the explosives are not exposed to weather and deterioration.
- Keeping accurate records.
- The issue and receipt of explosives only to authorised persons.
- Immediately reporting any loss or theft of explosives to the Project Manager.
- Exercise good stock rotation practice. Conduct regular checks of the condition of explosives being stored.
- Ensuring that the inside of the store is kept clean and free from grit at all times and nothing but explosives shall be stored in the magazine, except essential non-ferrous items eg. a broom.
- Keeping the area surrounding the explosives store clear of grass, shrubbery, spilled fuel oil, or other organic material in order to minimise the risk of fire.
- Stock is checked to ensure that the totals of items that have been used on that day are correct. Total stock checks are done and recorded in the book on a regular basis.

3.2.4 Blast Controller

The Blast Controller's primary role is to ensure that the blasting danger zone is clear of personnel, secured against entry from outside, and to communicate directly with the Shotfirer as per the blasting procedure to allow the safe firing of shots without risk to personnel. It is not the role of the Blast Controller to determine the extent of the danger zone. The Blast Controller does not need blasting experience and could be for instance a construction supervisor.

Blast Controller key responsibilities**:**
- To make any ‘public - BAS’ notifications, internal quarry notifications and to place any signs as required in this document. If this is delegated, they must ensure that it has been done.
- For each blast, to select sentries (previously appointed) and brief them of their location and specific duties for that blast. Ensure that they have a radio, and understand their specific duties. At this point ensure that the sentries understand who is acting as Blast Controller.
- Ensure that they are able to communicate with all the sentries and the shotfirer.
- To ensure that no person is left in the danger zone once sentries are in position. Only the shotfirer and those personnel with specific duties in the clearance procedure enter the danger zone at this time.
- To only give the instruction to the Shotfirer that they may fire the shot when the danger zone is secure and clear as per the procedure in these rules. The acting shotfirer and trainee shotfirers under their control are the only people allowed to enter the danger zone from this instruction until the 'all clear' is given by the shotfirer.
- Only communicate to the shotfirer when he may fire the blast, when there is no doubt in communications, or interference in communications of any sort.
- If anyone gives the STOP, STOP, STOP notice, ensure that the Shotfirer confirms this. If not, repeat the notice until the Shotfirer confirms. Once confirmed, investigate the cause and only recommence the procedure once safe.

3.2.5 Sentries

The primary role of sentries is to guard a position so as to prevent access to the blasting danger zone from the time they are positioned until relieved by the 'all clear'. Sentries may have additional roles prior to taking up their position eg. checking an area is clear of personnel then working outwards to the entrance before blocking access to it.

Sentries will be instructed by the Blast Controller and must only follow instructions from the Blast Controller, or the Shotfirer directly.

Sentries will be briefed on their specific role for each blast by the Blast Controller. They will be given clear instructions, informing them of their duties and responsibilities and where they must position themselves for the blast.

- They must ensure that they are in position in sufficient time to clear their area of responsibility, take up position and bar entry to the danger zone.
- They must ensure that they understand the method of communication.
- They must be in contact with the Blast Controller and Shotfirer and when asked to do so, report that they are in position and that there area of responsibility is secure, or not.
- Immediately report to the Shotfirer, if at any stage the danger zone is breached, or there is some other matter affecting the safety of the blast. Call **STOP, STOP, STOP** at any time to postpone firing - explanation can be made after.
- Stay in position when the shot is fired and bar all entry to the danger zone until the 'all clear' signal is sounded and you are relieved by the Blast Controller by radio. If in doubt **stay in position** and contact the Blast Controller.

3.2.6 Laser Surveyor

The laser surveyor is responsible for carrying out face profiling using laser profiling equipment, and hole surveying using either a manual method or an electronic probe. In addition the surveyor is responsible for preparing face profiles, sections, plans and elevations as required by the Shotfirer or Explosives Supervisor.

They must only use equipment that is within calibration and when conditions are suitable to allow a survey to be carried out and used as part of a compliant blast specification as required by the Quarries Regulations 1999.

3.2.7 Drillers

Drillers are responsible for drilling holes as per the driller's log instruction and within limits of allowable variations. They must:

- Report to the Explosive Supervisor should they be unable to drill any shot hole as indicated on the drill log, or within the allowable variation allowable.
- Ensure that all cavities, obstructions, clay bands, basalt and other geological features that may affect the shot encountered during drilling are recorded on the drill log.
- Securely anchor the drill rig if drilling on steeply inclined ground.
- Do not leave the rig unattended during drilling operations. Lock and isolate the rig when it is unattended.
- If there is not adequate lighting then all operations will cease during poor visibility and darkness.

3.3 General Rules

No person shall carry out any operation unless they are qualified and appointed to do so.

Everyone must report to their supervisor any accident or injury, defects in plant or equipment, or hazards in their workplace.

All personnel will undergo a site induction as required by that individual site and sign-in / clock-in and out at the appropriate place at all times.

All personnel must follow site rules and wear appropriate PPE at all times.

All personnel should ensure that they are aware of the contents of the site specific risk assessment for drill and blast operations - maintained by the Explosives Supervisor.

3.4 Restricted Working Area

The area where explosives are being used will be controlled as a restricted area and be under the constant supervision of either the Shotfirer, or another appropriate person if no charging is being undertaken. Access to this area should be restricted to those personnel directly involved in the operations and with the permission of the Shotfirer (verbal permission is adequate). The Shotfirer may prohibit anyone from accessing the charging area.

Barriers, or cones and rope, plus signs must be placed around the blast area to warn people and prevent access to the blast site by unauthorised personnel and general quarry traffic.

3.5 Working under faces

Extra caution is required when work needs to be undertaken below a quarry face. This includes toe holes and production holes which might be at risk from material falling from above. The procedure for this will involve the Driller and the Shotfirer assessing each individual blast with the Quarry Supervisor and completing a risk assessment that will form part of the documentation for that blast (eg. BAM Ritchies DB RA03 Risk Assessment for drilling below faces).

The conditions must be re-assessed each day and any changes reported to the Quarry Supervisor. Any instructions arising from the risk assessment must be adhered to before work continues.

3.6 Edge Protection

On commencing works, the Explosives Supervisor will undertake a risk assessment to determine the most suitable form of edge protection following the hierarchal approach and risk assessment as per drill and blast guidance DB G12 Selection of Edge Protection.

3.7 Explosives Custody

Explosives will be either in the locked explosives magazine, designated field storage location, or under the constant supervision of an appointed person. Supervision does not imply use and the explosives may be supervised by any of the persons with explosives appointments when verbally instructed by the Shotfirer.

Explosives deliveries will only be received by the Explosives Storekeeper or Shotfirer.

Explosives and detonators must be transferred as soon as practical to the approved magazines or designated storage area.

The delivery shall be recorded in the Explosives Record book as soon as practicable. This must be done at the latest by the end of the shift

Explosives being transported will be transferred to a suitable vehicle and remain under constant supervision of at all times.

The shotfirer will ensure that:

- Manufacturers’ containers or other suitable robust containers are used for transportation.
- Detonators will be carried within the manufacturers’ containers **or** a lockable container lined with shock absorbing, antistatic material, kept clean and used only for detonators.

Detonators and explosives materials will only be removed from the manufacturers’ container immediately before use.

Unused detonators, primers or explosives will remain within a manufacturer's containers and under the constant supervision of the shotfirer at all times until returned to the magazine or storage area. Detonators, primers and explosives cartridges can be laid out at each blast hole as per the blast specification, with no more laid out that would compromise the requirement for constant supervision**.** Excess cartridges from a previous hole may be moved onto the next hole to avoid being used by mistake. The loose cartridges must remain in the box at the next hole until used.

All boxes will be checked to ensure they contain no explosives residue and will be stored in the immediate blast area before disposal.

3.8 Explosive Deliveries, transport and storage at BAS Rothera

Explosives will arrive at Rothera by sea and be off-loaded at the temporary South Cove wharf. These explosives will be carried in 20ft shipping containers, or other storage magazines, and may have mixed loads of class 1.1D packaged explosives and 1.4S packaged detonators. These containers will be unloaded from the vessel in their containers and taken to a temporary lay-down location for transfer to other vehicles to be taken to the project storage areas. In addition to the explosives being delivered, there may be existing stocks of BAS or BAM Rothera Wharf project explosives and detonators in the existing storage magazines.

In outline, this process will involve the following activities:

- Preparation of the ski-way storage depot.
- All of the BAM detonators will be transferred to the BAM on-site detonator magazine.
- Approximately 800kg and 100 boosters from the BAM stock should be transferred to the BAM on-station magazine.
- The remainder of the BAM class 1.1D explosives should be transferred to the ski-way storage. This consists of Senatel Powerfrag and boosters.

3.8.1 Explosives Storage – Ski-way

Due to the large explosives requirement for the blasting operations it will not be possible to store the project explosives at the current BAS station storage location and instead these explosives will be stored on the glacier as shown in figure 10 and as per the arrangements for the Rothera Wharf project.

The ski-way depot will hold roughly the following: 170 boxes of Senatel powerfrag and 200 small boxes of Dunarit boosters. The depot will be laid on the snow surface - due to low snow accumulation levels at the ski-way and potential manual handling/depot footprint issues with raising the depot onto empty drums.

Access will only be by BAM shotfirer or appointed persons assisting during explosives transfers. The storage area is approximately half way along the skiway and 60m outside the local travel area to ensure restricted access to authorised personnel only. The location will allow Twin Otter's to taxi to the store, minimizing double handling.

The tarpaulin will be laid on the snow surface (with the ratchet straps underneath), the 1.22 x 2.44 x 0.18m marine plywood boards laid on top of the tarp and explosive boxes stacked 6 high. The depot will run parallel to the ski-way, 1.2m wide and approximately 6m long – though may be larger if existing explosives remain. The boxes (600mm x 257mm) should be stacked in piles, 6 per layer, alternating the pattern for stability - the boxes will overlap ply-boards as the rows move down the depot – see figure 11.

The boxes of Pentex boosters must be stored at one end of the depot to allow ease of access and stacked as high as practical. Boxes must be wrapped in heavy duty plastic to protect against snow ingress, the bottom boxes should be individually wrapped and the stacks can be wrapped together afterwards in sections.

Figure 10 - Ski-way explosives storage location.

The tarpaulin must then be folded back over the top and significantly overlapped – giving side to side cover and adequate protection from snow ingress. The end tarpaulin will need to be positioned to allow complete coverage of the depot ends. Spare shipping pallets from relief will be placed against the edges and on top of the depot as required, to spread any ratchet strap force and to provide a solid buffer if any digging is required. Ratchet straps will be spaced sensibly to provide enough stability to the structure.

A BAS Field Guide will supervise the location and construction of the store and check the area for potential crevassing.

Materials required – from existing depot:

- 4x marine plywood boards – Size: 1.2m x 2.44m
- 10x ratchet straps – 8m tail
- 3x tarpaulins 7m x 11m
- Maximum of 10 pallets salvaged from station relief operations
- 3x rolls stretch wrap film 200m x 400mm

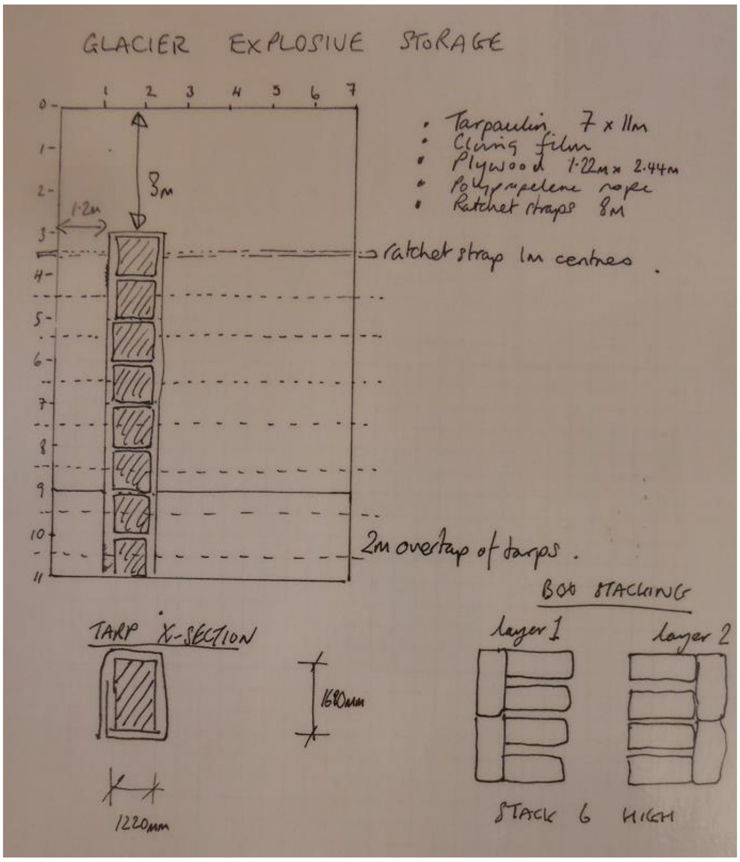


Figure 11 - Diagram showing style of depot.

3.8.2 Explosives Storage – On-Station

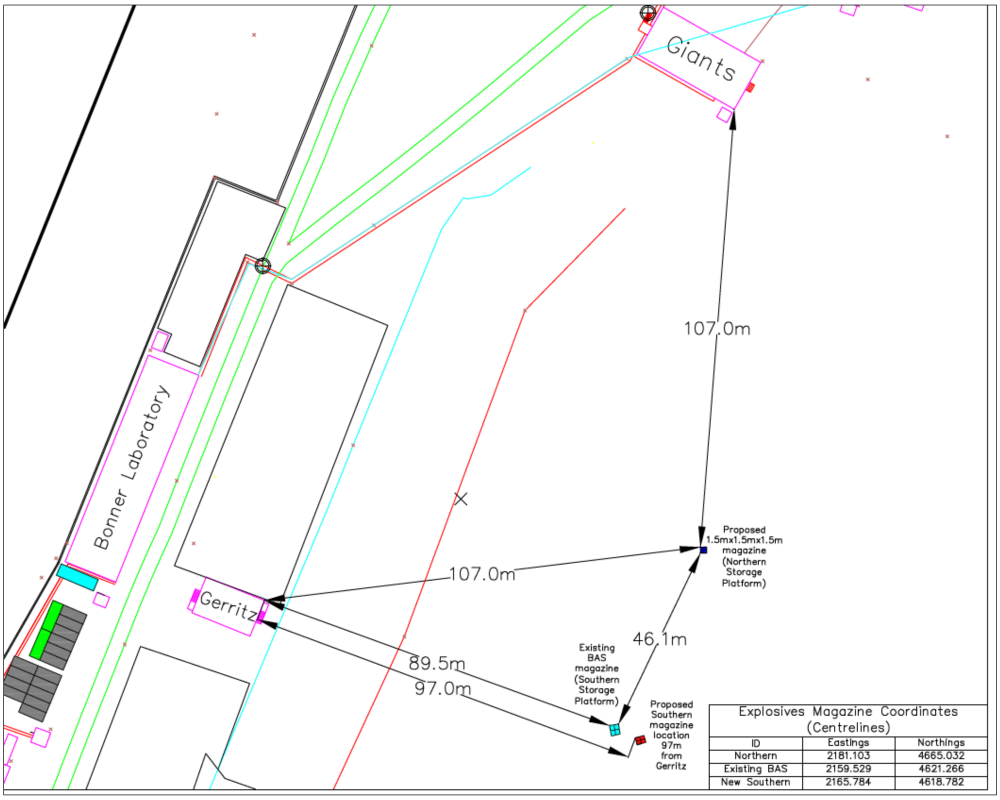
In addition to the glacier storage, it is possible to store up to a maximum of 1000kg at the Rothera station using both the existing BAS storage magazines and two BAM magazines installed in 2018 for the Rothera Wharf Project. The 1000kg is split between two locations a minimum of 24m apart as shown in figure 12, and this capacity is subject to ‘Table 3, Hazard type 1 explosives in a metal-built bunded store, Explosives Regulations 2014: Safety Provisions’.

- The northerly storage location is separated by a minimum of 107m from both Giants House and Gerritsz laboratory. This location consists of the new 1.5m x 1.5m x 1.5m magazine surrounded on three sides with a bund wall. Maximum capacity 550kg. This magazine is already in place and located on a platform created in the fresh water body. No new works are required at this location.
- The southerly storage location is separated by at least 24m from the northerly magazine and 97m from Gerritsz laboratory and consists of the existing BAS magazines and the new detonator magazine. The main BAS magazine will be surrounded on two sides with a bund wall. Maximum capacity 450kg for both magazines at this location combined, including detonators. No new works are required at this location.

The bund wall shall be 1.0m thick, and 2.0m high with no explosives stacked in the magazine greater than 1.4m high to ensure that the bund overtops the explosives by 0.6m. The bund shall be separated from the magazine by 0.6m to 1.0m and extend laterally 1.0m beyond the end of the magazine on any side facing buildings or the other magazine. The bund need not be built right around the magazines, but must cover the sides facing the other magazine and the closest buildings as shown in figure 12. The bund shall be constructed of sand in bulk bags.

Once explosives and detonators are removed from the storage areas they will remain under the close control of the Shotfirer in a restricted working area. No smoking or hot works will be permitted in the vicinity of explosives.

Records of explosives stored and used will be kept by the Explosives Storekeeper. Care BAS detonators are electrically fired and are therefore subject to radio frequency control measures.



Explosives Magazine Coordinates (Centrelines)

ID	Eastings	Northings
Northern	2181.103	4665.032
Existing BAS	2159.529	4621.266
New Southern	2165.784	4618.782

Figure 12 – Detail of magazine locations.

Figure 13 BAM on-station explosives magazine.

Figure 14 – BAM on-station detonator magazine. The existing BAS magazine is enclosed by the bund.

3.8.3 Receipt of Explosives at Rothera

Coordination between ship and shore is of the utmost importance when discharging explosives at BAS Rothera and it is essential that the Shotfirer is in charge on shore during the operation and has good communication with the ship.

1. All personnel involved in the transfer must be briefed by the shotfirer and BAS project support coordinator and understand their duties in the operation. There should be sufficient personnel to ensure that custody of the explosives is preserved.
2. The explosives will arrive in 20ft shipping container(s). These containers should be transferred to the north-west side of the runway to a temporary lay-down area for transfer to air-transport, or on-site transport vehicles – see figure 15. Transport to this lay-down area will be undertaken using either the BAS container handler, or the containers will be loaded directly from the ship to a tractor drawn trailer and then be unloaded from the trailer using a mobile crane at the temporary lay-down location. The chosen method must be briefed to all involves prior to the ships arrival and all equipment ready. Crane operators and slingers should be available if this method is used.
3. The designated lay-down area shall be cordoned off using cones and rope for this purpose and no fuel shall be stored within 25m of this location – see figure 15.
4. The explosives storage area on the glacier must have been pre-prepared prior to the delivery to avoid delay.
5. The aircraft or vehicles required for the safe and prompt transfer of explosives shall be pre-arranged for the transport operation.
6. The shotfirer should open the containers as soon as possible at the lay-down area and check the contents for damage. It may not be possible to count the contents immediately, so a strict count of the contents being removed must be kept to allow a stock check at the earliest possible moment.

Figure 15 – Apron transfer area.

Once the containers are in the temporary storage location, the detonators should be removed first and taken the short transfer to the on-site storage location. The main explosives should be supervised by the Shotfirer, or appointed person until all loads have been transferred to the field storage location, except for a reserve stock which can be kept in the Rothera base magazines. This activity is likely to take some time. In the event that the transfer to the glacier storage is not completed in one day, the containers should be locked and the cones and rope cordon preserved. The explosives supervisor and station leader may then determine if the explosives can be left unguarded overnight, provided that no activities are being undertaken in that area. Every effort should be made to remove the explosives to the glacier storage at the earliest opportunity.

3.8.4 Transport of Explosives at Rothera

Transport at Rothera is split between transport on station, and to and from the glacier storage depot, with a transfer location to the NW of the Rothera station runway.

Transport between Rothera station and the Rothera ice-runway storage depot:

- The BAS preferred method of transport between the Rothera station transfer point and the ice-runway storage location is by air using Twin Otter aircraft. Each aircraft has a 3000lb (1363kg) payload. Loading of aircraft will be undertaken as per s5.4.3 BAS Explosives COP 2007. BAS will ensure suitable licences are in place and have been provided with explosives technical data sheets for this purpose.
- Blast planning will aim to minimise the number of journeys by planning explosive usage to match full loads. A buffer stock can be maintained on station using the magazines available – both existing BAS magazines and new project magazines.
- As a back-up, and subject to approval by BAS station management, transport may be undertaken using the BAS owned Tucker snow-cat and a sledge trailer, or skidoo and trailer. These can carry up to 1250kg and 200kg respectively.

Transport on the base:

- This should be undertaken as per BAS Explosives COP 2007.
- This should preferably be undertaken using a tractor and trailer, with a net or tarpaulin used to secure the explosives.
- **NEVER** load explosives and detonators on the same vehicle or trailer.
- No spark producing metal, spark producing tools, oils, matches, firearms, electric storage batteries, flammable substances, acid, oxidising materials or corrosive compounds may be carried in the body of a vehicle transporting explosive materials. The vehicle should not be used to carry other equipment except essential shotfiring equipment and fire-fighting equipment.
- Display warning signs front, back and sides either saying “EXPLOSIVES”, or an explosives hazard diamond.
- Carry a minimum of two dry powder fire extinguishers of 2kg or more.
- Be kept clean and free of grit.
- In the event of fire the trailer should be separated if possible. Only fires on the tractor itself should be fought.
- As a back-up explosives may be transferred by BAS John Deere Gators that can carry approximately 200kg each per journey. The route and transfer location is shown in green on Figure 17.
- Once loaded the transport should go directly from the loading location to the destination location. The transport journey should not commence if it cannot be completed e.g. due to aircraft operations.
- Vehicles carrying explosives must not enter, pass closely or wait next to offices, workshops or fuel storage areas.

Transfer at the foot of the ramp:

- Where explosives are going to, or from the runway to the blast site, it is necessary to transfer them from the tractor and trailer to the Twin Otter, or vice versa. This should be undertaken at a designated location well clear of the fuel storage facility.
- No explosives shall be stored at this location.

Figure 16 – Explosives storage location on the glacier.

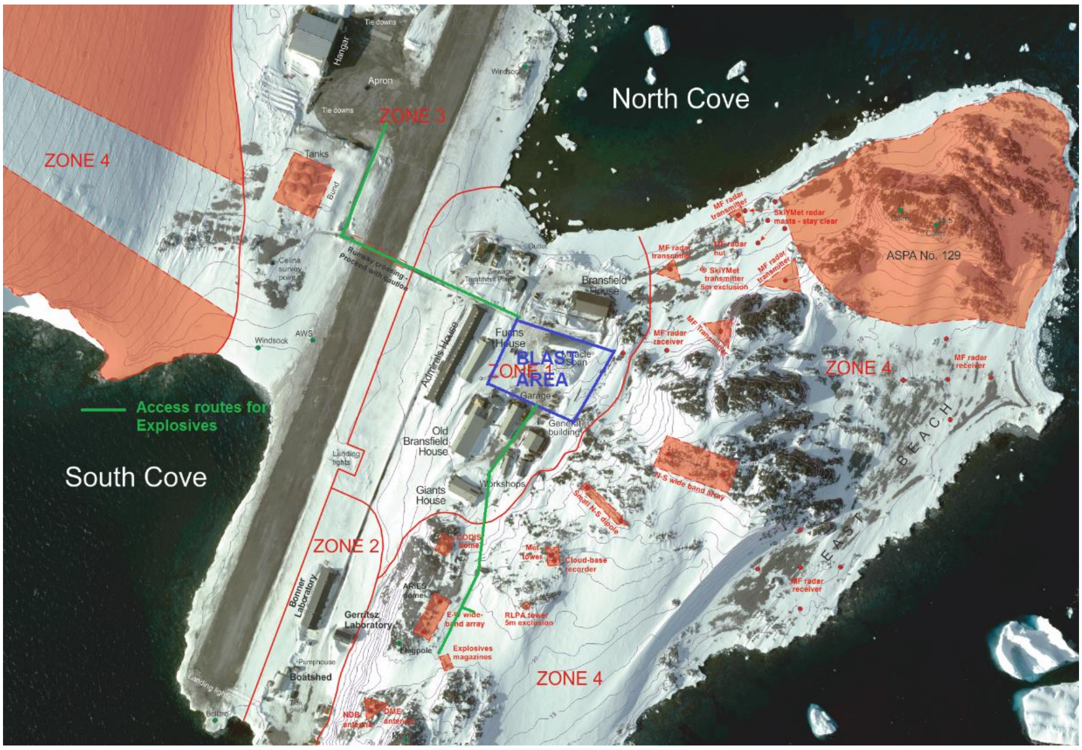


Figure 17 – Explosive transport routes and transfer areas. The transfer area may vary depending on flight operations.

3.8.5 Control of keys

The keys to the explosives stores will be kept by the Station Leader in a secure place. The keys must only be released to a recognised Explosives Storekeeper or Shotfirer. The release of keys will be recorded on BAS form 'BAM Explosives Locker Key Sign Out Sheet'. During the day the keys must be held kept on the person and be returned to the secure place at the end of the day.

Keys may not be passed from BAM personnel directly to other BAS staff without the explicit approval of the Station Leader.

3.8.6 Explosives stock records

A permanent record must be kept of the contents of all explosives stores. All movements of materials in and out of the stores must be recorded. The primary record will reside with the station leader unless otherwise agreed on site.

3.8.7 Storage procedure

Care must be taken to ensure that, during delivery of explosives to a storage place or during the removal of material from it, no grit is allowed to contaminate the cases or the store and the floor of the magazine must be thoroughly swept after any delivery or withdrawal of explosives.

All cases of explosives should be stored flat with their top sides uppermost and in such a way as to allow the name of the explosive and of its manufacturer and the date of manufacture to be clearly visible. If this is not possible in the confines of the small storage space available, then the boxes must be marked up with the relevant information on the face which is visible on entry to the store. Cases of explosive must be so stacked that any pile is stable and so as to allow all-round ventilation.

Only persons who are appointed may enter the explosives store / storage area (Explosives Supervisor, Shotfirer, and Explosives Storekeeper). Before entering the explosives store, personnel must ensure footwear is clean and free from grit.

Footwear with exposed metal parts (exposed steel toe-caps, steel tips or studs) must not be worn in the explosives store.

The Shotfirer must ensure that any surplus explosives are returned to the explosives store / storage area at the earliest opportunity and the records amended accordingly; no attempt to fire the shot takes place until surplus explosives (including detonators) have been removed from the blast area.
Stock record books must be completed at the time of adding or removing stock from the magazine. Copies of material safety data sheets and technical data sheets should also be available for every product held – these records may be kept electronically or as hard copies in the office. When explosives are added or removed, the storekeeper must check that the resulting stock matches the record book for that type of explosive.

A total stock check must be undertaken at least once per week and the magazine book signed as a full check. Ideally this should be undertaken by a separate authorised person eg. Shotfirer or Explosives Supervisor.

Any discrepancy must be immediately investigated eg. re-check the quantities written down in the record book against the delivery note, specification or other document. If the difference is not immediately found, or does not relate to the current entry for that day, it must be reported to the Project Manager and Explosives Supervisor. The Explosives Supervisor must then ensure that the difference is investigated by checking the record book against delivery notes and blasting specifications and either rectify the error in the record book, or when there is any evidence of theft, or when missing explosives cannot be accounted for, this must be reported to the Station Leader.

Other requirements:
- Stacks should not exceed a height of 1.4m and a 10cm ventilation gap should be maintained between the explosives and the wall and between stacks.
- All excess packaging shall be removed.
- Only one box shall be opened of each type at a time. Any part boxes shall be labelled with the actual contents.
- The magazine must be earthed.
- No dragging boxes across the floor of the store.
- No tools or equipment should be kept in an explosives store except such as are required for keeping the store clean. Cleaning equipment must not incorporate parts made of iron or steel.

3.8.8 Fire Prevention

It is essential that smoking materials, matches, lighters or any other sources of ignition are not taken in to an explosives storage area. Fires, naked lights or lighted cigarettes are not permitted within 25m of any explosives store. No petrol, oil, flammable solvents, wastepaper or similar material whose ignition might imperil the explosives store is permitted within 25m of any place where explosives are stored.

3.8.9 Demobilisation of Explosives & Storage

At the time of preparation of this document, it is not possible to determine the exact nature of the demobilisation of explosives at Rothera at the end of the Rothera Modernisation Project, however it is the absolute responsibility of BAM to ensure that explosives are either removed, destroyed, or transferred to another stage of the project with clearly defined responsibilities going forward. If no arrangement is made for further use, the default option must be destruction.

Requirements:

- BAS explosives stored at the ski-way must be returned to the on-station storage.
- The bund walls surrounding the BAM on-station storage must be dismantled and placed in storage – location to be determined. The total explosives storage must be reduced to the unbunded-metal-store storage limits as per the Explosives Regulations 2014.

Demobilisation of the explosives at the end of the Rothera Wharf Project:

- The BAM shotfirer will destroy all excess explosives at the end of the project, unless one of the following options is clearly planned and approved:
  - Transfer to another BAM project at Rothera.
  - Transfer to another BAM BAS partnership project eg. KEP.

Destruction will be undertaken following UK guidance as per BAM Ritchies Guidance DB G27 Disposal of Explosives During Blasting Activities.

3.9 Shotfiring Equipment

The Explosives Supervisor is responsible for ensuring that equipment provided is suitable and safe and to take out of use anything that is not. Equipment must be tested / checked and assessed as outlined below.

1. Exploders for non-electric exploders will be tested every 6 months by BAM Ritchies on-site.

2. Equipment used with electronic detonation systems, however named eg. loggers, blasters, will be tested by an external tester approved by the supplier. This will be undertaken prior to the project and then as advised by the supplier during the project. If necessary these small items can be taken back to the UK between seasons for this purpose.

3. Laser profiling equipment and electronic hole probes, will be tested every 12 months as advised by the supplier. If necessary these small items can be taken back to the UK between seasons for this purpose.

4. Other equipment – including measuring tapes, prickers, stemming rods, shovels, torches, inclinometers – will be field checked by the user prior to use and checked monthly by the Explosives Supervisor. This will be evidenced by completion of BAM Ritchies checklist DB PPEa or b and will be kept on-site and available for inspection.

All equipment will be tested following any major repair or failure, or for exploders, following an unexplained misfire.

Any equipment not safe or suitable will be removed from site, or labelled ‘out of service’.
Exploders will either have a removable key (or other devise that renders it inactive), or be small enough that they can be kept on the shotfirers person (some types of non-electric starters have no key, but are small enough to keep in a pocket – removal of key below means removal of the entire exploder for these types).

The Shotfirer will only fit the key once he is ready to fire the shot and will immediately remove the key after firing. The Shotfirer will keep the removable key in a safe place during the charging of the shot. Any duplicate keys must to be kept in a secure place.

3.10 Explosive Products

Although explosives are only used by trained and competent users, there are a great number of alternative explosive products available from different manufacturers and suppliers, and whether they are packaged explosives, boosters or initiation products, Explosives Supervisors and Shotfirers must ensure that they understand the nature and safe use of each product prior to its use.

As a minimum users should have read the product information provided eg Technical Data Sheets and Material Safety Data Sheets from the supplier. Some products may require more specific training eg electronic initiation systems. If in doubt contact the Explosives Supervisor. The Explosive Supervisor may contact the manufacturer, or the BAM Ritchies Manager, Drill and Blast for additional information.

The following explosives types will be used:

- Packaged emulsion explosives (eg. Orica's Senatel Powerfrag, or similar) will form the main explosive charge.
- Cast boosters (primers) will be used to initiate/boost the packaged emulsion explosives.

Figure 18 - A packaged emulsion explosive and cast boosters.

These explosives have been selected for a number of reasons to minimise impact to the environment:

1. The explosives have been manufactured to a high standard of quality control in an explosives factory to have a good oxygen balance, minimising the production of harmful toxic emissions of NOx and excessive CO, CO_2. Some emissions will be released to the atmosphere as indicated in product 'material safety data sheets'.
2. These explosives contain no nitro-glycerine and deteriorate to a greater state of safety in the unlikely event of a misfire.
3. They are relatively insensitive during handling in relation to other explosives types, and are suitable for cold conditions.
4. They are waterproof.

Although most packaged emulsion explosives are detonator sensitive, cast boosters can be used to avoid desensitisation in difficult conditions.

Non-electric have been selected to initiate the explosives and to control the initiation sequence. These detonators are not affected by radio frequency hazards and are sufficiently robust for use in the process described below.

Figure 19 - Examples of non-electric detonators

Waste packaging from explosives must be burned on site in a controlled manner in an open fire as this is the best means of disposal of potentially contaminated packaging in a safe manner. This is as per the HSE / CBI Guidance for the Safe Management of the Disposal of Explosives 2007 s11.2.3.5, as referenced in the UK Explosives Regulations 2014. This process is anticipated to have a minimal impact with the small size of the blasting operations. No other waste will be burnt during this process.

3.11 Blasting Times

Blasting will be permitted 6 days per week Mon - Sat during daylight hours.

The Explosives Supervisor will check the local weather condition and weather forecast with the Station Leader prior to commencing charging to identify any adverse weather conditions that may either affect safety in, as follows:

- Conditions that may restrict visibility eg. snow, fog, low cloud.
- Risk of electrical storms.
- High winds.
- Any other adverse weather.

Conditions will be discussed with the Project Manager, or his deputy, to determine if charging should commence. Both must agree if the decision is to start charging, though either one alone may postpone the shot.

Prior to commencing the blasting procedure (including clearance and securing of the danger zone), the Shotfirer and Blast Controller will assess the conditions once again to ensure that there is sufficient visibility to safely clear and secure the danger zone and fire the shot, including allowing time to carry out the post-blast inspection. Both must agree if the decision is to fire the shot, though either one alone may postpone the shot. In the event of doubt (marginal conditions) the Explosives Supervisor should be consulted for advice. The Shotfirer and Blast Controller still retain the right to postpone.

3.12 Blasting Constraints

The following are not permitted:

- Blasting methods prohibited in the Quarries Regulations 1999 Reg.29 4(b) and (c)
- Initiating explosives except those confined in a shot-hole, or as part of an initiation system, or when destroying detonators unless approved in writing and an additional activity plan and risk assessment carried out (eg. blasting snow).

The table below details the required blast parameters for each given hole diameter and should form the basis of all design. This will be completed on-site by the Explosives Supervisor after inspection of the blast site but prior to the blasting works. Shotfirers **must** work within these constraints, or refer to the Explosives Supervisor if they consider it necessary to work outside these limits.

Should the Explosives Supervisor have to either design a blast, or approve a specification where the values are below the required minimum shown below in 3 and 5 and, or outside the allowable variation, then the reasons must be annotated on the given blast specification.

If the Explosives Supervisor wishes to impose greater restrictions for a specific blast then these should be communicated directly to the Shotfirer ideally before the shot is marked, but at least prior to approval of the blast specification. In addition restrictions should be written on the specification.

No	Item	Hole Diameter 70-76mm
1	*Maximum allowable variance from the design charge before discussing with Explosives Supervisor. Per hole.*	*+ 10%* *-100%*
2	*Design Stemming Depths*	*2.4m*
3	*Absolute Minimum Stemming Depths*	*1.7m*
4	*Design Burden based on desired pattern*	*2.0m*
5	*Minimum front row burden to be charged*	*2.0m*
6	*Minimum front row spacing to be charged*	*2.0m*
7	*Design Sub Drill*	*0.5m*
8	*Required Burden to be Reported by Burden Master*	*2.5m*

The Explosives Supervisor must be notified if two adjacent holes (in any direction) cannot be charged, to allow them to determine the best course of action (eg re-drill at a different location).

3.13 Environmental

There are a number of potential environmental effects that blasting at Rothera may have on receptors.

1. Removal of ground currently occupied by structures, science or communications equipment.
2. Permanent ground displacement in the immediate vicinity of the blasting that may affect the integrity of a structure or its foundations.
3. Rock projection from the blast site, or displacement from adjacent faces may affect anything within this region.
4. Ground vibrations from the blasting affecting structures, fauna or science adjacent to the blast area.
5. Sound pressure waves in the water from transmission from blasting on adjacent land may cause disturbance to marine fauna.
6. Air-overpressure (noise) affecting fauna in the vicinity.
7. Dust.
8. Fumes.

These aspects and mitigation measures are discussed in the following sections.

3.13.1 Removal of ground currently occupied.

Blasting will be undertaken for the purpose of ground levelling for construction, rather than for rock winning, and therefore no structures will be removed specifically for blasting. It should be noted that the Miracle Span is within the construction area and will need to be removed. In addition Fuchs House, Garage and Workshop attached to Old Bransfield House are in very close proximity to the extraction area.

3.13.2 Permanent ground displacement

Disturbance due to permanent ground displacement beyond the blast area will only affect a very small distance of a few meters beyond the extraction area, and will be controlled through the blast design process to minimise back-break. It is possible that this may adversely affect those buildings within 5m of the blast area and blasting towards these areas must be monitored and hydraulic breaking used if required. Geological and geotechnical conditions will be taken into consideration to avoid ground failure that might extend beyond the blast area.

3.13.3 Rock throw and rock fall from adjacent faces

Rock throw is strictly controlled through the blast design process, which involves laser surveys of the face, hole surveys and the production of a 3D model of the blast to allow carefully considered explosive placement. Rock throw is therefore contained in the working area in front of the face, with minimal ejection behind the blast beyond a few meters. The size of the exclusion zone beyond the blast area is a safety measure and does not represent the extent of expected rock projection.

In addition to the blast design measures above, blast mats may be placed on top of the blast to further restrict rock throw. These mats are constructed from rubber tyres and are placed over the blast using an excavator and secured using chains.

To prevent damage to the New Bransfield House from rock fall/roll from the adjacent un-blasted face a rock bund may be required at the foot of the slope between the building and the blast area.

3.13.4 Vibration

For any specific site, the intensity of blast vibrations are related to the size of the charge fired, the distance from the blast site to the receiver, and the geological and topographical conditions at that location. Although the effect that specific geological and topographical conditions at Rothera will have on vibration attenuation is not known, it is possible to make outline predictions of the intensity of vibration levels at different distances for a given charge weight and use these predictions to guide the decision process.

At very close proximity to the blast - a few metres - it is permanent displacement rather than ground vibration that will have the controlling influence on structures. Beyond a few metres of the blast site the vibrations are transient with a small proportion of the explosive energy is transmitted into the rock mass as seismic waves.

It is possible to make prediction of the likely intensity of the vibrations at each location based on an empirical relationship derived by the US Bureau of Mines relating ground vibration to distance and charge weight, taking into account local geological factors, as follows:

$PPV = a\,(SD)^{b}$

Where:

PPV = peak particle velocity (mm/s)

SD = scaled distance = Distance (D in meters) **/** maximum instantaneous charge (MIC in kg)$^{1/2}$

a and **b** are dimensionless site factors,

Appendix B lists the sensitive receptors identified at Rothera, their distance from the blast area and predicted peak particle velocity values for each. The predictions shown use site factors from the ISEE Blaster's Handbook 18th Edition for predicting upper boundary limits for construction blasting. Values are given for various maximum instantaneous charge weights (MIC) at various distances – the actual charge weights will be determined by the Explosives Supervisor and Shotfirer during the blast design process.

The relative sensitivity of structures and instrumentation has been discussed with the owners / managers of the sensitive receptors.

The specific requirements relating to each sensitive receptor are shown in appendix B and are discussed briefly below:

- No buildings have any specific sensitivity to blasting vibration. Vibration levels will therefore be considered against the requirements of *BS7385-2:1993 Evaluation and measurement for vibration in buildings*. It should be noted that initial predictions show vibration levels at the closest buildings in excess of those shown in BS7385. As blasting progresses towards these buildings, vibration levels will be monitored to determine peak particle velocity and frequency values. These values will be compared to BS7385-2. In the event that compliance is not possible at the closest proximity, the option is to allow exceedance with a potential for damage, or use a hydraulic breaker. It may be reasonable to accept/risk minor cosmetic damage to those industrial building

marked for demolition. The decision to accept/risk minor damage will be discussed with the client's representative.
- POM Sun Photometer – this can easily be removed and must be removed during blasting.
- Newcastle University GPS receiver – this has been reported as not adversely affected, however notification of blast times required to remove anomalies from results.
- The search coil magnetometer has been reported as not adversely affected by blasting, however notification of blast times is required to remove anomalies from results.
- Other meteorological, science and communications equipment has been reported as unaffected by blasting vibration.
- The five memorials are at a considerable distance from the blasting area should not be affected by the proposed blasting.
- A survey cairn in the ASPA area is not considered to be at risk due to the considerable separation from the blast area.

3.13.5 Blasting adjacent to the marine environment

Blasting will be undertaken at approximately 100m from the closest shoreline, therefore the marine environment will be unaffected by these blasting works.

3.13.6 Air Overpressure and noise from blasting

When an explosive is detonated, transient airborne pressure waves are generated. As these pressure waves pass a given position, the pressure of the air rises very rapidly to a value above the ambient pressure, then falls more slowly to a value below atmospheric pressure, before returning to the ambient value after a series of oscillations. The maximum pressure reached is the peak air overpressure.

These pressure waves comprise of energy over a wide frequency range, with above 20 Hz audible to the human ear as sound, whilst that below 20 Hz is in the form of concussion. The sound and concussion together is known as air overpressure and is usually measured in decibels (dB) with no frequency filtering applied.

In a blast, these airborne pressure waves are produced from five main sources:
- Rock displacement from the face.
- Ground induced airborne vibration.
- Release of gases through natural fissures.
- Release of gases through stemming.
- Insufficiently confined explosive charges.

Although it is possible to make predictions of the attenuation of air-overpressure, it is considered unrealistic to do so due to the affect that meteorological factors and surface topography have on the transmission of this energy. UK guidance contained within mineral planning guidance MPG 9:1992 and MPG 14:1995, MTAN1 (Wales) and the DETR report: The environmental effects of production blasting from surface mineral workings 1998 recommend that air-overpressure should be controlled at source rather than setting a specific limit. These control measures are discussed below in s3.13.7.

It is not anticipated that any structural damage, even cosmetic damage, will be caused by air-overpressure due to the nature of the controlled blasting that will be undertaken for these works.

The only terrestrial fauna identified in proximity to the blasting location are nesting Skuas as shown in figure 20 below and elephant seals that may occupy the surrounding areas. BAS staff have confirmed that in their opinion blasting air-overpressure should not adversely affect terrestrial fauna. Prior to blasting the Shotfirer will check the blast site to ensure that it is clear of any birds and seals and will report any disturbance.

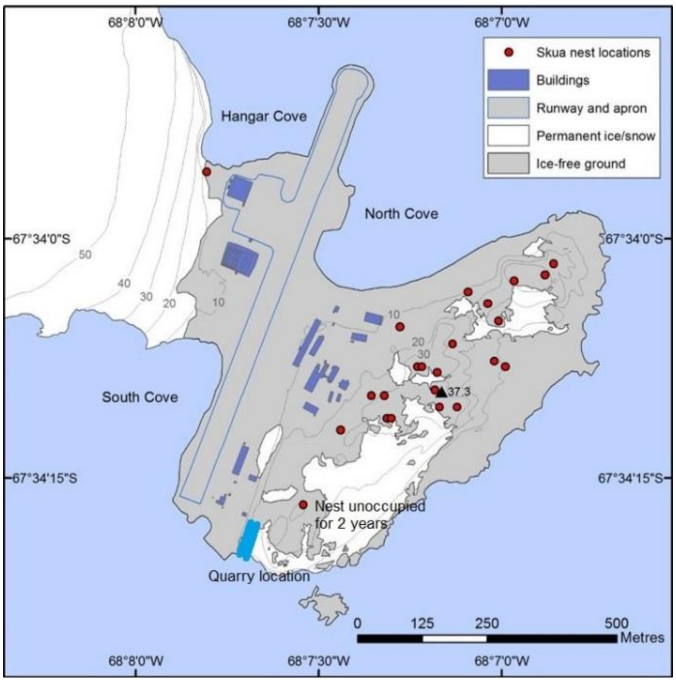


Figure 20 - Potential Skua nesting sites

3.13.7 Blast Design Control Measures

The following measures will be considered during the blast design process to minimise the effects of blasting vibration, air-overpressure and rock projection.

Blast design measures to reduce blast vibration:

- Reduce the maximum instantaneous charge by reducing the face height, reducing the hole diameter, or introducing decks of explosives in the hole. The ratio of explosives to rock must be maintained to avoid increased vibration.
- Strict control of drilling deviation, burdens and spacings to ensure even and appropriate distribution of explosives. Survey techniques and modelling will verify these parameters.
- Maximise the use of free faces to allow the rock to expand and avoid transmission of vibration.
- Use appropriate initiation sequences to ensure the rock moves in a controlled manner and new free faces are created.
- Control sub-grade drilling levels.
- Control the powder factor / blast ratio as reducing the explosive quantity may increase vibration if there is an insufficient quantity to break the rock. This is not just the ratio for the entire blast, individual heavy burdens may create high local blast ratios which will cause higher vibration.

Measures to reduce air-overpressure at source:

- Reducing the maximum instantaneous charge fired in any one delay period.
- Record geological conditions during drilling to ensure that weak areas are decked in the hole with aggregates to avoid energy escape.
- Correct confinement of explosives through use of correct burden and stemming.
- Utilise laser surveying of open faces and shot-holes to allow correct explosive placement and to avoid low burdens that allow energy to escape to the atmosphere.
- Ensure quality stemming is used in the top of the holes to prevent energy release through the hole collar.
- Use in-hole initiation systems.
- Avoiding un-confined explosives, including detonating cord, by using non-electric surface initiation systems.
- Avoid blasting when weather conditions may lead to increased propagation of air overpressure to the sensitive receptors; such as downwind conditions from the blasting site to the receptor(s) and when there is low cloud or an atmospheric temperature inversion.
- Controlling the direction of firing shots to help limit sound travelling in unfavourable directions.
- No secondary blasting of boulders.

- Careful selection of the location of the quarried rock source in conjunction with BAS management to minimise the impact through distance and orientation in respect to sensitive receptors.

3.13.8 Blast Vibration Monitoring and Analysis

During operations, blasting vibration levels will be monitored using blasting seismographs to measure levels of peak particle velocity and air-overpressure at selected site sensitive locations. This monitoring will be both to ensure compliance with site threshold limits and to further increase the number and distribution of results, to allow continuous improvement of vibration prediction models and increasing confidence in MIC predictions.

Monitoring should initially be undertaken at the closest sensitive receptors of each type, or agreed on site with project and station management. Once confidence is gained that vibration limits will not be exceeded at these receptors, monitoring should continue at varied distances to obtain data for prediction models.

Figure 21 – Example blasting Seismograph for monitoring PPV, air-overpressure, or peak pulse pressure

3.13.9 Monitoring the Condition of Memorials

There are five memorials located at Rothera Point which are considered of high value to current and past staff members, visitors and other interested parties. In general, it is the plaques that are considered of high importance, whilst the base structures should be maintained in good condition. Whilst the plaques are considered to be robust in relation to damage potential from blast vibration, the base structures may be subject to minor cracking damage.

In order to correctly monitor the condition of the memorials, pre-blast photographs will be taken of each one from all sides to form a baseline from which to compare and deterioration. During blasting operations, regular inspections will be made of the condition of each memorial, and repairs implemented to maintain the original condition after discussion with the Station Leader.

Should there be any risk of damage from rock projection to the actual plaques, then additional mitigation measures should be implemented, such as providing a protective covering, or temporarily removing the plaques to a safe location.

Details of the memorials are contained in appendix B.

3.13.10 Control of dust from operations

As far as possible the production of dust will be avoided, but the process of drilling and blasting of rock produces dust. The following measures outline how this will be controlled to minimise the dust becoming airborne and a hazard to personnel and the environment. Further general site measures to control dust such as water suppression is not repeated here.

1. Reduction of dust from drilling operations. The drill rig will be fitted with dust suppression equipment. This will normally consist of a dust hood at the foot of the mast, which makes a seal with the ground, a dust ring, which seals around the drill string, and a dust collection system

which extracts the dust directly away from the hole and places it onto the ground. Although the dust is still susceptible to being picked up by wind, the effects are significantly reduced. The driller should remain in the cab with the door closed.

2. Reduction of dust from blasting**.** Careful blast design will prevent excessive ejection of material into the air, however in dry conditions, some dust cannot be avoided. The direction of firing may reduce the pick-up of dust into the air by using natural topography to create shelter. On very windy days, or when the wind is blowing directly towards a close sensitive receptor, blasting may need to be suspended. For this to occur safely however the decision to suspend blasting operations should be taken before charging commences.

3. The blasted rock pile may be sprayed with seawater as part of general site dust suppression measures.

3.13.11 Fumes

All blasting produces harmful fumes during detonation. Although explosive selection has reduced the risk of these harmful fumes, they are not eliminated. Personnel must not muster downwind of the blast where they may be at risk of fumes. In general personnel outside the danger zone are not at risk. Shotfirers must wait until fumes have cleared before carrying out their post blast inspection. Fauna, generally elephant seals, removed from the danger zone during blasting should be far enough away from the blast to be clear of fumes.

3.14 Accidental Initiation

There are a number of sources of RF transmissions and therefore a risk of potential accidental initiation of electric detonators. Therefore only non-electric will be used for this project. This complies with BAS Explosives COP s6.3.2.

3.15 Electrical storms

There have been no electrical storms reported at Rothera during the last 40 years, however the potential consequence of an electrical storm is considered high and is therefore still considered. The first warning of electrical storms may come from the weather forecast. This will be checked on the morning of the blast by the Explosives Supervisor prior to commencing charging – see above.

Actions during the electrical storm

As soon as you hear thunder or see lightning operations should be suspended and you should take precautionary measures.

- Shotfirer to inform the Station Leader, Project Manager and Blast Controller of the need to evacuate the danger zone. Warning to be given over the designated radio channel.

- Blast Controller to implement the blasting danger zone as if the shot was to be fired. Care should be taken to avoid positioning sentries where they are at a danger from direct strikes.

- Other personnel evacuated from the area to retire to the safe designated place at New Bransfield House.

- Where a storm approaches during the blasting procedure and the danger zone is clear and secure, the Shotfirer and Blast Controller may agree to fire the blast if this can be done immediately.

Recommencement of Operations

After the electrical storm has passed, do not return to the site until the Shotfirer and Explosives Supervisor agree that it is safe to do so. As a minimum, this should be after a period of 30 minutes have passed since the last sighted lightning strike or thunder. A heightened level of vigilance should be maintained in case of a second storm approaching.

3.16 Indicative Blast Designs

The following blast designs are indicative and for information only. Actual blast designs will be made to suit site conditions and restraints and will be approved by the Explosives Supervisor.

Blast design parameter	Unit	Typical blast
Face height / cut depth	m	Up to 8m
Drill diameter	mm	64-76mm
Burden	m	1.8-2.0
Spacing	m	2.0-2.2
Sub-drill	m	0.5 - 1.0
Stemming length	m	2.0-2.4
Explosive diameter	mm	50-60
Explosive type		Packaged emulsion
Primer type		Cast booster
Initiation type		Electronic and/or non-electric
Powder factor	kg/m3	c.0.30-0.50
Hole angle (from vertical)	degrees	Vertical to 10

3.17 Drilling Operations

The area where the shot will be marked out will be communicated by the construction team to the Shotfirer on-site.

The Shotfirer will ensure that:
- The area has been checked as required to ensure that it is safe from face collapse, either on the bench, or from an adjacent bench.
- That the access route to the location is safe and sufficient for drilling equipment and shotfiring / charging vehicles.
- That the ground is sufficiently cleaned off to allow drilling.

The Shotfirer will also check that the proposed blast location, and access to it, is suitable, prior to the shot being marked.

The shot will be marked out by the Shotfirer and a ‘Driller’s log’ instruction prepared. The minimum to be marked on the ground will be the hole positions, hole numbers and azimuth markers for front row holes. For holes marked on a square/rectangular pattern, the azimuth marker for all other rows will be the hole in front. Where this differs an azimuth marker must be provided on the ground and on the driller’s log. Every effort will be made to avoid geological anomalies, which may give rise to fly rock.

The Driller’s log shall instruct the driller on hole location, diameter, depth and inclination and azimuth.

The driller shall carry out the drilling instructions. He will record on the driller’s log any variations from the intended hole locations and the position and extent of any voids, clay, broken ground, or zones of poorer quality rock identified during the drilling operation. Where there is a need for a substantial departure* from the instructions given, the driller must refer the matter to the Shotfirer or Explosives Supervisor. (*If the driller needs to move a hole more than 1m from its original position, or closer to the next hole than the minimums shown in section Blasting Constraints, or where there is any doubt.)

At each blast hole location, the driller will position the drill rig and set the drill mast at the angle specified in the Driller’s Log Instruction and in the direction of the hole indicator marked on the ground. The mast angle will be re-checked after approximately 2.0 meters of drilling and adjusted as necessary. Blast holes will be numbered sequentially, usually from right to left as the driller approaches the blast pattern from the top.

The rig must be positioned with the tracks perpendicular to the face to keep the rig’s centre of gravity as far away from the face as possible. If it is necessary to drill with the rig’s tracks parallel to the face a risk assessment will be completed prior to commencement.

As far as is reasonably practical, the front row will be drilled first, starting from any open end, working back through the blast hole pattern. The driller’s log will be completed continuously with information recorded during drilling or immediately after each hole is completed.

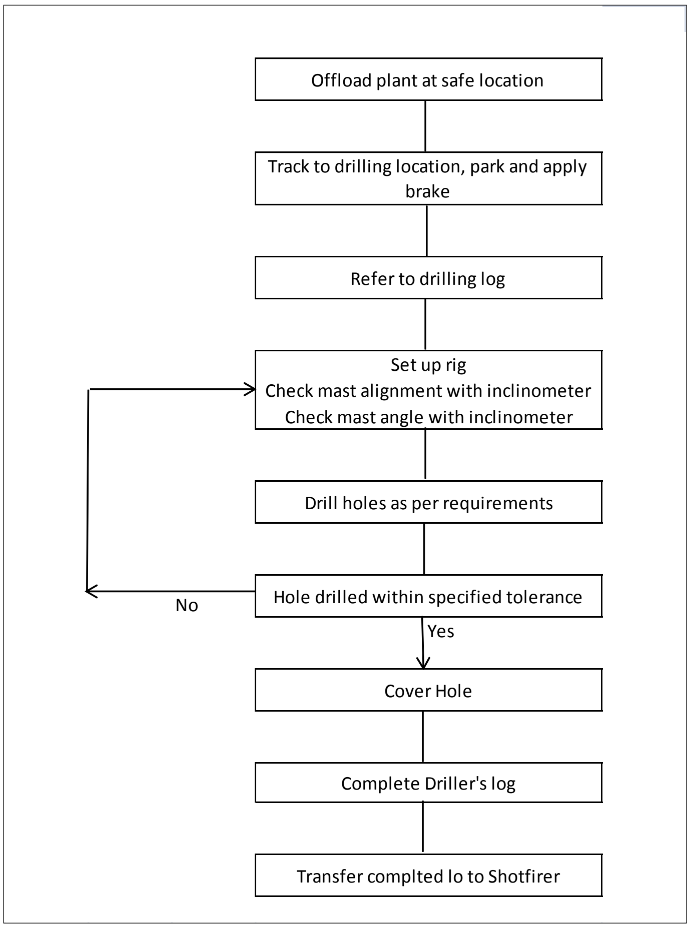


Figure 22 – Drilling Process Flowchart

On completion of drilling, the driller's log will be submitted to the Shotfirer or Explosives Supervisor to enable the blast specification to be produced - a copy of which will later be attached to the blast specification

Cones must be placed at the entrance to the top of the shot and on the quarry bench below to warn people and prevent access to the blast site by unauthorised personnel and general quarry traffic.

The Driller shall:

- Report to the Shotfirer or Explosive Supervisor should they be unable to drill any shot hole as per the driller's log, or within the allowable variation.
- Report to the Shotfirer or Explosive Supervisor if cavities, caves, holes, whether in-filled by clay or empty, are seen in the face or as a surface expression on the quarry top.
- Ensure that all cavities, obstructions, clay bands, faults and other geological features, which may affect the shot encountered during drilling are recorded on the drill log.
- Ensure that if the shot hole is not to be used for the purpose of the blast, it is in filled with inert incombustible material before any shot is charged.
- Check the hole depth with a tape measure to check the depth is correct and cover if required.

No drilling is permitted adjacent to charged holes where any part of the hole is within 10m of a charged hole without the completion of a specific activity plan and risk assessment for the activity (approved by the Explosive Supervisor). Although permitted, drilling adjacent to charged holes should be avoided wherever possible. Even with the appropriate control measures in place this should normally only be considered during the treatment of misfires.

3.18 Blasting Specifications

3.18.1 Surveying

To enable complete and accurate face surveys to be carried out the face must be cleared of all loose blasted material in the intended blast area. If any material is removed, or falls out of the face, after the survey then the survey should be repeated. Face surveys will be carried out using approved laser equipment (buffer blasts excepted).

All holes will be marked to identify hole numbers, going from left to right when looking at the face.

The Shotfirer will provide the Surveyor with details of the shot - number of holes, rows and provide the hole angles, unless the holes are to be probed. If the Surveyor is measuring the hole angles with a torch and inclinometer on the behalf of the Shotfirer, the Shotfirer must communicate any rules relating to the minimum length of holes that must be visible for a measurement to be valid, and details of any other information required. The responsibility remains with the Shotfirer and Explosives Supervisor.

Profiling will be carried out by an experienced surveyor, using laser profiling equipment within current calibration. The profiler will submit the completed survey to the Shotfirer or the Explosives Supervisor. New or irregular faces may require to be surveyed before drilling.

The laser operator will survey the face as required by the shotfirer taking care to ensure that any open ends are included and that a sufficient density of measurements are taken to ensure the accuracy of the survey. It may be necessary to survey the face from more than one location to ensure that a suitable density of measurements are obtained and there are no areas missed.

Figure 23 – Surveyor using electronic probe to survey holes

The collar of all holes will be surveyed using the laser profiling equipment.

The angle of all holes will be measured and recorded. This can be done manually using a torch and inclinometer, recording the values in a Blasting Record Book, or using an electronic probe.

The azimuth of all holes will be measured and recorded, either manually, or using an electronic probe. Where azimuths are checked manually, the following applies:

- For front row holes, and those adjacent to a face, an azimuth mark must be made on the ground and surveyed.
- For all other holes, standard practice is to use the hole in front as the azimuth marker. Where the actual azimuth differs an azimuth marker must be marked on the ground and surveyed.

Survey staffs should be in good condition and fitted with a levelling bubble to reduce errors. The surveyors acting assistant must ensure the staff is vertical. The staff should be held over the centre of the hole collar.

Avoid having the survey staff extended to great length as this increases the chance of positioning errors. If this is necessary for back-row holes, reduce the error on the front holes by having the staff in a low position for the front row and only extending it for the back row holes. Alternatively transfer a station by bearing and distance to the quarry top for the purpose of surveying back-row holes.

The surface position and direction of all holes will be recorded and part of the printout will include a table showing the surface position of all the holes.

Wet or deviated holes will be surveyed by electronic probe. This information will be downloaded directly to the survey program. When using a probe ensure that the magnetic declination is taken into account.

Figure 24 – Undertaking a laser profiling survey of the face

The surveyor will complete the survey and transfer the information to the Shotfirer / Explosives Supervisor who is responsible for confirming the validity of the information.

The surveyor will provide the following as a minimum:

- Profiles landscape with burden master matrix – all holes adjacent to a face.
- Front elevation view for all rows (showing hole to hole distances).
- Side view elevation between holes in different rows (one in front of the other).
- Plan (ideally to scale and showing the burdens and spacings).
- Survey assessment.
- Resection print out confirming the accuracy of the surveyor's position.
- 3D View.
- Hole Report – this provides co-ordinates of all holes.

3.18.2 Blast Specification Documentation

The specification will be prepared by the Explosives Supervisor or Shotfirer.

The Shotfirer will design each blast and prepare the blasting specification taking into account the survey information, site conditions and using experience gained from previous blasts in the locality to produce the desired outcome in a safe and controlled manner. In preparing the specification the Shotfirer will consider the information from, driller's logs, specified vibration constrains and other information including that gained from previous blasts in determining the hole charging plan and initiation sequence.

The initiation of individual explosive charges, either on a hole by hole basis or within an individual blast hole, will be designed to minimise environmental impact from ground vibration and air-blast whilst optimising the result of the blast.

The blasting specification will include the following:

- The angle of inclination, depth and diameter of each shot-hole and the length of sub-grade drilling.
- The face angle in-front of each hole.
- The level of any water in the holes.
- Details of any face inspection, especially where weak layers or cavities are identified.
- The burden in front of each hole to the face or the hole in front.
- The spacing between each hole.
- The completed driller's log.
- Type and quantity of explosive for each hole including stemming required.

- Position and number of primers and in-hole detonators.
- Surface initiation plan.
- Danger zone, sentry positions and firing position (this could be one plan used for all blasts within a specified area).

The blast design must ALSO CONSIDER:

- Any geo-technical information available.
- Any adjacent ice cliffs.
- Any ongoing construction activities.
- Previous blasting experience.
- Any sensitive receptors – structures, land & marine fauna and science.
- Air, marine or dive operations.

Prior to commencing charging the Shotfirer must sign the blasting specification and transfer it to the Explosives Supervisor. The Explosives Supervisor then checks the blasting specification is complete and adequate and then signs to approve it. The Explosives Supervisor should only sign the specification once they have checked that actual conditions are in line with the blasting specification.

Shotfiring operations must only commence when the blast specification is complete and signed. It is preferable that the Shotfirer and Explosives Supervisor roles are carried out by different people, though it is acceptable for the same person to undertake both roles.

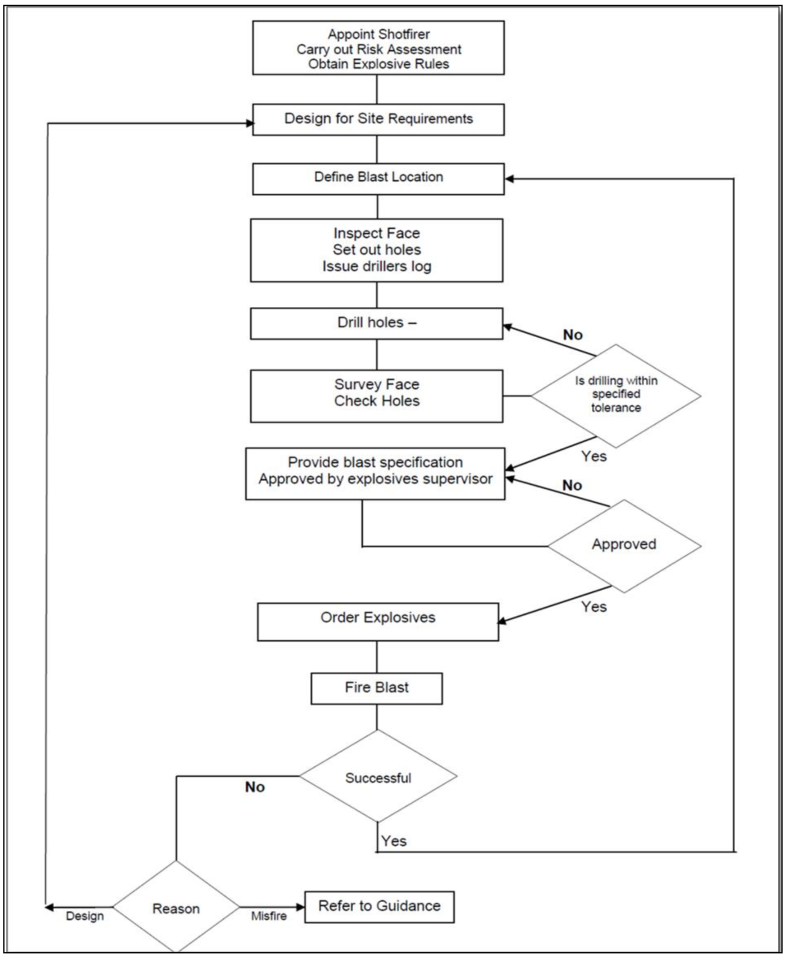


Figure 25 – Shotfiring Process Flowchart

Only one copy of the entire Blasting Specification will be produced. This will be held by the persons upon whom it imposes duties at that time. This is as follows:

Document	From	To
Drill log instruction	Shotfirer or Explosives Supervisor	Driller to complete
Completed drill log	Driller	Shotfirer or Explosives Supervisor
Survey profiles, plans and other data	Laser Surveyor	Shotfirer, or Explosives Supervisor
Complete proposed blasting specification	Shotfirer after completion and signing	Explosives Supervisor for approval
Complete proposed blasting specification	Explosives Supervisor	Shotfirer for charging
Completed actual Blasting Specification	Shotfirer after firing and completing post blast information.	Explosives Supervisor for review for future blasts
Completed actual Blasting Specification	Explosives Supervisor	Quarry Supervisor for filing
The danger zone plan, including sentry positions, should be copied as necessary and given to the acting Blast Controller, Sentries and publicised as described in section 3.20.		

3.19 Shotfiring Operations

3.19.1 Charging

The Shotfirer must be present at all times when holes are being charged. The shot / explosives may be guarded by a suitable person – but charging must be suspended until the Shotfirer returns. Where several Shotfirers are working together, the Shotfirer who has signed the blast specification is the acting Shotfirer for that blast and other shotfirers are acting under their instruction.

For packaged explosives the rise will be checked at regular intervals of not less than every 25kg. Any tape used must be of the correct length and have a non-ferrous weight.

Stemming material must be granular and loaded in such a way to avoid bridging – angular aggregate of approximately 0.1 to 0.15 times the shot-hole diameter.

The Shotfirer is allowed to increase or decrease any charge by the amount indicated in the section blasting constraints within this document, unless other specific restrictions are imposed by the Explosives Supervisor. The Shotfirer must record any changes on the blast specification sheet, and if at any time substantial changes are required, or if there is an increased risk resulting from shotfiring operations then the Explosives Supervisor must be informed.

If it is not possible to stem holes as per the specification, or within allowable variations, the Explosives Supervisor must be notified immediately.

The Shotfirer will ensure:

- Explosives are not removed from boxes or containers until required for immediate use and that, where practicable, only one container of explosives is open at a shot-hole at any one time.
- No detonators or shock tube connectors are used unless they are clearly marked and identifiable.
- Primers are assembled in the approved manner and in accordance with the specification for each shot-hole.
- Under no circumstances are two detonators attached to, or inserted into, a cast primer that is designed to receive only one detonator.
- Only approved non-ferrous tools in good order and free from grit are used when it is necessary to pierce a cartridge.
- Primer cartridges must be carefully lowered and the position checked against the specification.
- No person forcibly removes any detonator lead, or other system for initiating shots from a shot-hole after the shot has been charged and primed.
- Great care is taken to ensure that all down hole initiating lines are neatly coiled and secured near to the shot-hole collars.
- Detonating cord is only cut with a sharp knife in free air, or on a wooden anvil, or using specialist cutting equipment designed for this purpose.
- The Shotfirer must be fully satisfied that each shot-hole has been charged in accordance with the blasting specification and that the loading horizons and charge weights for each shot-hole have been accurately recorded.
- Detonators, other explosives or charged holes are not left unattended.

- The shotfirer will ensure that there is no naked flame within 10 metres of any explosives or detonators.
- Surplus explosives must be removed from the blast area before firing, not left unattended and returned to store as soon as possible.
- The shotfirer must ensure that no explosives remain in discarded containers by inspecting them prior to placing them at the burning location. These waste containers, and only this type of waste must be burnt after the shot, or at a designated place at least 100m from the shot.
- Before any shot-hole is fired for the purpose of a primary blast, the Shotfirer shall ensure that it has been charged in accordance with the blast specification. In the event that the Shotfirer finds that a shot-hole has not been charged in accordance with the blast specification he shall report that discrepancy immediately to the Explosive Supervisor.

Where practicable, all chippings for stemming and cover material for the shock tube connectors is placed near each shot-hole prior to charging taking place and the Shotfirer personally checks that all stemming material complies with the blasting specification.

3.19.2 Connecting the initiation system

The Shotfirer must ensure that:
- All charged shot-holes are connected up in accordance with the initiation plan in the specification.
- All detonators are connected to the harness wire or other nonel detonator tube as per the manufacturer’s recommendations.
- Nonel connector blocks are not overloaded with more nonel tubes than they are designed for.
- Nonel connectors are at least 1.2 metres apart and the initiating detonator is at least 1.0m from the connector being fired.
- Kinks in shock tubes, tubes crossing back over the connector block are avoided.
- Before the connector blocks are covered, the Shotfirer personally carries out a thorough check to confirm that all down-lines are connected into the connector blocks and that all connector blocks are connected into the circuit.
- All connector blocks are covered with a minimum of 200mm of damp dust or chippings to prevent damage to surface lines by shrapnel.
- Great care is taken to avoid contact between shovel and initiation lines during covering operations.

3.19.3 Covering the blast with blast mats

The need to use blast mats should form part of the blast design and should be noted on the blasting specification. If during charging, conditions change the Shotfirer decide that blast mats are required and should amend the blasting specification to reflect this.
- Blast mats should be laid over the blast using a hydraulic excavator or crane.
- The blast mats should be placed from the back of the shot to the front, with a large overlap giving almost a double layer.
- Once placed, chains should be used to link the mats together.
- Great care should be taken to ensure the initiation system is not damaged by the mats. Shock tube should not be too tight or be allowed to pass over sharp edges. They should be covered with fines as protection if necessary.

3.19.4 Testing the initiation system

The Shotfirer must ensure that:
- The connecting, testing and firing of initiation systems must only be carried out by themselves, or another Shotfirer.
- Only currently certificated testers and exploders must be used.
- Tests to live circuits are made from the blast shelter, or from outside the danger zone once the danger zone has been cleared of personnel.
- The testing of the non-electric exploder will be carried out using an off cut length of lead in line to ensure that it operates correctly.

When in charge of an exploder, the Shotfirer:
- Retains any removable handle or key in their possession throughout the period of duty.

- Does not place any removable handle or key in position in the apparatus until they are about to fire a shot.
- Where a shock tube-initiating device is used, this is classed as a key and is retained in their possession throughout the period of duty.

If the circuit tester indicates discontinuity, first disconnect the cable and retest it. If the fault remains then further examinations must be carried out. The removable handle or key will not be placed in the exploder until the exploder is about to be used by the Shotfirer and it will be removed immediately after firing.

3.20 Blasting Danger Zone

This Danger Zone is that described in the Quarries Regulations 1999. No personnel are allowed to be in areas demarcated as the danger at the time of firing the shot, except within a suitably located and constructed blasting shelter capable of offering protection from projected rock.

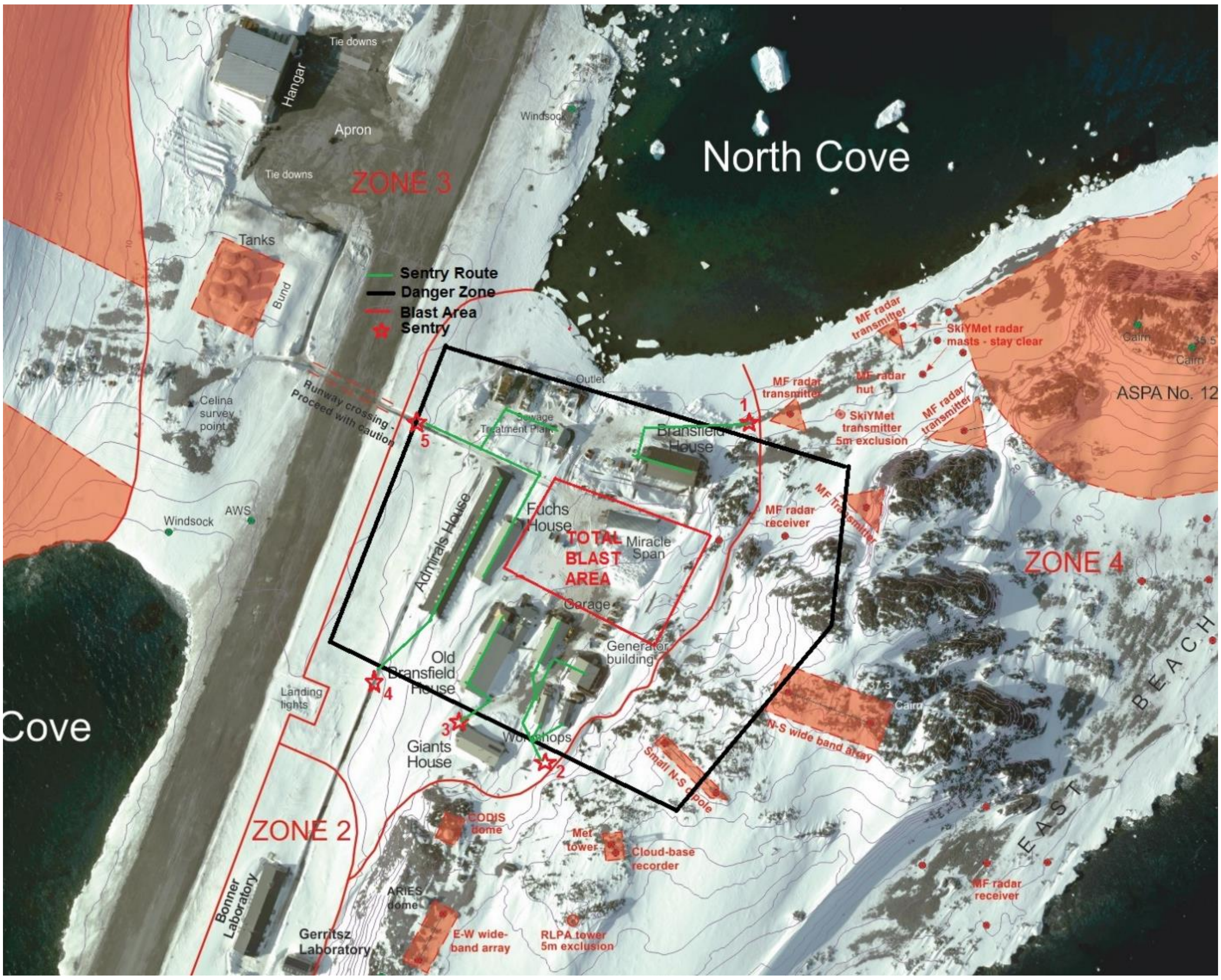


Figure 26 – Indicative Blasting Danger Zone

An indicative danger zone is shown in figure 26. The actual danger zone must be determined by the Explosives Supervisor on site. The Explosives Supervisor may also re-determine the danger zone and muster points at any time either routinely, during the preparation of the blasting specification or due to changes during charging. Any changes must be notified / publicised as described below.

The Danger zone plan for any blast must show the following items:

- The Danger zone boundary.
- The firing position
- Sentry positions with sentry names or numbers clearly marked.
- The blast location

The plan in use on the day must be publicised as follows:

- Personally to the Blast Controller from the Explosives Supervisor.
- Personally to all sentries by the Blast Controller.
- Posted on the notice board in New Bransfield House.
- Posted on the notice board in the site office.

The Explosives Supervisor and Shotfirer will reassess the suitability of the extent of the danger zone during preparation of the blast specification and again after charging if conditions change, or if charging was different to that proposed. Any changes will be notified to the Blast Controller as soon as possible, though this must be before the commencement of the firing procedure. Any changes after commencement of the firing procedure will result in a postponement and re-start – with sentries re-briefed as required.

During re-assessed of the extent of the danger zone the Explosives Supervisor will consider the following factors:

- prevailing face condition
- past experience in the behaviour of similar blast patterns and blast ratios at the location
- relevant information included in the geotechnical assessments
- orientation of the face
- type of blasting being carried out
- geological anomalies and other information revealed during drilling and loading of the shot holes
- feedback from the Station Leader and Construction Manager
- the proximity to access routes
- the degree of throw expected
- any other factors considered to be relevant on the day.

3.20.1 General Sentry Duties:

1. If you are asked to act as a sentry, you must have been appointed and have been briefed of your duties.

2. You will be given clear instructions, issued by the Blast Controller informing you of your duties and responsibilities and where you must position yourself for the blast. During blasting you are under the instruction of the Blast Controller and Shotfirer only, except to stop the blast.

3. You must ensure that you are in position in sufficient time to clear your area of responsibility and bar all entry to the danger zone.

4. You must ensure that you understand the method of communication.

5. You must undertake any checks assigned to you and then take up your assigned position. You must stop traffic and personnel as directed.

6. You must have clear communications with the Blast Controller and Shotfirer and when asked to do so, report that you are in position and that your area of responsibility is secure. As per the instructions overleaf.

7. You will immediately report to the shotfirer, if at any stage the danger zone is breached, or there is some other matter affecting the safety of the blast. If in doubt call STOP on VHF Ch 1.

IMPORTANT If someone is determined to pass, do not attempt to restrain them by any means other than gentle persuasion.

8. You must ensure that you fully understand the audible warning procedure as detailed overleaf.

9. You must stay in position when the shot is fired and bar all entry to the danger zone until the ‘all clear’ signal is sounded and the shotfirer gives the ‘all clear’ by radio. If in doubt **stay in position** and contact the shotfirer.

10. In the event of a misfire, you must stay in position and bar all entry to the danger zone until instructed to do otherwise by the shotfirer.

If at any time you are unable to properly discharge your responsibilities, you are required, without delay, to bring the matter to the notice of the Explosives Supervisor.

3.20.2 Specific Sentry Duties:

Sentry 1	Co-ordinates checks of New Bransfield House and the surrounding lower area. Takes up position on the round the point path.
Sentry 2	Co-ordinates checks of the Generator Building, Garage, workshops and Vikings and the surrounding area. Takes up position on the path past Giant's House.
Sentry 3	Co-ordinates checks of Old Bransfield House and the surrounding area. Takes up position at the entrance to Giants House.
Sentry 4	Co-ordinates checks of Admiral's House and the surrounding area. Takes up position on the path to the Bonner Lab.
Sentry 5	Co-ordinates checks of Fuch's House, the BAM workshop and Sewage Plant and the surrounding area. Takes up position at the runway crossing.
Station Leader / Deputy	Undertakes muster to ensure all personnel are accounted for.

3.20.3 Sentry Communications

The following main communications will be used:

- From the Blast Controller to a Sentry '***Sentry (name or number) are you in position and your area secured?***'
- Response from Sentry – for area secure '***Sentry (name or number) in position and area secure***'. If not secure '***Sentry (name or number) not secure***' then explain.
- From Blast Controller to Shotfirer to give permission to fire '***Blast Controller to Shotfirer you are authorised to fire when ready***'
- From Shotfirer to Blast Controller '***Firing in 'x' seconds unless anybody calls STOP***' (x = approximate time to firing).
- From Shotfirer to Blast Controller after firing '***All Clear'***, or explain otherwise.
- By anyone to stop the blast '***STOP, STOP, STOP'***.
- Other communications between the parties involved are allowed by way of explanation, but the above communication is required to allow the firing to proceed and the phrases should not be used in other contexts (eg. a sentry should not say 'in position and all clear').

3.21 Communication of Blast Times

The following notifications will take place 24 hours prior to blasting:

The Blast Controller should communicate to the following people. The agreed method of communication is shown on the blast checklist (see appendix A):

- BAM representative to notify BAS Station Management at the 07:45 MET briefing the day prior to the blast:
    - Attendees -Station Leader, Duty Comms Officer, Chief Pilot, MET & Science leader, Boat & Dive leader.
    - BAS Duty Comms Officer to notify Science & Bonner Lab Manager & any of the above not in attendance.
- Blast Controller to notify BAM Construction Manager (Sub-Agent)
- Blast Controller to notify key BAS personnel by email - rreng@bas.ac.uk; rmet@bas.ac.uk; rboat@bas.ac.uk; rdiver@bas.ac.uk; rops@bas.ac.uk; rcpilot@bas.ac.uk; rbc@bas.ac.uk; craon@bas.ac.uk; rfom@bas.ac.uk; ajmas@bas.ac.uk

- In addition the Blast Controller places a notice giving the time of the blast and the nature of the danger zone on a plan at the following locations:
    - *Project office notice board*
    - *New Bransfield House canteen notice board*

The Blast Controller completes the blast checklist and notes all communications and checks and the date and time that they are made.

On the morning of the blast the Blast Controller will place a ‘Danger Blasting’ sign with the time at the following locations:

- On the access road between Giant’s and Old Bransfield House.
- On the access road from the runway adjacent to Admiral’s.
- On the access from New Bransfield House.

Further checks and actions are required at 60 minutes prior to blasting and then from 15 minutes prior to blasting as described below. Again all actions should be recorded on the checklist.

3.22 Firing Procedure

The firing procedure will be carried out by the Blast Controller, with specific actions undertaken following the Blast Checklist – see example in Appendix A. The checklist requirements will be developed on site at the commencement of the blasting by the Explosives Supervisor to ensure that all safety measures are included.

When any communication is not clearly understood the safest situation must be maintained – the shot is not fired, or the danger zone is maintained.

Radio communications on the designated channel, except for emergencies, must cease from 15 minutes prior to blasting until after the ‘all clear’ – any interference may cause a postponement.

The following outline procedure is followed:

60 minutes prior to blasting

- All station warning - blasting in 1 hour.
- Personnel are notified of the blast time by their immediate supervisor and will stop work and leave the danger zone, by *15* minutes before the blasting time. All mobile plant will be parked in a safe place.
- Blast Controller to ensure sentries are ready and issued with radios. Radio check - channel 1.

15 Minutes prior to blasting

- All station warning, blasting in 15 minutes'
- All personnel should be clear of the blast area by this time.
- Sentries start their designated checks and move to position and secure the area. Confirmation received by Blast Controller.
- Shotfirer makes final check of blast area and checks for personnel and fauna

At 3 minutes prior to firing

- Blast Controller obtains confirmation from the shotfirer - ready to fire.
- Blast Controller checks sentries are in position and area secure.
- All station warning, blasting in 3 minutes'
- Sound horn - 2 x 15 seconds

Firing the shot and post blast

- The siren will be sounded for 1 x 30 seconds, immediately before the shotfirer fires the shot.
- Shotfirer checks that the shot has fired and radios the 'all-clear', or stay in position in the event of a misfire. 'All clear' repeated by Blast Controller.
- The siren is sounded 3 x 3 seconds and the sentries are stood down.
- Notify the BAM General Foreman of any remedial or safety measures required

Until the ALL CLEAR has been given **NO** person or vehicle traffic may return into the danger zone except:

- The Shotfirer.
- Those specifically authorised on that occasion by the Quarry Manager and Explosives Supervisor during treatment of a misfire.

3.23 Post Blast Inspections

After the shot is fired:

1. Remove the key from the exploder or personally retain the shock tube initiating device.
2. Disconnect the shotfiring cable from the exploder as appropriate.
3. Wait for the dust and fumes to disperse.
4. The shotfirer will inspect the blast site to check for misfires and the state of the face for overhangs and loose boulders. He will ensure that all precautions are taken during this exercise to avoid harm to himself.
5. Only when he has satisfied himself that it is safe should he give the “ALL CLEAR”.

In the event of a misfire, follow the misfire rules.

3.24 Safeguarding shots overnight

The Shotfirer must ensure that the Explosives Supervisor and Quarry Supervisor are informed as soon as it becomes apparent that the shot cannot be fired within permitted times.

The Quarry Supervisor must ensure that when a shot is being left overnight it must be guarded by a suitable person (appointed as Explosives Supervisor, Shotfirer, or Sentry), or made secure with barriers and warnings. Due to the nature of the remote location and the weather conditions, guarding may not be required, though suitable measures must be put in place and station staff notified to keep clear.

General:

- All charged shot holes will be completed and stemmed to prevent any off the detonators / explosives being removed from the column.
- No surface connector detonators are left attached. If already in place these should be removed and returned to the store.
- All in-hole detonator tubes/wires will be suitably anchored. This would normally be done by wrapping the loose ends around a large rock to ensure that they are not pulled into the stemming in the event that the column settles whilst being slept.
- The blasting record is completed, and all unused explosives, detonators and accessories are returned to the explosives store. In other words the paperwork reflects the current situation on site.
- All blasting keys are kept locked secure.
- Notices / barriers are erected to inform personnel that a danger exists. All entry points onto the bench containing the charged holes are coned off to restrict access and to demark the area that is being left charged; only authorised personnel are allowed to enter the coned area.

Charged holes should not be left unfired for a period exceeding 72 hours; this is to reduce the effects of water on the column of explosives.

3.25 Destruction of surplus explosives

Specific guidance is available on the disposal of surplus explosives in guidance ‘BAM Ritchies DB G27 Disposal of Explosives during Blasting Activities’ and from explosives suppliers. If you are not familiar with safe methods of disposal discuss with the Explosives Supervisor.

3.26 Misfires

The following procedure should be followed in the event of any type of misfire occurring or being discovered whilst shotfiring operations, inspecting the face or loading the rock-pile:

A misfire is described as:

Type A: Where testing before firing reveals broken continuity which cannot be rectified.

Type B: Where a shot or any part of a shot fails to initiate when an attempt is made to fire it.

- The Shotfirer shall remove the key from the exploder and disconnect the shotfiring cable or the shock tube from the starter. The Shotfirer must stay in the shotfiring shelter for a period of at least 5 minutes after the misfire has occurred.

- The Explosive Supervisor must be informed by the quickest possible means of the type and nature of the misfire.

- The ‘all clear’ should not be given and all personnel must remain out of the danger zone.

- The Explosive Supervisor must attend the scene with the Shotfirer as soon as possible, being in possession of:
    - The blast specification
    - These rules
    - The MPQC, Explosives at Quarries, Guidance Note 1 – Misfires
    - Camera
- The course of action to be taken to deal with the misfire will be agreed between the Explosive Supervisor and Shotfirer with reference to the MPQC Misfires - Guidance Note.

- These parties will assess the risks associated with any remedial actions. Where deemed necessary by these parties a written risk assessment and method statement should be prepared.

- Any misfired material found must be packaged, labelled ‘MISFIRED MATERIAL’ and removed to the explosive store. Explosives and detonators must be packaged separately.

- The misfired material must be made available for further investigation.

- Every effort shall be made to discover the cause of the misfire and the following should be recorded on BAM Ritchies misfire report DB MSF 01 and placed with the blast specification.
    - Who discovered the misfire
    - Date and time of discovery
    - Procedure adopted to deal with the misfire
    - The cause of the misfire (if known)
    - Date when he misfire was satisfactorily dealt with
    - Modifications necessary to existing procedures as a result of the investigation.

- The process of searching for explosive material in the heap with heavy loading equipment must be agreed by the Explosives Supervisor to include measures to minimise the risk of the bucket or falling rock causing detonation, banksman to work with the loading operator and for the material taken to level area to be carefully deposited and searched.

- Using available information the possible quantities and types of explosives involved should be determined.

- Once recovery is complete and the Explosives Supervisor has assessed the area normal working may be resumed.

- If the misfire contains accessible explosives and / or detonators an authorised guard must be posted to ensure there is no unauthorised access and to ensure the security of the explosives. In the event that recovery may take some time, a risk assessment should be completed before allowing the misfire to be left unguarded.

- It may be possible to remove stemming in order to gain access and to re-prime the charge but this should only be attempted after detailed consideration due to the hazards involved.

- Any attempt to re-fire part or all of the shot should take into account that much of the surrounding rock will have been loosened. It may therefore be necessary to build up a burden of inert material to achieve the confining of effect the solid burden and stemming. It is highly likely that the danger zone will have to be considerably extended.

- If there has been no prior indication of a misfire and explosives and / or detonators are discovered during loading operations, work will cease at once and the Explosives Supervisor informed immediately. All loaded dumpers running from the blast pile where the explosives were found must will be tipped off in a designated area to inspect the loads. Guidance can be found in BAM Ritchies Guidance 'DB G25 Recognising Uninitiated Explosives'.

- A Misfire is classed as a dangerous occurrence under the UK regulations 'Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 2013' (RIDDOR). Although not strictly applicable at this location, any misfire should be reported to the Manager Drill and Blast in the UK for reporting to the Health and Safety Executive (HSE) if appropriate.

3.27 Compliance and Auditing

3.27.1 Understanding of the rules

The first stage of ensuring compliance with these rules, is to ensure that they are fully understood by those persons upon whom they impose duties. This is done by the Quarry Supervisor or Explosives Supervisor directly issuing the rules to each person or group of persons and briefing them on the contents and checking their understanding. The individual must sign their copy once they have read, understood and are able to act following the rules. A record of the briefing, the receipt or alternative briefing record by the Quarry Supervisor.

3.27.2 Monitoring & Review

An audit of the blasting operations will be carried out at intervals not greater than once every construction season by the Project Manager Drill and Blast. The findings of the audit will be reported to the Explosives Supervisor.

The Explosives Supervisor will carry out an internal audit periodically, with not less than two audits it total per construction season.

The audits and spot checks are designed to confirm that:
- Those involved in the operation understand the requirements of the quarry's Shotfiring rules and are complying with them.
- They continue to be practical and workable.
- Changes necessary to accommodate altering circumstances and statutory requirements are introduced.

3.28 Record Keeping

Records of all appointments shall be kept at a suitable place for at least 3 years following the end of each individual's employment at the quarry, or if they cease to undertake that role. They should be marked cancelled and the date of cancellation noted.

Blast specifications and reports of misfires shall be kept for at least 3 years from the date on which it was made.

Retain exploder and circuit tester repair records for 3 years.

A copy of the written statement of duties of all persons appointed at the quarry under Part V of the Quarries Regulations 1999 shall be kept at a suitable place for at least 12 months after the date on which the appointment ceased to have effect.

4 Load, Haul and Rock Processing

Blasted rock from the modernisation cut will be loaded by hydraulic excavator to articulated dump trucks and taken to a designated area on the west side of the runway for screening. The screened rock will then be stockpiled and later returned to the modernisation site for use as fill. Placement of fill and other construction activities are not included in this document. Where there is a shortfall in the quantity of rock required for producing fill, additional rock will be taken from existing stocks sourced from the Rothera Wharf quarry area.

Type	Tonnage	Comments
0-80mm backfill	11,214m3	

4.1 Screening Location

Rock will be loaded and taken to the screening area to the west of the runway as shown in figure 27. Screened backfill material and oversize will then be stockpiled adjacent to the temporary boatshed until required.

Levelling of the screening area will be undertaken using surface overburden material from the modernization area.

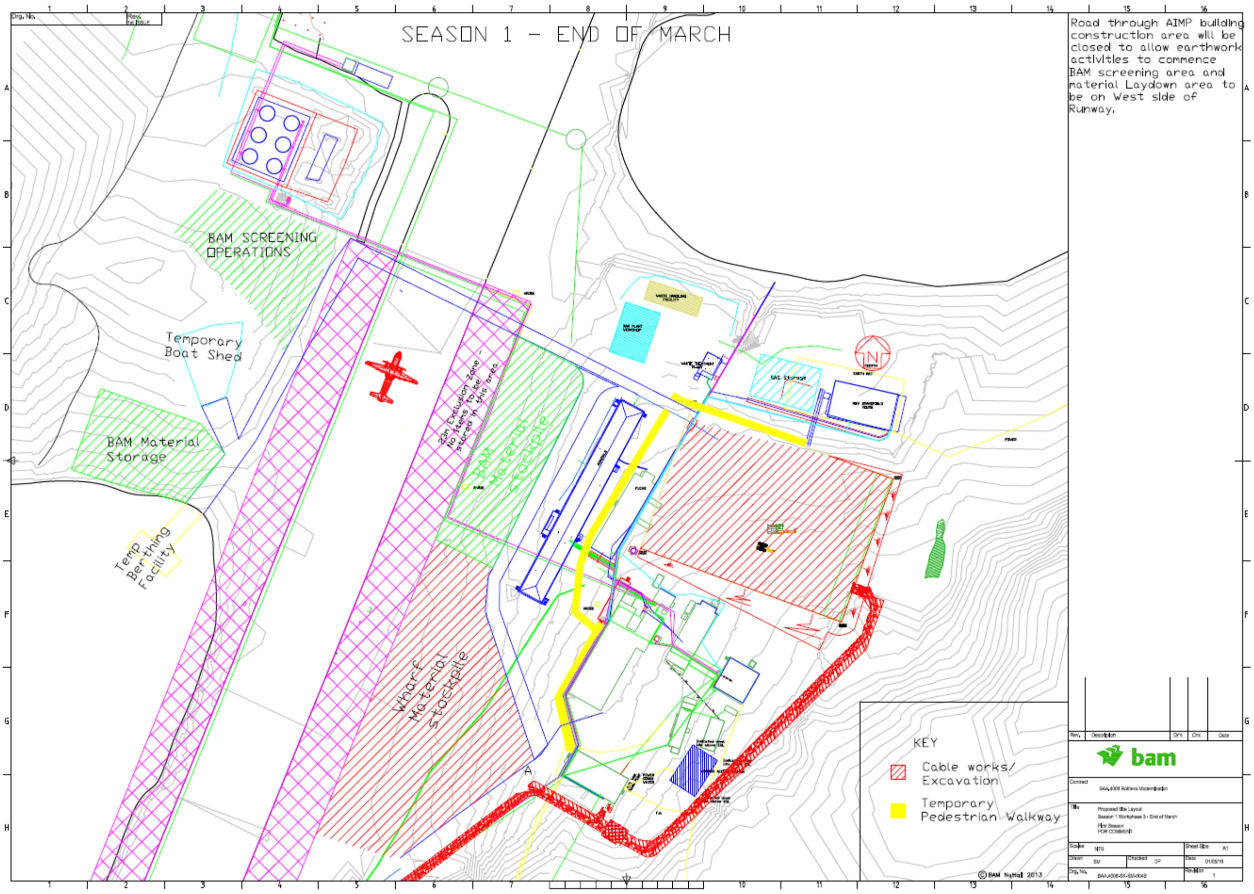


Figure 27 – Modernisation backfill processing and storage locations.

4.2 Production of Backfill Material from Blasted Rock

Production feed will come from as-blasted rock from the modernisation cut, augmented by additional rock from the Rothera Wharf quarry if required. All feed material will be screened to separate 0-80mm material from 80mm+ oversize using a mobile or fixed grizzly screen. This simple screening process does not impart any shape to the product. Product is then loaded to stock, or direct to the project. Oversize material will be stockpiled for use elsewhere. No crushing operations are planned.

Figure 28 - The mobile screen already at Rothera

4.3 Loading at the face

Blasted rock will be loaded using a hydraulic excavator into an articulated dump truck - as shown in the example below.

Figure 29 - Example of loading at the face

The excavators working at the face will create a rock platform and rock trap between the rock-pile and the platform to prevent the rock being worked collapsing on the excavator or dump trucks. This platform is constructed with material from the rock-pile compacted by the excavator tracking back and forward. As the rock-pile continues to be worked, the platform is extended as the excavator works along the rock-pile starting at one end, removing the platform from the worked out area in a progressive sequence. The slopes of the platform must not be undercut, but follow the natural angle of repose of the material. The height of the platform shall be such that it enables the excavator to load safely into the rear of the dump trucks or mobile crusher being loaded. Figure 30 shows the geometry of the rock platform and rock trap.

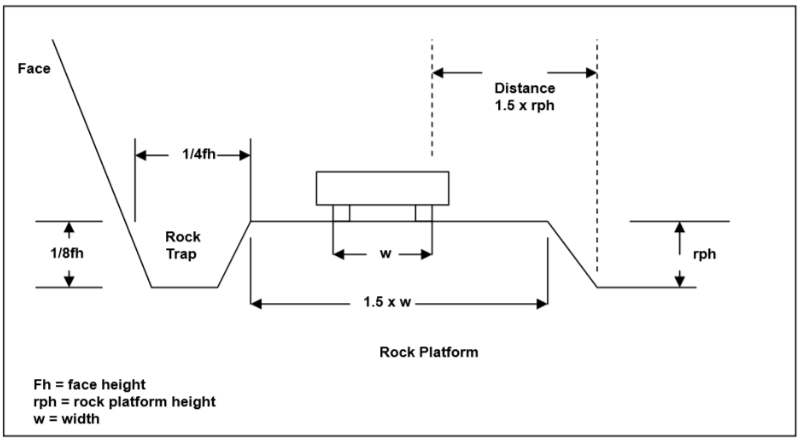


Figure 30 - Cross-sectional view of rock platform and rock trap.

The area where dump trucks are being loaded is a restricted loading zone - see figure 31. This loading zone is defined by the manoeuvring zone of the excavator or loading shovel and the manoeuvring zone of the trucks being loaded.

Within this restricted zone only the excavator and dump trucks being loaded may enter.

Access to the restricted zone for other vehicles will be controlled by the supervisor or designated banksman and will only be permitted when loading has been stopped and the equipment is in its safe position and will not recommence until the other vehicles have left the area and permission is given by the supervisor. Other vehicles will wait as directed by the supervisor and in an area separate to waiting dump trucks.

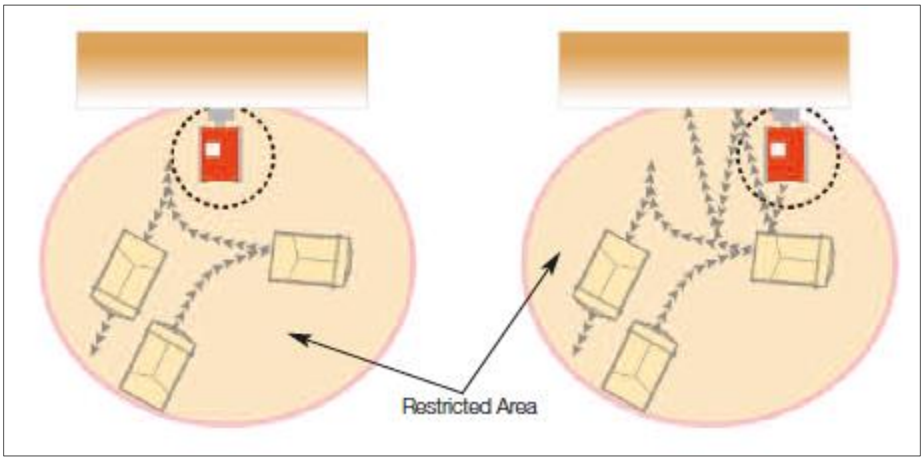


Figure 31 - Restricted area for loading operations

During normal loading operations, when the excavator operator is satisfied that a truck is positioned safely to receive a load he will discharge the load from the bucket. On completion of the load and when the excavator operator is satisfied the truck is safely loaded the excavator horn to inform the truck driver to move off. When a dump truck has been loaded it must leave the loading zone and proceed to the tipping area without delay.

4.4 Tipping Areas

The areas where dump trucks tip to feed processing plant, or in stocking areas, will be restricted areas in a similar way to the loading area describes above. Dump trucks coming from the face to areas where other personnel are present will be controlled by a designated banksman who will control when the truck can off-load. Where necessary trucks will wait in a designated area prior to tipping and will leave the tipping area as soon as possible.

Where tipping over an edge, a protection barrier will constructed using an excavator to prevent trucks being able to reverse too far. No ancillary plant or vehicle may enter the restricted area until allowed by the banksman or supervisor and only when tipping operations are stopped.

Figure 32 - Example edge protection for tipping operations

4.5 Control of dust from operations

As far as possible the production of dust will be avoided, but the process of, loading, transporting and screening rock produces dust. The following measures outline how this will be controlled to minimise the dust becoming airborne and a hazard to personnel and the environment.

Control of dust from plant. The following measures may help to reduce the source of dust from activities, by preventing their escape to the atmosphere:

- The primary method of dust suppression during loading, hauling and screening will be through the use of a bowser with seawater spray. This should be carried out on a regular basis on the blasted rock pile, haul roads and rock piles prior to screening.
- Use of screening plant within its design capacity prevents excess dust.
- Ensuring haul roads have a firm compact surface and are well maintained.
- Good maintenance of all plant and equipment
- Limiting drop heights during stockpiling, processing and loading operations.
- Maintain and enforce low speed limitations on site.
- Minimise double handling as far as practical to reduce the overall number of tipping actions.

Temporary suspension of operations may be required during high winds or excessively dry conditions, especially where the wind direction will blow dust towards sensitive receptors.

4.6 Traffic Management

Traffic will be managed to prevent accidents both involving individual vehicles and from accidents arising from the interaction between vehicles, especially between heavy and light vehicles, or pedestrians. This is achieved by a number methods outlined as follows and discussed below:

- Ensuring that the design of the excavation layout minimises the interactions between vehicles, especially different types of vehicles or pedestrians.
- Design of haul roads with gentle gradients, safety bunds and avoiding blind spots.
- Ensuring communication of rules and best practice through training, inductions, signs and traffic controllers/banksmen.
- Ensuring adequate maintenance of plant and haul roads.
- Ensuring adequate site visibility.
- Planning and maintaining pedestrian walkways.
- Communication with the comms tower prior to crossing the runway.

4.7 Plant Controllers / Banksmen

At key areas such as restricted tipping areas, plant controllers / banksmen will direct plant/vehicle movements. These will be specifically trained in their duties by the supervisor for that area. They will be competent in methods used to ensure their own and other people’s safety.

4.8 General Rules

When driving a vehicle on the site the following rules apply:

- Ensure that the area around the vehicle is clear before moving away or altering direction.
- Drive with due care and attention and at a speed that is appropriate to the prevailing ground, weather and visibility conditions, but not exceeding the appropriate speed limits - maximum 20kph.
- A safe distance must be maintained from the vehicle in front so that emergency action can be taken - minimum of 3 large truck lengths.
- Loaded vehicles always have priority over empty vehicles.
- Seat-belts should be worn at all times when the plant is running.
- Light vehicles must always give way to heavy vehicles and not enter heavy vehicle restricted areas without permission from traffic controllers.
- When vehicles of similar size and capacity are sharing a haul road and there is a need to give way, the vehicle travelling uphill has priority.
- Only trucks for loading or tipping purposes may enter the swing radius of an excavator or manoeuvring zone of a dozer or loading shovel.
- On no account should a vehicle be driven within any cordoned off areas.
- Vehicle operators must keep their cabs clean and tidy, store loose and personal items securely and ensure there are no obstructions to visibility aids, windows, controls, gauges, warning lights etc. Vehicles will be driven with the doors closed at all times.
- Plant operators must immediately contact a site supervisor in the event of any breakdowns, emergencies or any other unplanned event.
- The use of mobile phones when driving is strictly prohibited.
- Vehicles should be parked on level ground in an authorised parking/waiting wherever possible to minimise the possibility of them being set in motion.
- When leaving a vehicle unattended the engine should be switched off, ignition key removed, all brakes applied and the appropriate gear selected to suit any gradient.
- Ground engaging equipment i.e. excavator buckets, dozer blades, ripper teeth and scraper bowls should be lowered to the ground when parking and if stopping to be serviced or fuelled.
- Vehicles must always be reversed parked.
- Dump truck drivers shall stay in their cabs whilst loading is taking place.
- Tipping shall only take place on level ground to prevent overturning. After tipping, dump truck bodies shall be lowered before moving off.
- Plant operators shall not allow the bucket of any vehicle to pass over the cab of any dump truck or haulage vehicle.
- It is strictly forbidden for anyone to travel in a loading shovel/excavator bucket or to use it as a work platform.
- Where haul roads transit close to the bottom of a face, rock traps will be constructed to catch material and keep traffic clear of the face.
- Edge protection bunds will be provided to prevent mobile plant and ancillary vehicles from being driven over an unprotected edge. This will be a minimum of 1m, or the radius of the largest vehicles wheel, whichever is greater.
- Roads will be regularly maintained so that they do not develop bumps, ruts or potholes which may make control of vehicles difficult. Roads will be designed to drain naturally.
- Operational areas will be lit with mobile lighting towers during reduced visibility should it be necessary to work in these conditions.

4.9 Plant Maintenance

- Prior to use all plant and haulage equipment will be inspected to ensure it is suitable for use, including checks of brakes, lights and visibility aids.
- At the start of each shift plant operators will carry out a designated pre-start/start-up inspection of their vehicle.
- Plant will receive regular routine maintenance.
- Lights and windows must be kept clean at all times.
- Regular break testing will be undertaken in the designated area.

5 Resources - Personnel, equipment

5.1 Personnel

- 1 Explosives Supervisor
- 1 Shotfirer
- 1 Assistant Shotfirer
- 1 Driller
- 1 Excavator Operator
- 1 Loading Shovel / Screener Operator
- 1 or more Dump truck operators
- Assistance at the time of blasting as Blast Controller and Sentries
- Assistance with the transport of explosives, stemming and blast mats.

Notes:

- The roles of Laser Surveyor, Explosives Storekeeper will be held by the Shotfirer and / or Explosives Supervisor.
- An appropriate person will be instructed and appointed Blast Controller and may be part of the BAM or BAS teams.
- Sentries will be trained and appointed from the quarrying or construction personnel.

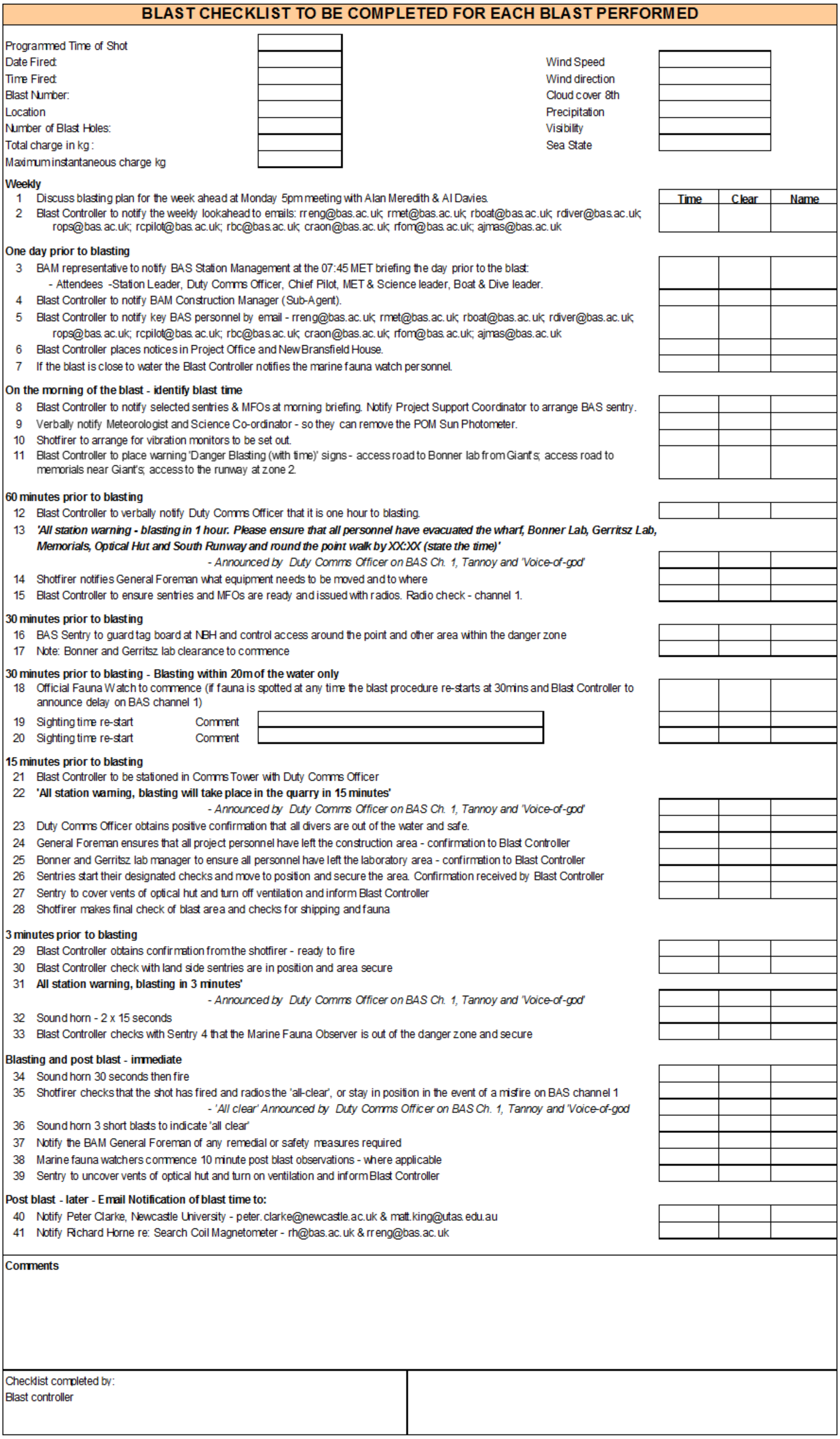
5.2 Equipment

The following main quarry equipment will be used drilling and blasting

Item	No.	Comments
Drill rig –Atlas Copco D7	1	From Rothera Wharf Project
Excavator 35-50t	1	From Rothera Wharf Project
Wheel Loader CAT966	1	From Rothera Wharf Project
Articulated dump truck (ADT)	1 or more	From Rothera Wharf Project

Additional ancillary equipment may be required, or be shared with construction activities. Eg. Water bowsers, fuel bowsers, maintenance equipment, tractors and trailers, and aircraft.

APPENDIX A – Example of Blasting Checklist from Rothera Wharf Project



BLAST CHECKLIST TO BE COMPLETED FOR EACH BLAST PERFORMED

Programmed Time of Shot
Date Fired:
Time Fired:
Blast Number:
Location
Number of Blast Holes:
Total charge in kg :
Maximum instantaneous charge kg

Wind Speed
Wind direction
Cloud cover 8th
Precipitation
Visibility
Sea State

Weekly

Time | Clear | Name

1 Discuss blasting plan for the week ahead at Monday 5pm meeting with Alan Meredith & Al Davies.
2 Blast Controller to notify the weekly lookahead to emails: rreng@bas.ac.uk; rmet@bas.ac.uk; rboat@bas.ac.uk; rdiver@bas.ac.uk; rops@bas.ac.uk; rcpilot@bas.ac.uk; rbc@bas.ac.uk; craon@bas.ac.uk; rfom@bas.ac.uk; ajmas@bas.ac.uk

One day prior to blasting

3 BAM representative to notify BAS Station Management at the 07:45 MET briefing the day prior to the blast:
- Attendees -Station Leader, Duty Comms Officer, Chief Pilot, MET & Science leader, Boat & Dive leader.
4 Blast Controller to notify BAM Construction Manager (Sub-Agent).
5 Blast Controller to notify key BAS personnel by email - rreng@bas.ac.uk; rmet@bas.ac.uk; rboat@bas.ac.uk; rdiver@bas.ac.uk; rops@bas.ac.uk; rcpilot@bas.ac.uk; rbc@bas.ac.uk; craon@bas.ac.uk; rfom@bas.ac.uk; ajmas@bas.ac.uk
6 Blast Controller places notices in Project Office and New Bransfield House.
7 If the blast is close to water the Blast Controller notifies the marine fauna watch personnel.

On the morning of the blast - identify blast time

8 Blast Controller to notify selected sentries & MFOs at morning briefing. Notify Project Support Coordinator to arrange BAS sentry.
9 Verbally notify Meteorologist and Science Co-ordinator - so they can remove the POM Sun Photometer.
10 Shotfirer to arrange for vibration monitors to be set out.
11 Blast Controller to place warning 'Danger Blasting (with time)' signs - access road to Bonner lab from Giant's; access road to memorials near Giant's; access to the runway at zone 2.

60 minutes prior to blasting

12 Blast Controller to verbally notify Duty Comms Officer that it is one hour to blasting.
13 ***'All station warning - blasting in 1 hour. Please ensure that all personnel have evacuated the wharf, Bonner Lab, Gerritsz Lab, Memorials, Optical Hut and South Runway and round the point walk by XX:XX (state the time)'***
- Announced by Duty Comms Officer on BAS Ch. 1, Tannoy and 'Voice-of-god'
14 Shotfirer notifies General Foreman what equipment needs to be moved and to where
15 Blast Controller to ensure sentries and MFOs are ready and issued with radios. Radio check - channel 1.

30 minutes prior to blasting

16 BAS Sentry to guard tag board at NBH and control access around the point and other area within the danger zone
17 Note: Bonner and Gerritsz lab clearance to commence

30 minutes prior to blasting - Blasting within 20m of the water only

18 Official Fauna Watch to commence (if fauna is spotted at any time the blast procedure re-starts at 30mins and Blast Controller to announce delay on BAS channel 1)
19 Sighting time re-start Comment
20 Sighting time re-start Comment

15 minutes prior to blasting

21 Blast Controller to be stationed in Comms Tower with Duty Comms Officer
22 **'All station warning, blasting will take place in the quarry in 15 minutes'**
- Announced by Duty Comms Officer on BAS Ch. 1, Tannoy and 'Voice-of-god'
23 Duty Comms Officer obtains positive confirmation that all divers are out of the water and safe.
24 General Foreman ensures that all project personnel have left the construction area - confirmation to Blast Controller
25 Bonner and Gerritsz lab manager to ensure all personnel have left the laboratory area - confirmation to Blast Controller
26 Sentries start their designated checks and move to position and secure the area. Confirmation received by Blast Controller
27 Sentry to cover vents of optical hut and turn off ventilation and inform Blast Controller
28 Shotfirer makes final check of blast area and checks for shipping and fauna

3 minutes prior to blasting

29 Blast Controller obtains confirmation from the shotfirer - ready to fire
30 Blast Controller check with land side sentries are in position and area secure
31 **All station warning, blasting in 3 minutes'**
- Announced by Duty Comms Officer on BAS Ch. 1, Tannoy and 'Voice-of-god'
32 Sound horn - 2 x 15 seconds
33 Blast Controller checks with Sentry 4 that the Marine Fauna Observer is out of the danger zone and secure

Blasting and post blast - immediate

34 Sound horn 30 seconds then fire
35 Shotfirer checks that the shot has fired and radios the 'all-clear', or stay in position in the event of a misfire on BAS channel 1
- 'All clear' Announced by Duty Comms Officer on BAS Ch. 1, Tannoy and 'Voice-of-god
36 Sound horn 3 short blasts to indicate 'all clear'
37 Notify the BAM General Foreman of any remedial or safety measures required
38 Marine fauna watchers commence 10 minute post blast observations - where applicable
39 Sentry to uncover vents of optical hut and turn on ventilation and inform Blast Controller

Post blast - later - Email Notification of blast time to:

40 Notify Peter Clarke, Newcastle University - peter.clarke@newcastle.ac.uk & matt.king@utas.edu.au
41 Notify Richard Horne re: Search Coil Magnetometer - rh@bas.ac.uk & rreng@bas.ac.uk

Comments

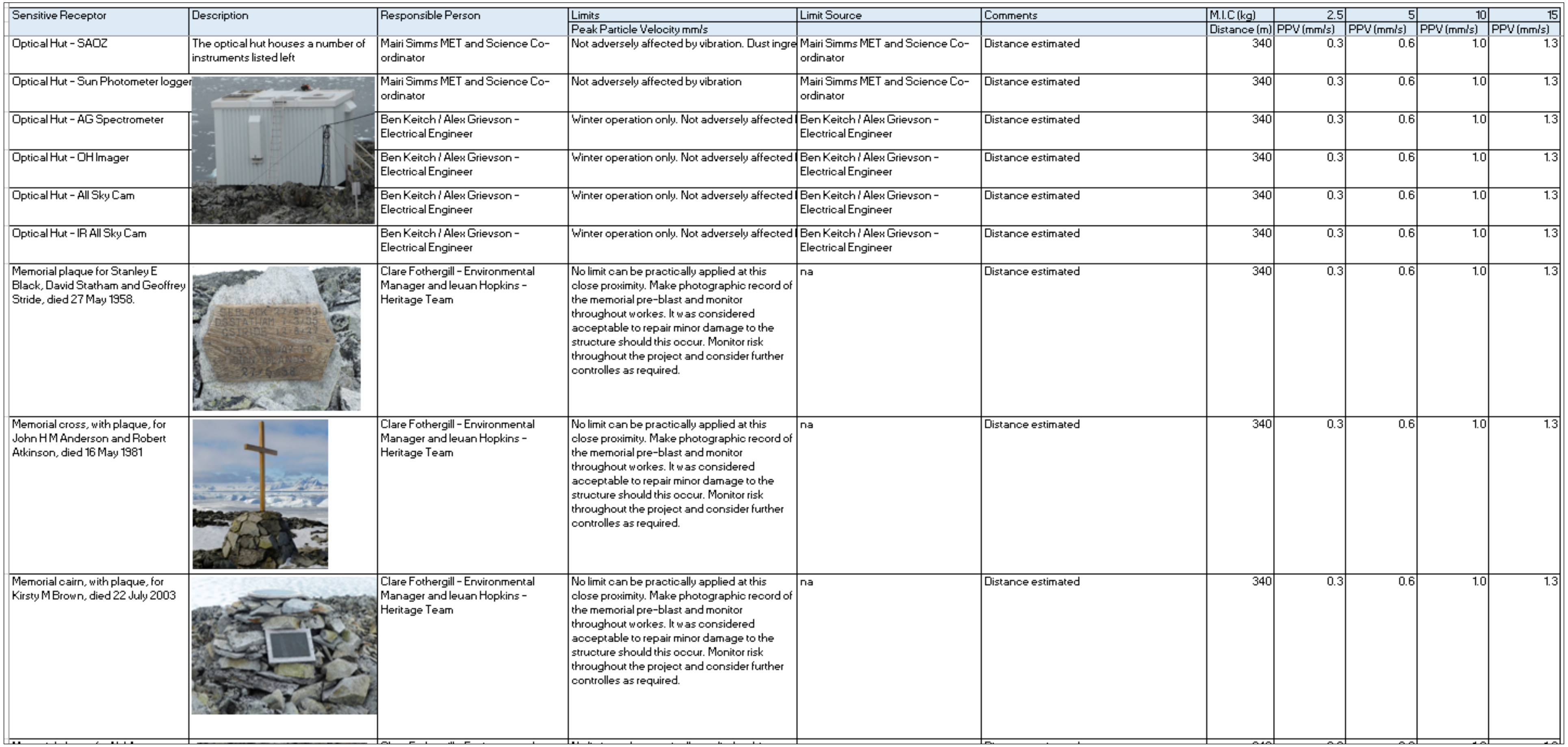
Checklist completed by:
Blast controller

APPENDIX B

Sensitive Receptor	Description	Responsible Person	Limit Guidance	Limit Source	Comments	M.I.C (kg)	2.5	5	10	15
			Peak Particle Velocity mm/s			Distance (m)	PPV (mm/s)	PPV (mm/s)	PPV (mm/s)	PPV (mm/s)
Bransfield House	C 	BAS - Station Leader	50	BS7385:2-1993		17	38.7	67.4	117.3	162.3
Miracle Span		BAS - Station Leader	50	BS7385:2-1993	To be removed - directly in the blast area.	NA				
Waste Plant		BAS - Station Leader	50	BS7385:2-1993		22	25.6	44.6	77.7	107.4
Fuch's House		BAS - Station Leader	50	BS7385:2-1993	To be removed - directly in the blast area.	NA				
Workshop - left in image		BAS - Station Leader	50	BS7385:2-1993	May not possible to control vibrations within BS7385 guidance. To be monitored as blasting approaches. Building to be removed.	7	160.0	278.7	485.2	671.1
Garage - right in image		BAS - Station Leader	50	BS7385:2-1993	May not possible to control vibrations within BS7385 guidance. To be monitored as blasting approaches. Building to be removed.	1	NA	NA	NA	NA
Old Bransfield House	Offices, workshops 	BAS - Station Leader	50	BS7385:2-1993	May not possible to control vibrations within BS7385 guidance. To be monitored as blasting approaches. Building to be removed.	18	35.3	61.5	107.1	148.1
OBH Control Tower		BAS - Station Leader	50	BS7385:2-1993	May not possible to control vibrations within BS7385 guidance. To be monitored as blasting approaches. Building to be removed.	6	204.8	356.6	620.9	858.8

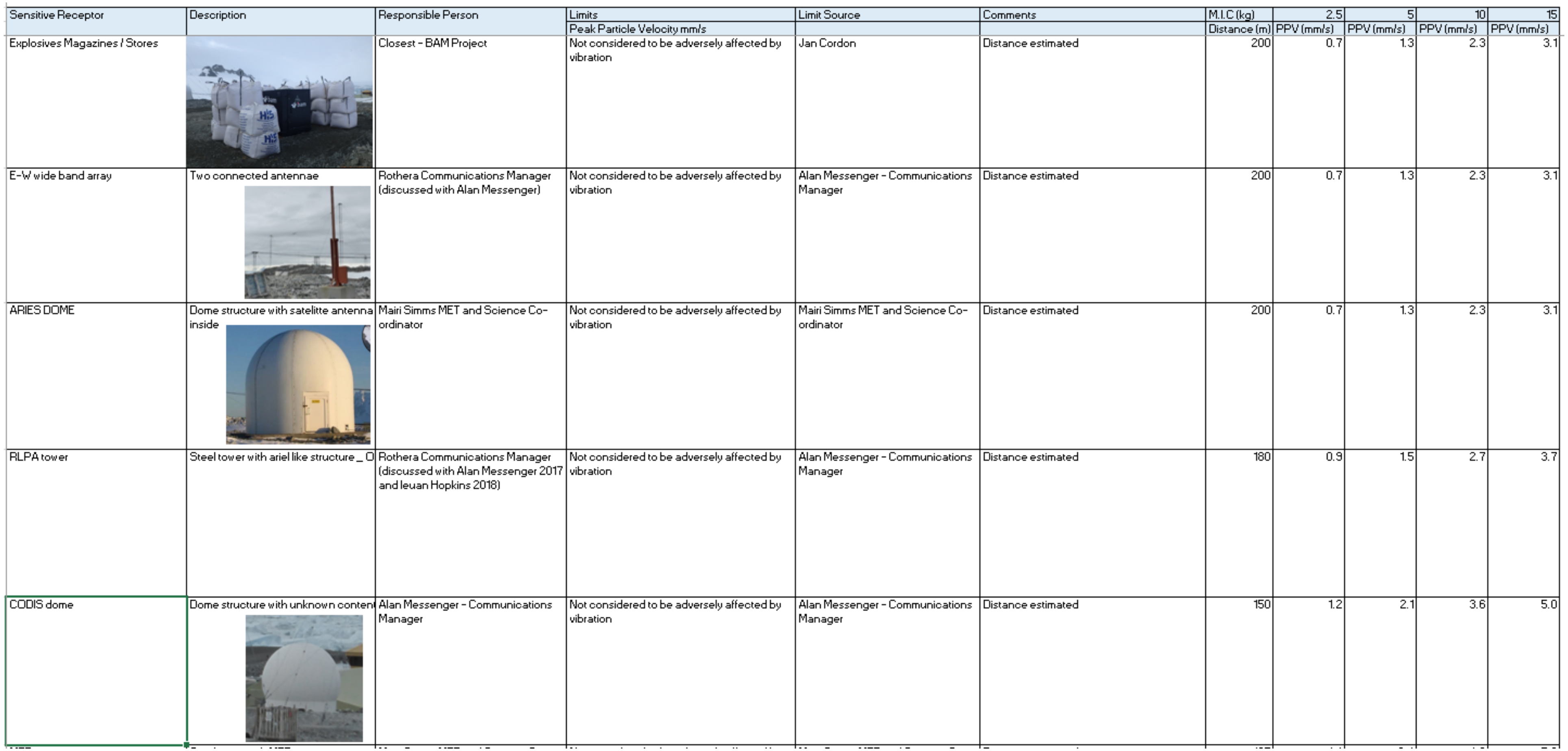
Sensitive Receptor	Description	Responsible Person	Limit Guidance	Limit Source	Comments	M.I.C (kg)	2.5	5	10	15
			Peak Particle Velocity mm/s			Distance (m)	PPV (mm/s)	PPV (mm/s)	PPV (mm/s)	PPV (mm/s)
Instrument at OBH?					To be confirmed. May be withing the blast area	10	90.4	157.5	274.2	379.2
Admirals House	Accommodation 	BAS - Station Leader	50	BS7385:2-1993	May not possible to control vibrations within BS7385 guidance. To be monitored as blasting approaches.	6	204.8	356.6	620.9	858.8
Generator Building		BAS - Station Leader	50	BS7385:2-1993	May not possible to control vibrations within BS7385 guidance. To be monitored as blasting approaches.	13	59.4	103.5	180.2	249.2
Carpeter's Building / Vikings		BAS - Station Leader	50	BS7385:2-1993	Distance estimated	50	6.9	12.0	20.9	28.9
Giants House	Accommodation 	BAS - Station Leader	50	BS7385:2-1993	Distance estimated	90	2.7	4.7	8.2	11.3
Fuel Tanks		BAS - Station Leader	50	BS7385:2-1993	Distance estimated	240	0.6	1.0	1.7	2.3
Hanger		BAS - Station Leader	50	BS7385:2-1993	Distance estimated	300	0.4	0.7	1.2	1.6
BAM Workshop		BAM Project	50	BS7385:2-1993	Distance estimated	50	6.9	12.0	20.9	28.9

Sensitive Receptor	Description	Responsible Person	Limits	Limit Source	Comments	M.I.C (kg)	2.5	5	10	15
			Peak Particle Velocity mm/s			Distance (m)	PPV (mm/s)	PPV (mm/s)	PPV (mm/s)	PPV (mm/s)
Bonnar Laboratory	Science Building 	General station building	50	BS7385:2-1993	Distance estimated	230	0.6	1.0	1.8	2.5
Gerritsz Laboratory		Dutch Antarctic Survey	50	BS7385:2-1993	Distance estimated	260	0.5	0.9	1.5	2.1
Boatshed	 e replace	General station building	50	BS7385:2-1993	Distance estimated	330	0.3	0.6	1.0	1.4
General MET instruments	Various	Mairi Simms MET and Science Co-ordinator	Dust is considered an issue for MET instruments, in particular the Sun Photometer. BAS understand that blasting creates dust that is difficult to limit. Blasting will be avoided when the wind is blowing S-N.	Mairi Simms MET and Science Co-ordinator		na				
POM Sun Photometer	Instrument bolted on concrete pillar 	Mairi Simms MET and Science Co-ordinator	Unknown impact from blasting vibration, but impact from dust expected to be considerable. It has been agreed that this instrument will be removed during blasting, for short duration (eg 1 hour), or for the entire blasting programme. The MET and Science co-ordinator will be included on the blast protocol to allow this to be carried out.	Mairi Simms MET and Science Co-ordinator	Sensitive to dust, so to be removed during blasting. Easily removed	290	0.4	0.7	1.3	1.7
GPS receiver	GPS receiver for long term movements 	Peter.clarke@newcastle.ac.uk	Not considered to be adversely affected by vibration - email 22.02.17 Peter Clarke of Newcastle University.	Peter Clarke	Peter Clarke at Newcastle University to be notified post-blast of the blasting time to allow checks on data anomolies. Add this to the drilling and blasting management plan, blast protocol.	290	0.4	0.7	1.3	1.7

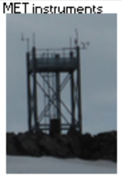
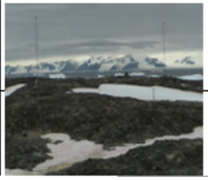


Sensitive Receptor	Description	Responsible Person	Limits	Limit Source	Comments	M.I.C (kg)	2.5	5	10	15
			Peak Particle Velocity mm/s			Distance (m)	PPV (mm/s)	PPV (mm/s)	PPV (mm/s)	PPV (mm/s)
Optical Hut - SAOZ	The optical hut houses a number of instruments listed left	Mairi Simms MET and Science Co-ordinator	Not adversely affected by vibration. Dust ingre	Mairi Simms MET and Science Co-ordinator	Distance estimated	340	0.3	0.6	1.0	1.3
Optical Hut - Sun Photometer logger		Mairi Simms MET and Science Co-ordinator	Not adversely affected by vibration	Mairi Simms MET and Science Co-ordinator	Distance estimated	340	0.3	0.6	1.0	1.3
Optical Hut - AG Spectrometer		Ben Keitch / Alex Grievson - Electrical Engineer	Winter operation only. Not adversely affected	Ben Keitch / Alex Grievson - Electrical Engineer	Distance estimated	340	0.3	0.6	1.0	1.3
Optical Hut - OH Imager		Ben Keitch / Alex Grievson - Electrical Engineer	Winter operation only. Not adversely affected	Ben Keitch / Alex Grievson - Electrical Engineer	Distance estimated	340	0.3	0.6	1.0	1.3
Optical Hut - All Sky Cam		Ben Keitch / Alex Grievson - Electrical Engineer	Winter operation only. Not adversely affected	Ben Keitch / Alex Grievson - Electrical Engineer	Distance estimated	340	0.3	0.6	1.0	1.3
Optical Hut - IR All Sky Cam		Ben Keitch / Alex Grievson - Electrical Engineer	Winter operation only. Not adversely affected	Ben Keitch / Alex Grievson - Electrical Engineer	Distance estimated	340	0.3	0.6	1.0	1.3
Memorial plaque for Stanley E Black, David Statham and Geoffrey Stride, died 27 May 1958.		Clare Fothergill - Environmental Manager and Ieuan Hopkins - Heritage Team	No limit can be practically applied at this close proximity. Make photographic record of the memorial pre-blast and monitor throughout workes. It was considered acceptable to repair minor damage to the structure should this occur. Monitor risk throughout the project and consider further controlles as required.	na	Distance estimated	340	0.3	0.6	1.0	1.3
Memorial cross, with plaque, for John H M Anderson and Robert Atkinson, died 16 May 1981		Clare Fothergill - Environmental Manager and Ieuan Hopkins - Heritage Team	No limit can be practically applied at this close proximity. Make photographic record of the memorial pre-blast and monitor throughout workes. It was considered acceptable to repair minor damage to the structure should this occur. Monitor risk throughout the project and consider further controlles as required.	na	Distance estimated	340	0.3	0.6	1.0	1.3
Memorial cairn, with plaque, for Kirsty M Brown, died 22 July 2003		Clare Fothergill - Environmental Manager and Ieuan Hopkins - Heritage Team	No limit can be practically applied at this close proximity. Make photographic record of the memorial pre-blast and monitor throughout workes. It was considered acceptable to repair minor damage to the structure should this occur. Monitor risk throughout the project and consider further controlles as required.	na	Distance estimated	340	0.3	0.6	1.0	1.3

Sensitive Receptor	Description	Responsible Person	Limits	Limit Source	Comments	M.I.C (kg)	2.5	5	10	15
			Peak Particle Velocity mm/s			Distance (m)	PPV (mm/s)	PPV (mm/s)	PPV (mm/s)	PPV (mm/s)
Memorial plaque for N J Armstrong (Canada), D N Fredlund (Canada), J C Armstrong (Canada) and E P Odegard (Norway), died 23 Nov 1994)		Clare Fothergill - Environmental Manager and Ieuan Hopkins - Heritage Team	No limit can be practically applied at this close proximity. Make photographic record of the memorial pre-blast and monitor throughout workes. It was considered acceptable to repair minor damage to the structure should this occur. Monitor risk throughout the project and consider further controlles as required.	na	Distance estimated	340	0.3	0.6	1.0	1.3
The British Antarctic Sledge Dog plaque.		Clare Fothergill - Environmental Manager and Ieuan Hopkins - Heritage Team	No limit can be practically applied at this close proximity. Make photographic record of the memorial pre-blast and monitor throughout workes. It was considered acceptable to repair minor damage to the structure should this occur. Monitor risk throughout the project and consider further controlles as required.	na	Distance estimated	340	0.3	0.6	1.0	1.3
Cairn, built from rocks. Erected Sept. 1957 by Nigel Procter, and used in Oct. 1957 by John Rothera as a survey station during the first mapping of the area, referred to as Adelaide Island Trig Point (see relevant reports in BAS Archives, refs. AD6/2Y/1957/K13 and 14).	No image	Clare Fothergill - Environmental Manager and Ieuan Hopkins - Heritage Team	Not considered to be adversely affected by vibration due to distance.	Jan Cordon	No access easily available	340	0.3	0.6	1.0	1.3
UKHO survey pillar	Concrete pillar 	Rothera Station Leader	Not considered to be adversely affected by vibration	Jan Cordon	Predicted vibration is below BS7385-2:1993 for cosmetic damage to buildings	330	0.3	0.6	1.0	1.4
Flagpole	Steel pole on concrete base 	Rothera Station Leader	Not considered to be adversely affected by vibration	Jan Cordon	Distance estimated	260	0.5	0.9	1.5	2.1



Sensitive Receptor	Description	Responsible Person	Limits	Limit Source	Comments	M.I.C (kg)	2.5	5	10	15
			Peak Particle Velocity mm/s			Distance (m)	PPV (mm/s)	PPV (mm/s)	PPV (mm/s)	PPV (mm/s)
Explosives Magazines / Stores		Closest - BAM Project	Not considered to be adversely affected by vibration	Jan Cordon	Distance estimated	200	0.7	1.3	2.3	3.1
E-W wide band array	Two connected antennae	Rothera Communications Manager (discussed with Alan Messenger)	Not considered to be adversely affected by vibration	Alan Messenger - Communications Manager	Distance estimated	200	0.7	1.3	2.3	3.1
ARIES DOME	Dome structure with satellite antenna inside	Mairi Simms MET and Science Co-ordinator	Not considered to be adversely affected by vibration	Mairi Simms MET and Science Co-ordinator	Distance estimated	200	0.7	1.3	2.3	3.1
RLPA tower	Steel tower with ariel like structure _ O	Rothera Communications Manager (discussed with Alan Messenger 2017 and Ieuan Hopkins 2018)	Not considered to be adversely affected by vibration	Alan Messenger - Communications Manager	Distance estimated	180	0.9	1.5	2.7	3.7
CODIS dome	Dome structure with unknown content	Alan Messenger - Communications Manager	Not considered to be adversely affected by vibration	Alan Messenger - Communications Manager	Distance estimated	150	1.2	2.1	3.6	5.0

Sensitive Receptor	Description	Responsible Person	Limits	Limit Source	Comments	M.I.C (kg)	2.5	5	10	15
			Peak Particle Velocity mm/s			Distance (m)	PPV (mm/s)	PPV (mm/s)	PPV (mm/s)	PPV (mm/s)
MET tower - sonic anemometer, sun duration sensor, 3x present weather sensors, cloud vase recorder, sun radiation sensor	Steel tower with MET instruments 	Mairi Simms MET and Science Co-ordinator	Not considered to be adversely affected by vibration	Mairi Simms MET and Science Co-ordinator	Distance estimated	135	1.4	2.4	4.3	5.9
Snow Gauge (tipping cup)	Close to Giant's House 	Mairi Simms MET and Science Co-ordinator	Not considered to be adversely affected by vibration	Mairi Simms MET and Science Co-ordinator	Distance estimated	135	1.4	2.4	4.3	5.9
AWS air wind speed	Opposite side of runway 	Mairi Simms MET and Science Co-ordinator	Not considered to be adversely affected by vibration	Mairi Simms MET and Science Co-ordinator	Distance estimated	210	0.7	1.2	2.1	2.9
Ozone detector	East Beach - not seen	Mairi Simms MET and Science Co-ordinator	Not considered to be adversely affected by vibration	Mairi Simms MET and Science Co-ordinator	Location not confirmed - assumed as equal to closest East Beach MF Radar. Very distant to blast location.	310	0.4	0.6	1.1	1.6
Bentham Container - MET tower comms		Mairi Simms MET and Science Co-ordinator	Not considered to be adversely affected by vibration	Mairi Simms MET and Science Co-ordinator	Distance estimated	160	1.1	1.9	3.2	4.5
Small N-S dipole	Two connected antennae 	Alan Messenger - Communications Manager	Not considered to be adversely affected by vibration	Alan Messenger - Communications Manager	Distance estimated	70	4.0	7.0	12.2	16.9
N-S wide band array		Alan Messenger - Communications Manager	Not considered to be adversely affected by vibration	Alan Messenger - Communications Manager	Distance estimated	100	2.3	4.0	6.9	9.5

Sensitive Receptor	Description	Responsible Person	Limits	Limit Source	Comments	M.I.C (kg)	2.5	5	10	15
			Peak Particle Velocity mm/s			Distance (m)	PPV (mm/s)	PPV (mm/s)	PPV (mm/s)	PPV (mm/s)
MF radar receiver (east beach)		Ben Keitch / Alex Grievson - Electrical Engineer	Not considered to be adversely affected by vibration	Ben Keitch / Alex Grievson - Electrical Engineer	Distance estimated	310	0.4	0.6	1.1	1.6
MF radar receiver (Bransfield Hse)		Ben Keitch / Alex Grievson - Electrical Engineer	Not considered to be adversely affected by vibration	Ben Keitch / Alex Grievson - Electrical Engineer	Distance estimated	35	12.2	21.2	36.9	51.1
MF radar transmitter (closest)		Ben Keitch / Alex Grievson - Electrical Engineer	Not considered to be adversely affected by vibration	Ben Keitch / Alex Grievson - Electrical Engineer	Distance estimated	125	1.6	2.8	4.8	6.7
SkiYMet transmitter		Ben Keitch / Alex Grievson - Electrical Engineer	Not considered to be adversely affected by vibration	Ben Keitch / Alex Grievson - Electrical Engineer	Distance estimated	125	1.6	2.8	4.8	6.7
SkiYMet radar masts		Ben Keitch / Alex Grievson - Electrical Engineer	Not considered to be adversely affected by vibration	Ben Keitch / Alex Grievson - Electrical Engineer	Distance estimated	185	0.8	1.5	2.6	3.6
Search Coil Magnetometer	Location unkown - Last known East Beach	Richard Horne rh@bas.ac.uk	No specific limit due to location. Results will be affected.	Richard Horne, David Maxfield and Ben Kietch	Notify blast times to Richard Horne rh@bas.ac.uk and David Maxfield djmax@bas.ac.uk	310	0.4	0.6	1.1	1.6
ASPA No. 129	Designated control area with natural landscape	n/a	Not considered to be adversely affected by vibration	Jan Cordon	Land set aside for control purposes and of no concern due to distance	205	0.7	1.3	2.2	3.0
Tide gauge	Suspended in water in shaft near boathouse	Mairi Simms MET and Science Co-ordinator	Not considered to be adversely affected by vibration	Mairi Simms MET and Science Co-ordinator		350	0.3	0.5	0.9	1.3
Bonnar Laboratory Science		Ali Massey - Science leader	Not considered to be adversely affected by vibration	Ali Massey - Science leader	Science leader to be added to blast protocol	230	0.6	1.0	1.8	2.5
Gerritsz Laboratory Science	 Science Projects	Dutch Antarctic Survey / Ali Massey	Not adversely affected by vibration. No science operations are planned until 2019.	Ali Massey - Science leader	No operations planned until 2019	260				
Marine Fauna due to transmission to water	Transmission of shock waves to water from land blasting adjacent to water.		No limit as such, though consider marine fauna watch if calculated values are an issue.	Ali Massey - Science leader	Calculation made as per Canadian Guidance and will be included in D&B Mgt Plan	NA				
Land based fauna		Richard Philips raphil@bas.ac.uk	Not considered an issue - email 22.02.17, though any adverse effects should be monitored. This should include a check for Fauna immediately prior to blasting, including in the sea in the immediate vicinity of the blast area. Any disturbance to be reported immediatley. Include this check in the blasting protoo.	Richard Philips	Email sent to Richard Philips 21.02.17	To be observed on site				

Appendix B: Site Waste Management Plan

Schedule C1 Schedule C5 Site Waste Management Plan (Extracted from the PEP)

NOTE: This model SWMP will be finalised prior to mobilisation to site.

This declaration is to be used in conjunction with and uploaded into BAM Site – the web-based sustainability monitoring and reporting tool

Project reference	BAA.4008
Project title	Rothera Modernisation
Client	Natural Environmental Research Council / British Antarctic Survey
Principal contractor	BAM
Site waste coordinator / Environment engineer	Neil Goulding
Contract value	
Address/location	Rothera Research Station, Rothera Point, Adelaide Island, Antarctica **Position Lat. 67°35'8"S, Long. 68°7'59"W**
Project description	Modernisation of Rothera Research Station including: • The demolition of Fuch’s House, Old Bransfield House, Bingham’s, Chippy Shed, Generator Shed, Vehicle Garage and the Miracle Span • Constructing new Science and Operations Buildings • Removal of existing utilities • Provision of new utilities
Document prepared by	Neil Goulding

Declaration:

We the client and principal contractor confirm that all reasonable steps will be taken to ensure that:

a) all waste from the site is dealt with in accordance with the duty of care in section 34 of the Environmental Protection Act

b) materials will be handled efficiently and waste managed appropriately

Client:	Signed:
Principal contractor:	Signed:
Key subcontractor(s):	Signed:

This plan is reviewed at least every three months by the site waste coordinator and updated as necessary to ensure that waste management practices are in accordance with this plan.

Reviewed by	Date	Rev no.	Revision details (where applicable)

Introduction

This site waste management plan identifies and monitors:

- Legislative requirements for waste management
- Types and quantities of waste expected to be generated during the Rothera Modernisation works
- reuse of materials on the project e.g. cut and fill, site won materials
- waste minimisation methods to be implemented on the project
- waste management options for waste generated during the works including waste generated by subcontractors
- Storage and disposal options for each waste stream
- any cost savings achieved through waste minimisation

Materials identified within this SWMP are not necessarily statutory waste as they do not fall within the legal definition of waste i.e. ‘any substance or object which the holder discards intends to discard or is required to discard.’ There is no intention to discard materials such as:

- site won excavated materials
- aggregates crushed in accordance with the WRAP Quality Protocol (on or off site)
- pre-planned use of materials

All materials whether they are imported, reused ‘as is’ on site, recycled (on or off site) or sent off site for disposal are identified within the plan.

(See Appendix 1 for roles and responsibilities.)

Legislation

Antarctic Environmental Legislation

To ensure the protection of the Antarctic environment, the Antarctic Treaty nations adopted the Protocol on Environmental Protection to the Antarctic Treaty in 1991. The UK enforces the provisions of the Protocol through the Antarctic Act, 1994, the Antarctic Act 2013, and the Antarctic Regulations, 1995/490 (as amended). Following the guidance provided in this document will ensure that BAS complies with the requirements of the Protocol and other national and international legislation listed below.

Annex III: Waste Disposal and Waste Management

Annex III of the Environmental Protocol sets out regulations both for waste management planning and disposal of wastes (see Appendix 1). The Annex obliges all operators to reduce the quantity of waste produced and or disposed of in Antarctica in order to minimise any impact on the environment. Emphasis is placed on the storage, disposal and removal of waste from the Antarctic Treaty area, as well as recycling and source reduction.

BAS complies with the requirements of the Annex by means of conditions attached to the Operating Permit granted by the Foreign and Commonwealth Office.

Annex IV: Prevention of Marine Pollution

Within the Antarctic Treaty Area (south of 60o latitude) the discharge of all toxic and noxious chemicals, oil and oily wastes, plastics and other forms of non-biodegradable rubbish into the sea is prohibited. Annex IV largely parallels the international regulations controlling ship-generated pollution under MARPOL 73/78.

MARPOL 73/78

Since 1992, the Antarctic Treaty Area has been designated by the International Maritime Organisation (IMO) as a Special Area under Annex I (Oil) and Annex V (Garbage) of MARPOL 73/78 (Revised 2013). This means that the discharge of any oil or oily mixture, bulk chemicals or garbage from a ship is prohibited in Antarctica. Most waste, other than food and sewage, is discharged at port reception facilities outside the Special Area.

BAS avoids the intentional discharge of processed bilge water from machinery spaces containing oily mixtures whilst in Special Areas. However, when there is a requirement to do so, and if the requirements of MARPOL are met, this is allowed in consultation with the Designated Person Ashore and the Head of the Environment Office.

BAS vessel the RRS James Clark Ross, maintains a garbage disposal record book, as required under MARPOL. A copy of the *Marine Standing Instruction MSI/Gen/21 Bilge and Garbage Disposal* is held on the ship and should be referred whilst on board.

UK Environmental Legislation

The Waste (England and Wales) (Amendment) Regulations, 2014

The Waste Framework Directive, which is the primary European legislation for the management of waste, is implemented through the Waste (England and Wales) (Amendment) Regulations 2014. It places great emphasis on the waste hierarchy to ensure that organisations deal with waste in the priority order of:

The waste hierarchy is partly implemented through the amended Duty of Care regulations.

The Duty of Care Regulations, 1991

Under the Environmental Protection (Duty of Care) Regulations, 1991, BAM is required to take all reasonable steps to keep its waste safe and secure so that it does not cause pollution or injury.

In particular, BAM must:

- Fulfil the legal requirement to apply the waste hierarchy.
- Ensure safe and correct packing and containment. This is of particular importance while the waste is in transit.
- Check that waste contractors are appropriately registered with the Environment Agency.
- Describe the waste on a Duty of Care transfer note so that the waste carrier can avoid committing an offence under the Regulations.

Failure to comply with the Duty of Care Regulations is a criminal offence, and could result in a fine of an unlimited amount. The Environment Manager is responsible for compliance with the Environmental Protection (Duty of Care) Regulations, 1991 with regard to wastes returned by BAM from Antarctica for disposal in the UK.

The Hazardous Waste Regulations, 2005

Hazardous wastes are amongst the most harmful and difficult wastes to deal with. The Hazardous Waste Regulations 2005 control the licensing, transfer and disposal of such waste in the UK. The main element of these regulations which BAM must comply with is preparation of consignment notes for every movement of hazardous waste in the UK. And ensure legal disposal!!

The Head of the Environment Office is responsible for compliance with the Hazardous Waste Regulations, for hazardous waste being returned by BAS from Antarctica which is disposed of in the UK.

Materials resource efficiency

The following waste reduction and reuse measures have been included in the design and/or specification for this project and will be further developed as the design progresses:

Design specifications	Earthwork fill specification to be amended from British standards to suit materials available on site
Choice of materials	Use of site won materials for 99.8% of earthworks (only 50 tonnes of sand import compared to 25000 tonnes of site won fill) Spare sheet piles from the existing Wharf will be used for the foundations of the Waste Handling Facility Steel from the jig used to construct the new Wharf frames will be reused for widening the services bridge at Admirals The scaffold tower from the same jig will be used for access to the New Operations Building during installation. Processed 30mm down fill, a by-product from the Wharf screening, to be used for the crane matts, and permanent landscaping and instead of importing sand for under the New Operations Building Redundant electrical cables to be used for site power distribution. Aim for high percentage of recycled aggregates and cement replacements in concrete mixes. Aim for high percentage of recycled material in steel.
Methods of construction	
Pre-fabrication off site	All concrete elements will be pre-cast outside of the Antarctic region and shipped to Rothera. Control Tower and staircase to be fabricated in the UK Plant rooms to be fabricated in the UK Main service corridors to be fabricated in the UK MEP Plant room components to be fabricated and tested in the UK before being broken down for transportation to Rothera Insulated wall panels are to be pre-fabricated outside of the Antarctic region and shipped to Rothera Use of flat pack systems for internal components including the sauna

Forecast of the types and quantities of waste

It is estimated that this site will produce the following types and quantities of waste: These figures will be updated as the design is developed. All waste that cannot be re-used at Rothera will be returned to the UK for recycling/disposal at a licenced waste management facility.

Excavation Waste

Type of Waste	**EWC Code**	**Estimated Quantity Tonnes/(m^3)**					**Waste Management Action in Detail**
		Total	**Re-Use**	**Recycle**	**Recover**	**Dispose**	
Inert Soil and Stone	17 05 04	72,150 (6,900)	72,150 (6,900)				Material to be re-distributed on site at Rothera

Construction Waste

Type of Waste	**EWC Code**	**Estimated Quantity kg/(m^3)**					**Waste Management Action in Detail**
		Total	**Re-Use**	**Recycle**	**Recover**	**Dispose**	
Steel	17 04 05	4,000 (0.51)		4,000 (0.51)			
Concrete / Grout	17 01 01	1,150 (0.5)	1,150 (0.5)				Waste grout to be crushed and used as aggregate
Cementitious Wash Water		10,000 (10)				10,000 (10)	Solids removed, remaining liquid neutralised using CO2 or citric acid and discharged to ground.
Alkaline Batteries	20 01 33	14 (0.005)				14 (0.005)	
Clothing / Textiles	20 01 10	50 (2.0)				50 (2.0)	
Cardboard	20 01 01	2,600 (20)		2,600 (20)			

Paper	20 01 01	150 (2.0)		150 (2.0)			
Timber	17 02 01	2,500 (5.0)	1,000 (2.0)	1,500 (3.0)			
Plastic	20 01 39	6,000 (6)		3,600 (3.6)	1,500 (1.5)	900 (0.9)	
Oil	13 02 07	5000 (5)				5000 (5)	
Oil Filters	16 01 07	50 (0.1)				50 (0.1)	
Oil Contaminated Rags	15 02 02	50 (0.2)				50 (0.2)	
Aerosols	16 05 04 16 05 05	64 (0.3)		32 (0.15)		32 (0.15)	
Glass	17 02 02	100 (0.02)					Stored in 205 litre steel drum

Demolition Waste

The table below detail the main waste expected to be generated from the demolition of the listed buildings. Additional waste will be contained in the seven ISO containers that serve as Technical Services Office and stores for a variety of materials. Quantities of demolition waste have been calculated from the original construction drawing where available. Discussions with the BAS Antarctic Estates team have provided information on the waste M&E equipment, fixtures and fittings as well as any modifications that have been made to the structure. Investigations of the buildings to be deconstructed will be undertaken this season which may provide additional information. Individual SWMPs will be produced for each building to be deconstructed once full information is available.

Where concrete foundations of building are below ground, the option of leaving concrete buried underground will be considered. Waste concrete will be crushed on site for re-use as aggregate. Wood and steel will be returned to the UK for recycling. All other demolition materials will be returned to the UK and recycled where possible. BAMs target is to send less than 10% of all waste to landfill.

Demolition Waste from Buildings

	Concrete	Wood	Steel	Insulation	Plaster Board	Calcium Silicate Board	Cement Particle Board	Aqua Elite Board	Acoustic Insulation
	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)
Fuchs House	44.08	70.47	0.10	173.81					
Old Bransfield House	95.11	347.83	3.60	656.78		5.62		22.66	2.27
Ops Tower	20.00	18.11	2.57	25.83	9.12	0.10			
Generator Shed	75.38	22.06	2.00	47.43			7.538		
Tractor Garage	107.28	22.84	5.60	28.02	3.79				
Miracle Span	84.86		0.80						
Chippy Shed / Binghams	2.29	20.28		39.55					
Totals	**429**	**501.59**	**14.67**	**971.42**	**19.18**	**6.44**	**8.76**	**22.66**	**2.27**

Demolition Waste from Services

	Metals				Plastics							Wood
	Copper	**Steel**	**Al.**	**Galv. Steel**	**PVC**	**HDPE**	**ABS**	**PP**	**PE**	**Armaflex**	**Insudite**	**Ply**
	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)
Electrical	1.29	0.67			3.79							
Fuel		1.09										
Heating					0.18							
Potable Water						0.6						
Sea Water					1.29		0.51	0.28	22.29			
Waste Water					1.36		0.36			9.23		
Fire Systems	0.03		0.01								0.14	
Data	0.001								0.008			
Ducting						2.59						
Wooden Box Trunking												38.95
Cable trays				0.34								
Totals	**1.32**	**1.76**	**0.01**	**0.34**	**6.62**	**3.19**	**0.87**	**0.28**	**22.30**	**9.23**	**0.14**	**38.95**

Management of waste

The production of waste material on this site during the construction phase is avoided wherever possible by following the '*reduce, reuse, recycle, recover'* measures outlined below. Only where these options have been exhausted is waste sent for disposal.

Reduction and reuse measures

The following measures will be employed to reduce and reuse waste on this site:

General	
Reduction measures	**Reuse measures**
• All buildings to be constructed using a modular design with panels pre-fabricated in Europe.	• All excavated material (except any hazardous material) to be re-distributed at Rothera.
• Accurate measurement, and minimal wastage will be allowed when ordering materials	• All construction waste materials to be offered to the Research Station Manager for re-use within the station
• Materials are to be stored and transported correctly so as to avoid damage	•
• Materials are to be kept off the ground by the use of pallets or timber bites	•
• All operatives are to receive training on the agreed reduction measures	•
• *(any other measures)*	•
Concrete and hardcore	
Reduction measures	**Reuse measures**
• Foundations to be constructed from pre-cast concrete, cast outside the Antarctic region	•

<table>
<tr><th colspan="2">Excavated material (soil & stones)</th></tr>
<tr><td>Reduction measures</td><td>Reuse measures</td></tr>
<tr><td>•</td><td>• Excavated soil and stone to be re-distributed on site</td></tr>
<tr><td colspan="2">Timber</td></tr>
<tr><td>Reduction measures</td><td>Reuse measures</td></tr>
<tr><td>• All buildings to be constructed using a modular design with panels pre-fabricated in Europe.</td><td>• All construction waste materials to be offered to the Research Station Manager for re-use within the station</td></tr>
<tr><td>• The use of reusable plastic pallets to be used</td><td>•</td></tr>
<tr><td>•</td><td>•</td></tr>
<tr><td colspan="2">Metals</td></tr>
<tr><td>Reduction measures</td><td>Reuse measures</td></tr>
<tr><td>• All buildings to be constructed using a modular design with panels pre-fabricated in Europe.</td><td>• All construction waste materials to be offered to the Research Station Manager for re-use within the station</td></tr>
</table>

Recycle and recovery measures

The following waste streams are to be segregated for recycling/ recovery off site:

Waste stream	EWC code	Storage option	Management option
• Mixed Plastics	21 01 39	Stored in FIBC within ISO container	Return to UK for segregation into different plastic waste streams and recycled where possible
• Wood	17 02 01	Stored in FIBC within ISO container or directly within	Return to UK for re-use where possible. Remainder to be sent to waste to energy plant.
• Mixed Metals	17 04 07	Stored in FIBC within ISO container or directly in ISO container if too large for FIBC	Return to UK for segregation into different metal waste streams and recycled.
• Cables	17 04 11	Stored in FIBC within ISO container or directly in ISO container if too large for FIBC	Return to UK for segregation into different waste streams and recycled where possible
• Alkaline Batteries	20 01 33	Stored in plastic lined re-used wooden crates	Tape up terminals. Stored in plastic lined re-used wooden crates labelled “ASSORTED WASTE BATTERIES, NON REGULATED”.
• Clothing / Textiles	20 01 10	Stored in FIBC within ISO container	Return to UK. Disposal to follow waste hierarchy
• Cardboard	20 01 01	Stored in FIBC or bales within ISO container	Broken down and baled or packed into FIBC. Returned to the UK for recycling
• Glass	17 02 02	Stored in re-used 205 litre drum.	Containers to be marked “WASTE GLASS” and returned to the UK for recycling

• Paper	20 01 01	FIBC marked “PAPER” and with the recycling triangle.	Re-use on site for packaging where suitable. Store in FIBC marked “PAPER” and with the recycling triangle. Return to the UK for recycling
• Oil	13 02 07	Stored in re-used 25 ltr plastic containers marked “WASTE LUBRICANTS”	Returned to the UK for recycling
• Oil Filters	16 01 07	Stored in 205 ltr drum marked “OIL FILTERS” and “UN 3077 Class 9 Environmentally Hazardous Substance, solid, n.o.s.” Place inside hazardous waste ISO container	Empty oil filter before storing. Return to the UK for disposal.
• Oil Contaminated Rags	15 02 02	Stored in FIBC within hazardous waste ISO container and labelled “WASTE OILY RAGS”	Allocate hazard class 4.2, UN no. 1856. Return to the UK for disposal
• Aerosols	16 05 04 16 05 05	Store in plastic lined re-used wooden crate, marked “WASTE AEROSOLS”	Seal tops of aerosols with packing tape Affix appropriate hazard labels and label the case UN no. 1950. If a case contains a mixture of aerosols with different hazard classes, then label with all relevant hazard classes. Return to the UK for disposal
• Detergents and Disinfectants	20 01 30	Store In original bottles in plastic lined re-used wooden crate, marked “WASTE DETERGENTS AND DISINFECTANTS”	Offer to Rothera Station Leader before disposal. Return to the UK for disposal
• Paint and thinners	20 01 27 20 01 28	Store in plastic lined re-used wooden crate, marked “WASTE PAINT” or “WASTE PAINT RELATED PRODUCTS”	Paint is to be offered to the Rothera Station Leader for re-use. Return to the UK for disposal.

Hazardous Wastes Classification

Hazardous wastes must be carried in accordance with the *International Marine Dangerous Goods (IMDG) Code*. This covers the carriage of dangerous goods at sea. It is the Chief Officer's responsibility to ensure that the regulations are followed onboard ship. Hazardous materials must be separated into nine different general classes based on the United Nations (UN) hazard classification. The general classes and subclasses are as follows:

Hazard Class	**Class Description**
Class 1	Explosive
Class 2.1	Flammable gas
Class 2.2	Compressed gas (non-flammable, non-toxic)
Class 2.3	Toxic gas
Class 3	Flammable liquid *
Class 4.1	Flammable solid
Class 4.2	Spontaneously combustible
Class 4.3	Dangerous when wet
Class 5.1	Oxidising agent
Class 5.2	Organic peroxide
Class 6.1	Toxic
Class 6.2	Infectious substance
Class 7	Radioactive material
Class 8	Corrosive
Class 9	Miscellaneous substance
*** Packing Groups for flammable liquids:**	
I	Flammable liquids - flash point below -18°C
II	Flammable liquids - flash point -18°C up to +22°C
III	Flammable liquids - flash point +23°C up to +61°C

If chemicals of the same class are mixed a list should be attached to the container identifying the approximate volumes of each different chemical it contains.
NEVER mix substances with different UN hazard classes. This is highly dangerous.
Special attention must be given to ensure that oxidising agents (Hazard Class 5.1) are kept separate from other chemicals
Acids and alkalis (hazard class 8) are not to be packed in the same container. They must be clearly labelled in separate containers.

Shipping Documentation

All waste sent out from BAS research stations and ships must be accompanied by an accurate Bill of Lading (BOL). BOLs are the principal documentation for waste removed from Antarctica. They are primarily used to ensure goods are loaded and transported appropriately and discharged in the correct location.
In addition the BOL's for waste are used to agree waste disposal contracts, verifying disposal invoices, auditing the waste management system and monitoring the quantity of waste that is produced in Antarctica. **Waste data has to be reported to the Antarctic Treaty Parties, HM Treasury, BAM Nuttall, NERC and the BAS Board.** It is therefore essential that the information provided on the BOL is complete, accurate and dated.

BOL's must be prepared by the person who is responsible for the waste, in conjunction with the Station Leader.

BOLs for major construction activity need to specify which project the waste originated from so that these records can be attributed to the correct project.

Each base has been provided with a pallet truck which has built in scales. Standard weights and volumes for use on BOL's are shown below. These should be used **only** in the absence of weighing or measuring facilities. **It is important that the weights and volumes are as accurate as possible.**

Waste	**Volume (m³)**	**Weight (kg)**
205 litre drum – Empty	0.3	20
205 litre drum - Filled e.g. fuel, seawater (do not fill to the top - part fill only)	0.3	185
205 litre drum - Crushed	0.065	20
25 litre drum – Filled e.g. chemicals (do not fill to the top - part fill only)	0.04	30
ISO-container empty	25.0	As per tare plate on container
ISO-container full (crushed drums)	25.0	14,500
Skips	6	Dependent on contents
Small FIBC	0.5(max)	Dependent on contents
Large FIBC	0.75(max)	Dependent on contents

Completing a BOL

Examples of completed BOLs for both non-hazardous waste and hazardous wastes are shown at the end of this section.

The following information is required on all waste BOLs:

- Date
- Consignor
- Consignee
- Station/vessel generating waste
- Vessel used for transportation of waste
- Special stowage instructions (if applicable)
- BOL number
- Quantity and type of package
- Full description of contents
- Case/drum number (new number for each individual item; not required for wastes off-loaded in FI)
- Case dimensions (cm)
- Weight (kg)
- Volume (m3) per item
- Estimated value (if applicable)

Appendix C: Biosecurity Plan

Antarctic Construction Partnership – Rothera Modernisation

Employer	NERC/British Antarctic Survey	Project Number	BAA4008
Tech Adv	Ramboll	Document Number	BAA4008-BAM-ZZ-YYY-RC-YE-0004
Contractor	BAM	Revision	P-01

Rothera Modernisation Biosecurity Plan

Reference Sheet

Document Number	Description
	BAS Biosecurity Regulations 2019

Revision History

Revision	Date	Revision Description
P-01	10-03-17	First Draft

Prepared by	Checked by		Approved by
NDG	DPH		MSI
Author	Project	Corporate / Area Process Owner	Project Manager

Status Definition **(latest revision)**	**Total number of pages** **(including attachments)**
For Issue	19

0.17

Table of contents

1. Introduction

Many plant and animal species have been moved around the world through human activities to areas they would not reach naturally. Once in a new location, these 'non-native' species may establish, with potentially severe impacts on local species and ecosystems. The Antarctic continent currently has few confirmed non-native species, but numbers are increasing. Future increases in human presence in the Antarctic region, either through tourism, governmental operators or other commercial activities, will increase the risk of further non-native species introductions. At the same time, climate change may increase the chances of non-native species establishment and range expansion.

The Antarctic Act (1994, amended 2013) legislates to minimise the risk of non-native species introductions in the Antarctic, and BAM is obliged to conform to this legislation. BAM are also obliged to follow the BAS Biosecurity Regulations and the Biosecurity Policy with Contractors.

BAMs projects in the Antarctic cover several locations of distinct biological diversity. It is essential that all necessary precautions are taken to prevent the introduction of non-native species to Rothera Point and the surrounding area from other locations, including Europe, South America or any of the other BAS Research Stations or logistics hubs.

This document provides guidance to BAM personnel on the measures to be taken when moving plant, materials or personnel to Rothera Research Station.

1.1. Prohibited Items

No BAM personnel or their subcontractors will be permitted to take any of the items below to the Antarctic:

- Any living plant, animal or microorganism.
- Non-sterile soil or compost.
- Any plant propagules (e.g. seeds, bulbs, cuttings) or invertebrate eggs (e.g. brine shrimp or sea monkey eggs).
- Untreated wood where bark remains attached.
- Any perishable foods including fruit, vegetables, cheese, fish or meat in personal cargo (no personal foods are allowed but fresh foods as part of the construction team food supply will be arranged).
- Packing materials of polystyrene beads or chips, used sacking, hay, straw, chaff or wood shavings.

1.2. Roles & Responsibilities

- Environmental Lead – Neil Goulding, neil.goulding@bamnuttall.co.uk - 07770 223441
    - Overall responsibility for environmental management of the project.
    - Ensuring that the designers, buyers and construction team are aware of the biosecurity issues covered in this document.
    - Nominating and training of biosecurity inspectors.
    - Training of the Environmental Engineer
    - Answer any queries or questions from BAM staff on environmental or biosecurity issues.

- Project Manager – Maurice Siemensma, maurice.siemensma@bam.com – 07539 477186
    - Responsible for all construction works including mobilisation and demobilisation

  - Appointing an Environmental Engineer from within the site team.
  - Ensuring cargo is biosecure before off loading at Rothera

- BAM Environmental Engineer: TBC (appointed from within the Rothera construction team on site)
  - Responsible for managing and monitoring the environmental performance and biosecurity measures on site.
  - Responsible for managing the Biosecurity Inspectors on site.
  - Carries out all final biosecurity inspections before cargo is offloaded from the ship to Rothera
  - Completes the relevant biosecurity checklists (Checklists 2, 3, 4, 5 and Form 1)
  - Reports to the BAM Environmental Lead

- BAM Biosecurity Inspectors: TBC (at least one member of the Rothera construction team and at least one BAM staff member responsible for checking cargo at packing and loading stages in the UK)
  - Responsible for ensuring that all plant and materials are thoroughly inspected and pose no biosecurity risk.
  - Responsible for completing the relevant biosecurity checklists (Checklists 2, 3, 4, 5)
  - Inspections will be required at the port where materials are loaded
  - Report to the BAM Environmental Lead unless at Rothera in which case reports to the Environmental Engineer

- All BAM Personnel
  - Personnel will be responsible for ensuring that their personal belongings are biosecure and do not contain any prohibited items.

2. Pre-departure Biosecurity

2.1. *Biosecurity Training*

Prior to departure, all construction team members will receive a project specific briefing (in addition to the general environmental pre-departure briefing) to ensure that they are aware of the specific biosecurity requirements of the project's EIA and any associated permit.

Construction team members will sign a register to confirm that they have attended the briefing and understood the biosecurity requirements of the EIA and permit.

Additionally, selected members of the construction team will be trained as biosecurity inspectors to assist in inspections at the port of departure and more specifically on arrival at Rothera.

2.2. *Personal Biosecurity*

- Immediately before leaving home for Rothera, BAM personnel should ensure that all outer clothing has been washed, at the hottest temperature suitable for the garment, to remove seeds, soil and other propagules. Particular attention should be paid to Velcro, gaiters, pockets, turn-ups in trousers and hoods of jackets. (Please see Appendix A. Checklist 1).
- Footwear should be cleaned (inside and out) to remove soil, seeds or any other plant material.
- Personal clothing and equipment shall also be checked on the ship prior to arrival in Antarctica.
- Avoid picking up soil, seeds and other propagules on your clothing during travel to Antarctica (i.e. be careful to ensure clothing is clean after walking in the countryside in any South American countries or South Atlantic gateways prior to departure)
- If possible, before entering Antarctica wear new/clean items of outer clothing which will be free of non-native species and propagules.
- If moving between BAS stations please check clothing and personal belongings to prevent transport of biological material between sites (especially from South Georgia station to Antarctic locations).
- Ensure all clothing and personal effects are packed indoors in a clean environment.
- Before handing in any personal items to the BAM Logistics Stores in the UK, Netherlands or Chile for transportation to Antarctica, ensure that they are clean and free of soil and propagules.

2.3. *Supplier Biosecurity*

Many of the components that will be used to construct the Science and Operations building will be prefabricated in factories in Europe. Other goods such as mechanical and electrical components may be packed ready for export in the supplier's premises.

In order to ensure that that pre-fabricated elements such as wall cassettes are biosecure, inspection will be carried out on supplier's premises at the earliest opportunity to ensure that biosecurity arrangements meet the required standards. Supplier's premises must conform to the standard shown below for cargo packing areas.

2.4. *Cargo Packing Areas*

Plant and materials bound for the Rothera Modernisation project will be loaded onto ships at European ports, which are yet to be selected. Logistic centres will be established close to the ports for storing plant and material before loading onto vessels. The following biosecurity measures will be adopted for cargo packing areas (Please see Appendix A. Checklist 2).

- Cargo packing and storage areas shall be deep cleaned prior to the commencement of use by BAM and, thereafter, at least once per year or as deemed necessary.
- Internal and external cargo storage and packing areas shall be free of weeds, plants and invertebrate infestations. (i.e. regular spraying of weeds that emerge on hard standing).
- Any pallets stored outside shall be checked for bird nests before use, and if found should be removed and the pallet cleaned.
- Rodent and insect pest control measures will be in place in cargo packing and storage areas (i.e. regularly inspected sticky traps for insects and bait boxes for rodents).
- Store doors are to be kept closed, whenever possible.
- Cargo will be stored inside, where possible.
- Shipping containers should be stored on concrete surfaces (as opposed to bare earth). When containers cannot be stored on concrete, they will be raised above the ground on batons of, either timber, concrete or steel, and additional checks shall be made to ensure they are free from soil and biological material prior to on-ward transportation.

2.5. Packaging

The following packaging materials are prohibited:

- No used meat, fruit or plant product cartons will be reused.
- No polystyrene beads or chips, soil, moss, used sacking, hay, straw, chaff or wood shavings will be used.

The following packaging types are acceptable:

- Reusable packaging (e.g. reusable Nefab boxes or aluminium or plastic trunks) as long as it is new or has been inspected and thoroughly cleaned (preferably with disinfectant) prior to repacking.
- All packaging containers (boxes, Nefab, trunks etc.) shall contain an internal sealed plastic liner and all containers shall be taped and sealed shut on all sides.
- Packaging and filling materials may include shredded paper, vermiculite, bubble wrap and other air-filled cushioning materials.
- Wood packaging (such as cases, crates, dunnage, pallets and timbers for the purpose of bracing, separating, protecting or securing cargo) as long as it is new and complies with the International Standards for Phytosanitary Measures No. 15 (ISPM 15).
- Where other cost-effective options exist, use of corrugated card board boxes should be minimized, as they may carry non-native invertebrates within the corrugations.

2.6. Break Bulk Cargo

Break bulk cargo may present a more substantial biosecurity risk than containerised cargo, therefore, it is important that the amount of break bulk cargo generated is kept to a minimum. Break bulk cargo can vary greatly in shape, size and type (e.g. construction materials, timber, scaffolding poles, etc.). All break bulk cargo must be clean and free of soil and biological material before loading on the ship. All items of break bulk cargo, including packaging, shall be visually inspected for signs of rodent gnawing or rodent ingress. Cargo shall also be checked for any soil or biological material and if found the item shall be cleaned.

2.7. Small Plant & Tools

Prior to packing any previously used small tools or small plant items for transport to, or between, Antarctic Research Stations, the following procedure is to be followed. The high levels of cleanliness apply to all mechanical plant and tools, irrespective of size; however, individual hand tools do not need to be listed separately in the Appendix A. Biosecurity Checklist 3 Small Plant and Tools.

- Plant items are to be placed on a clean concrete or asphalt hard standing.
- Where practical, plant is to be cleaned externally using a high pressure jet wash to ensure that no soil, mud or biological material is left on the items. Where the use of water is not possible, the item will be cleaned using a combination of hard and soft brushes and/or a damp cloth.
- Following cleaning, small tools and plant are to be inspected by a nominated Biosecurity Inspector to ensure that they are free of visible soil and biological material (e.g. plant fragments, seeds and insects) This information is to be recorded for auditing purposes (Please see section Appendix A. Checklist 3)
- Care should be taken not to contaminate the small tools and plant prior to loading onto the ship or aircraft. Plant storage facilities should minimise the potential for recontamination of cleaned small plant and tools to transport and, if necessary, arrangements should be made to thoroughly clean the small plant and tools at the ship or aircraft loading site.
- Immediately before being loaded onto the ship or aircraft for transportation, all small tools and plant should be checked by a nominated Biosecurity Inspector to ensure they are free of soil and biological material. If any soil or biological material is found, the contaminated item should be cleaned and re-inspected before being transported.

2.8. Vehicles & Large Mechanical Plant

Mechanical plant (particularly tracked vehicles) pose a high risk to biosecurity. The undercarriage of wheeled or tracked plant can pick up soil which could contain plant fragments, seeds, invertebrates or invertebrate eggs.

Prior to loading any item of large mechanical plant for transport to or between Antarctic Research Stations, the following procedure is to be followed (Please see Appendix A. Checklist 4):

- Plant items are to be placed on a clean concrete or asphalt hard standing.
- Where practical, plant is to be cleaned externally using a high pressure jet wash to ensure that no soil, mud or biological material is left on the vehicle, including the wheels, wheel arches, tracks and areas underneath the vehicle. Plant accessories, such as forks and buckets, should be cleaned in a similar manner.
- Where the plant has a cab, upholstery and mats should be brushed and/or vacuum cleaned to remove any soil or biological material.
- Following cleaning, plant is to be inspected by a nominated Biosecurity Inspector to ensure that they are free of visible soil and biological material (e.g. plant fragments, seeds and insects).
- Care should be taken not to contaminate the plant prior to loading onto the ship or aircraft. Plant storage facilities should minimise the potential for recontamination of cleaned vehicles prior to transport and, if necessary, arrangements should be made to thoroughly clean the vehicles at the ship or aircraft loading site.
- Immediately before being loaded onto the ship or aircraft for transportation, all vehicles should be checked by a nominated Biosecurity Inspector to ensure they are free of soil and biological material. If any soil or biological material is found, the contaminated vehicle should be cleaned and re-inspected before being transported.

- Motorised plant is to have its engines started before loading, to ensure rats and mice are not living in the engine compartments.

2.9. Construction Materials

The following section does not constitute a complete list of the construction materials but simply identifies the materials considered to pose the highest biosecurity risk and details the specific measures to be taken.

2.9.1. Aggregates

Aggregate is defined as any course particulate material used in construction, including sand, gravel, crushed stone, boulders, pebbles or slag. It presents a biosecurity risk because biological material such as seeds, soil and invertebrates can easily become entrained during production and transport.

- Aggregate to be obtained from marine sources.
- To prevent seed contamination during storage and transport aggregate must be contained in clean sealed packaging (such as FIBCs).
- Packaged aggregate will be transported in clean ISO containers.
- Aggregate must be carefully handled to prevent damage to the packaging.
- Only the minimum amount of aggregate needed for the project will be sent to the site.
- All aggregate will be used as quickly as possible after delivery to the site to reduce the risk of establishment of any non-native species present in the aggregate.
- Aggregate must be stored in a defined area at the construction site. Any spilled aggregate must be cleaned up immediately and contained within packaging, until used.
- Aggregate will be stored in its sealed packaging at the site and will not be left open to the environment.
- When aggregate is removed from its packaging for use, it must be used as soon as possible.
- Aggregate must be encapsulated as a component of concrete, or buried so that propagule release is not possible.

In the event that one or more of these management steps are not possible, further consultation with the BAS Environment Office must take place. Consultation with the BAS Environment Office must occur prior to any aggregate being purchased from suppliers.

2.9.2. Timber

Timber will be required as a construction material and required for packaging materials. Due to the risk of infestation by pests the following precautions must be observed before timber can be imported to Antarctica:

- Timber materials must be heated in accordance with a specific time–temperature schedule that achieves a minimum temperature of 56 °C for a minimum duration of 30 continuous minutes throughout the entire profile of the wood (including at its core).
- All timber products are to be inspected for signs of wood borrowing animals such as wood boring beetles and woodworm (a beetle larvae) before being shipped.
- If any evidence wood burrowing animals is discovered the timber must be treated with a pesticide or fumigated in a sealed container.

- All packaging timber should conform to the requirements of International Standards for Phytosanitary Measures No. 15 (ISPM 15) and be stamped with IPPC logo, country of origin and method of treatment.

2.9.3. Mechanical and Electrical (M&E) Fittings

An extensive quantity of M&E fittings will be required within the new Operations Building. The fittings include pipework, ducting, conduit and pumps, all of which contain voids where invertebrates could hide from predation. Inspections and audits will be carried out on the premises of sub-contractors supplying this equipment. All tubes (ducting and pipework) have ends sealed to prevent ingress of contaminants immediately after manufacture. Where possible, all M&E equipment will be transported in containers, which will be fumigated before loading onto the vessel for transportation.

2.9.4. Scaffold Tubes

Scaffold tubes will be used for temporary works such as access to the façade of the new Operations Building. The hollow section forms an ideal place for invertebrates to hide from predation. Scaffold tubes shall be cleaned using a pressure washer, taking care to clean any invertebrates or their eggs from the inside of the tubes. After cleaning, scaffolding tube ends are to be sealed with duct tape or scaffold end caps to prevent the future ingress of contaminants.

2.10. ISO Containers

Prior to loading any ISO or other sealed container for transport to or between Antarctic Research Stations, the following procedure is to be followed.

- Shipping containers are to be stored on concrete surfaces (as opposed to bare earth).
- Shipping containers are to be kept clean and free of soil, mud, spiders' webs, invertebrates, debris, wood fragments (e.g. from pallets) and plant material. A record shall be kept of this inspection for auditing purposes (Please see Appendix A. Checklist 5). If deemed necessary by the nominated Environmental Engineer, containers shall be washed inside and out before being sent to Antarctica.
- Prior to loading, if deemed necessary by the nominated Environmental Engineer, containers are to be washed inside and out. Particular attention is to be paid to underneath and to the corner fastening systems.
- Prior to being sealed for the last time before being sent to Antarctica, containers (except those containing fresh foods) shall be fumigated using a single-use pyrethrum fogger, to eradicate any invertebrates within.

2.11. Fresh foods

Provisions for biosecurity measures associated with fresh foods have not be detailed in this document, as all fresh foods for BAM personnel will be supplied by BAS

3. In-transit Biosecurity

3.1. Ships

Any ship chartered by BAM for the transport of cargo and personnel must meet the following biosecurity measures and evidence needs to be provided to BAS that the following biosecurity requirements are included in the contract:

- All ships must have a Ship Sanitation Certificate (SSC).
- All ships must conform with Resolution MEPC.163(56) Guidelines For Ballast Water Exchange In The Antarctic Treaty Area.
- All ships shall have rodent boxes with poison bait that are inspected before, during and after each port visit.
- Insect sticky traps should be placed in food storage areas, and replaced when necessary.
- Electric UV insect killers shall be used in food storage areas.
- Biosecurity inspections of all ship and Antarctic station cargo shall be undertaken prior to loading and off-loading. (Please see checklists 3, 4, and 5)

3.1.1. When in Port

- Ships must have rat guards on the mooring lines.
- The gangway shall be lifted at night, or if lowered, lit with flood lights. An ultrasonic rat deterrent must be available and switched on.
- External doors and windows should be closed, wherever possible, to minimise the attraction of insects onto the ship.
- Boot/shoe washing facilities must be made available at the gangway to allow boot/shoe washing ON and OFF the ship.
- The inside of the tenders shall be cleaned between each landing to remove soil and other biological material knocked off passengers’ boots.
- It is important that the boots and clothing of those arriving in Antarctica by ship is adequately cleaned before disembarkation. At a suitable interval before the arrival date, BAM should inform landing personnel and crew that clothing must be cleaned to remove soil, seed and other propagules. Spot check shall be undertaken to ensure compliance.
- Just prior to disembarkation at locations in Antarctica, all footwear must be cleaned in disinfectant (e.g. Virkon S).
- Disinfectants can become ineffective over time, or if contaminated excessively with soil or organic material. Therefore, disinfectant solutions provided for footwear cleaning shall be changed regularly (at least once per week), and a specific individual assigned this task as part of their duties.

3.2. Cargo Inspection Pre-offload

3.2.1. Cargo Boxes and Break Bulk

All items of break bulk cargo, including packaging, shall be visually inspected by the Biosecurity Inspector for signs of rodent gnawing or rodent ingress. They shall also be checked for any soil or biological material and if found the item shall be cleaned. Once these checks are complete and the item is biosecure, a nominated BAM staff member will check the item against the manifest and then allow it to be transported to the station. If a biosecurity issue is noted, the cargo shall not be off-loaded until this issue is resolved.

3.2.2. Vehicles and Large Mechanical Plant

All vehicles must be inspected before off-loading and a record of this made (Please see Appendix A. Checklist 4). If contamination is found, further cleaning must be done before off-loading.

3.2.1. ISO Containers

ISO containers shall be inspected externally for soil, plant material and invertebrates prior to off-loading. Details of the check shall be kept for auditing purposes (Please see Appendix A. Checklist 5)

4. Biosecurity on Arrival at Rothera

4.1. Personnel Disembarkation

- Personnel disembarking at Rothera Point or elsewhere in Antarctica or South Georgia must adequately clean their clothing, personal belongings and boots before they leave the ship and upon returning to the ship (see Appendix A: Biosecurity Checklist 1. Personal Biosecurity).
- Clothing and personal belongings (such as bags, camera cases etc.) must be checked for biological material at a suitable time before arrival - remove any seeds, soil and other propagules found whilst still on the ship. Check Velcro, gaiters, pockets, turn-ups in trousers and hoods of jackets.
- Boots must be inspected and cleaned and any soil or seeds removed before arrival at Rothera Point.
- All personnel must use the boot washing facilities (provided by the vessel) at the gangway to disinfect their footwear before disembarkation.

4.2. Inspection of Cargo

External surfaces shall be checked to ensure cargo items are free of soil, biological material and signs of gnawing, or other routes of rat ingress. Those opening ISO containers upon arrival, should stay vigilant for signs of live invertebrates. If found, these invertebrates should be eradicated immediately.
When opening cargo boxes, remain vigilant for imported soil or biological material.

4.3. Aggregate

- On arrival at Rothera Point, aggregate should be contained in sealed packaging and stored in a demarked area (preferably hard standing/concrete or on a tarpaulin.
- If aggregate is to be used in concrete, this should be done at a designated concrete batching area and then the concrete moved out to the site where it is to be used

4.4. General Awareness

When on station all personnel shall remain vigilant for any indications of:

- biosecurity breaches
- evidence of non-Antarctic soil importation
- non-native species colonisation, including within buildings
- rats or rodents

If in doubt, personnel should report any potential issues to the BAM Environmental Lead, who will assess the situation and, as appropriate, take any immediate action and complete and submit an AINME report.

5. Non-conformances

- All biosecurity breaches and near misses should be reported to the BAM Environmental Lead, the BAM Project Manager, the BAS Station Leader and the BAS Environment Office at the time of the incident.

- A near miss/environmental incident report must be produced and provided to the BAS Station Leader for inclusion in the Accident, Incident, Near-Miss and Environment (AINME) Reporting System as soon as relevant information is available and at most within 48 hours.

- Examples of biosecurity breaches may include, but are not limited to, the following:
  - Non-Antarctic soil or biological material (e.g. weeds) found on vehicles or other plant after unloading at Rothera
  - Live insects within cargo
  - ISO containers with soil or biological material on the interior and exterior surfaces
  - Any rodent sighting or any evidence of rodents (gnawing, etc.)
  - Failure to clean items delivered to station
  - Failure for biosecurity measures to be performed at appropriate stage of the supply chain
  - Failure for personnel to adequately clean their clothing or personal equipment.
  - Unintentional or deliberate importation of soil or biological material by BAM staff.
  - Importation of wood with bark still attached.
  - Failure for appropriate biosecurity checks of cargo packing areas to be performed.

Appendix A: Biosecurity Checklists

Biosecurity Checklist 1. Personal Biosecurity

(Pre-departure and pre-arrival for individuals going to Antarctica)

This checklist will be circulated to all BAM personnel prior to their deployment to Antarctica and is intended as a guide to assist individuals in undertaking their own biosecurity checks before travelling south.

Non-native species are those species that do not occur naturally in an area, but have been introduced by human activities, either intentionally or unintentionally. Unpermitted importation of non-native species is a breach of UK legislation and is in contravention of the Environmental Protocol and could lead to serious consequences for the responsible individual and BAM, including up to two years imprisonment and/or an unlimited fine.

Use the following checklist to reduce your risk of importing non-native species:

Personal Biosecurity Checklist	✓
Name and Signature	
All clothing is either new (i.e. straight out of the packet) <u>or</u> has been washed to remove plant seeds, invertebrates and soil (*Tip: check any Velcro® is clean and pay particular attention to pockets!*)	
All footwear has been scrubbed free of all plant seeds, invertebrates and soil (*Tip: check under the insole and tongue too!*)	
All bags and personal equipment have been cleaned, washed and/or vacuumed and are free of plant seeds, invertebrates and soil.	
All personal recreational equipment (including climbing gear, walking poles, ski and snow board equipment, kiting equipment and bicycles) has been cleaned and is free of soil and biological material.	
The following items have NOT been packed:	
• Any living plant, animal or microorganism - unless in possession of an appropriate permit	
• Non-sterile soil or compost	
• Any plant propagules (e.g. seeds, bulbs, cuttings) or invertebrate eggs (e.g. brine shrimp or sea monkey eggs) - growing plants and animals in Antarctica and South Georgia is <u>NOT</u> permitted	
• Untreated wood where bark remains attached	
• Any perishable foods including fruit, vegetables, cheese, fish or meat.	
You have explained the above restrictions to any person that is likely to send gifts or packages to you while in South Georgia or Antarctica.	

Biosecurity Checklist 2. Cargo Packing Areas

For each Cargo Packing Area that BAM utilises, a weekly checklist will be completed (for the duration of the packing period). The checklists will be stored on file and made available for auditing purposes either by BAM or by BAS personnel.

Weekly Cargo Packing Area Biosecurity Checklist	**Yes/No**	**Date checked**	**Any subsequent action or other notes**
Name of Facility Being Inspected			
Name (print) and Signature of Inspector			
Site is free of weeds and vegetation[1]			
Site is free of wind-blown seeds (e.g. from dandelions)			
Site is free of invertebrate infestation			
Site is free of rodents			
Rodent bait boxes are charged with poison bait[2]			
Insect sticky traps are present and still effective[3]			
Storage area doors are kept closed as much as possible			
Pallets and packing materials are kept inside in a clean area			
ISO containers are stored on hard standing			

[1] Regular use of herbicides may be required

[2] Using the AINME system, provide details of any rodents caught in bait stations.

[3] State the date when the insect sticky traps are replaced (typically every 2 months)

Biosecurity Checklist 3. Small Plant & Tools

All small plant and tools that have been used on jobs in other parts of the world shall be cleaned and checked prior to being sent to Antarctica.

Checks prior to off-loading shall be simple visual checks as described for all general cargo. If for some reason any checks are not possible at any stage of the supply chain, please note details of the circumstances here and report using the AINME system. Individual hand tools do not need to be listed separately using this checklist, but do need to be free of soil and biological material before transfer to Rothera. The checklists will be stored on file and made available for auditing purposes either by BAM or BAS personnel.

Small plant/tools identification details:		
Details of journey initial and final destinations (e.g. UK to Rothera, or Rothera to KEP):		
Transporting vessel (e.g. RRS Shackleton):		
Name (print) and Signature of Inspector		
Post-cleaning check	**Date completed**	**Notes (including details of any associated AINME reporting)**
Exterior surfaces (top and side)		
Exterior underneath surfaces		
Interior surfaces (as possible)		
Insect spray in crevices (as possible)		

Small plant/tools identification details:		
Details of journey initial and final destinations (e.g. UK to Rothera, or Rothera to KEP):		
Transporting vessel (e.g. RRS Shackleton):		
Name (print) and Signature of Inspector		
Post-cleaning check	**Date completed**	**Notes (including details of any associated AINME reporting)**
Exterior surfaces (top and side)		
Exterior underneath surfaces		
Interior surfaces (as possible)		

Small plant/tools identification details:		
Details of journey initial and final destinations (e.g. UK to Rothera, or Rothera to KEP):		
Transporting vessel (e.g. RRS Shackleton):		
Name (print) and Signature of Inspector		
Post-cleaning check	**Date completed**	**Notes (including details of any associated AINME reporting)**
Exterior surfaces (top and side)		
Exterior underneath surfaces		
Interior surfaces (as possible)		

Biosecurity Checklist 4. Vehicle & Large Mechanical Plant

Mechanical plant (particularly tracked vehicles) pose a high risk to biosecurity. The undercarriage of wheeled or tracked plant can pick up soil which could contain plant fragments, seeds, invertebrates or invertebrate eggs.

The following checklist and the procedures listed in Section 2.6 of this document will be followed to ensure vehicles and large mechanical plant arrive in Antarctica and/or the sub-Antarctic free of soil and biological material. If these checks are not completed at any stage of the supply chain, please note details of the circumstances here and report using the BAS AINME system

A checklist for each vehicle or plant consigned to Rothera will be stored on file and made available for auditing purposes either by BAM or by BAS personnel.

Vehicle model and identification details:		
Details of journey initial and final destinations (e.g. UK to Rothera, or Rothera to KEP):		
Transporting vessel (e.g. RRS Shackleton):		
Name (print) and Signature of Inspector		
Post-cleaning check: remain vigilant for mud, soil, debris, plant material, webbing or live spiders, other invertebrates or signs of rodents	**Date completed**	**Notes (including details of any associated AINME reporting)**
Vehicle exterior (top and sides)		
Vehicle wing mirrors and windscreen		
Vehicle exterior (underneath)		
Wheels and wheel arches		
Vehicle interior (including under floor mats, door pockets, down the sides and below the front seats, the boot/trunk, and under the spare tyre).		
Vehicle accessories (forks, buckets, etc.)		
Engine started to ensure no rodents/birds in vehicle interior		
Use insecticide spray in crevices where possible		

Name (print) and Signature of Inspector		
Check prior to loading onto vessel remain vigilant for mud, soil, debris, plant material, webbing or live spiders, other invertebrates or signs of rodents	**Date completed**	**Notes (including details of any associated AINME reporting)**
Vehicle exterior (top and sides)		
Vehicle wing mirrors and windscreen		
Vehicle exterior (underneath)		
Wheels and wheel arches		
Vehicle interior (including under floor mats, door pockets, down the sides and below the front seats, the boot/trunk, and under the spare tyre).		
Vehicle accessories (forks, buckets, etc.)		
Engine started to ensure no rodents/birds in vehicle interior		
Use insecticide spray in crevices where possible		
Name (print) and Signature of Inspector		
Check prior to off-loading at BAS station	**Date completed**	**Notes (including details of any associated AINME reporting)**
Vehicle exterior (top and sides)		
Vehicle wing mirrors and windscreen		
Vehicle exterior (underneath)		
Wheels and wheel arches		
Vehicle interior (including under floor mats, door pockets, down the sides and below the front seats, the boot/trunk, and under the spare tyre).		
Vehicle accessories (forks, buckets, etc.)		
Use insecticide spray in crevices where possible		

Biosecurity Checklist 5. ISO Containers

All ISO containers must be checked prior to loading on the ship and prior to off-loading at the stations. Appropriate cleaning equipment must be made available during checks.

For each ISO container consigned to Rothera a checklist will be completed and stored on file. The checklist will be made available for auditing purposes either by BAM or by BAS personnel.

If these checks are not completed at any stage of the supply chain, please note details of the circumstances here and report using the BAS AINME system

ISO container or Bunk-a-bin identification details:		
Details of journey initial and final destinations (e.g. UK to Bird Island):		
Transporting vessel (e.g. RRS Shackleton):		
Name (print) and Signature of Inspector		
Check prior to packing container*	**Date completed**	**Notes (including details of any associated AINME reporting)**
Container exterior surfaces (top and sides)		
Container exterior doors and hinges		
Container exterior underneath surfaces (as possible)		
Container interior surfaces		
Container interior high and low level corners and door hinges		
Container fumigated prior to locking doors		
Name (print) and Signature of Inspector		
Check prior to loading onto vessel*	**Date completed**	**Notes (including details of any associated AINME reporting)**
Container exterior surfaces (top and sides)		
Container exterior doors and hinges		
Container exterior underneath surfaces (as possible)		

Name (print) and Signature of Inspector		
Check prior to off-loading at BAS station*	**Date completed**	**Notes (including details of any associated AINME reporting)**
Container exterior surfaces (top and sides)		
Container exterior doors and hinges		
Container exterior underneath surfaces (as possible)		

Biosecurity Checklist 6.- All break-bulk items (any item which is not containerised and not covered by a specific checklist)

All breakbulk (individual boxes/crates, timber, cladding and other cargo which is not containerised) must be checked prior to loading on the ship and prior to off-loading at the stations. Appropriate cleaning equipment must be made available during checks. If these checks are not completed at any stage, please note details of the circumstances here and report using the BAS AINME system.

For each break-bulk inspection a checklist will be completed and stored on file detailing the items inspected and any outcomes. The checklist will be made available for auditing purposes either by BAM or by BAS personnel.

Description of all break-bulk inspected (i.e. 10 x wooden crates, 10 x zarges boxes, 20 x bundles of timber, 15 x bundles of cladding)		
Details of journey initial and final destinations (e.g. UK to Bird Island):		
Transporting vessel (e.g. RRS Shackleton):		
Name (print) and Signature of Inspector		
Check break bulk items prior to loading onto vessel	**Date completed**	**Notes (including details of any associated AINME reporting)**
Items exterior surfaces (top and sides)		
Items exterior underneath surfaces (where possible)		
Items clean and free of soil, biological material and any signs of rodent gnawing or ingress, invertebrates such as spider webbing or cocoons.		
Name (print) and Signature of Inspector		
Check break bulk items prior to off-loading at BAS station	**Date completed**	**Notes (including details of any associated AINME reporting)**
Items exterior surfaces (top and sides)		
Items exterior underneath surfaces (where possible)		
Items clean and free of soil, biological material and any signs of rodent gnawing or ingress, invertebrates such as spider webbing or cocoons.		

Appendix D: Ground Investigation Report

Ground Investigation Report - Science and Operations Building

Sweco UK Limited
Sweco 2nd Floor Quay 2
139 Fountainbridge
Edinburgh, EH3 9QG
+44 1315506300

Rothera Modernisation

Rothera Research Station, Antarctica

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Rev.	Date	Change concerns	Prepared	Reviewed	Approved
00	12/04/19	DRAFT, AWAITING GEOTECHNICAL LABORATORY TESTING	CDL 12/04/19	AGJ 12/04/19	NT 12/04/2019
01	29/04/19	MINOR AMENDMENTS TO APPENDICES, AWAITING GEOTECHNICAL LABORATORY TESTING	CDL 29/04/19	AGJ 29/04/19	NT 29/04/2019

Contents

1. Introduction

1.1 General

Sweco UK Ltd (Sweco) has been commissioned by BAM, on behalf of the British Antarctic Survey (BAS), to design, supervise and report on the findings of an intrusive ground investigation (GI) for the proposed new Science and Operations Building, at Rothera Research Station in Antarctica, herein referred to as the Site. The Site location is shown in Figure 1 and forms part of the wider Rothera Modernisation project.

The aim of the GI, herein referred to as the Sweco GI, was to confirm the ground conditions and geotechnical properties of strata underlying the Site.

Figure 1: Indicative Site Location within Rothera Research Station
Note: Approximate position of new Science and Operations Building highlighted in red

1.2 Objectives

The objectives of this report are to:

- Summarise the results of the GI and evaluate the encountered ground conditions.
- Provide a geotechnical assessment based on the development proposal.

1.3 Limitations of Report

To the extent that this GIR is based on information gathered during the recent GI works, persons using or relying on it should recognise that any such investigation can examine only a small proportion of the subsurface conditions which have inherent natural variability. Intrusive investigations are based on sampling at localised points and as such there remains a risk that contamination or unforeseen ground conditions may not be identified.

2. Desk Study Summary

2.1 Introduction

A Geotechnical Desk Study was undertaken by Ramboll in October 2017[1]. The Desk Study included a preliminary ground model and recommended a GI is undertaken at the site.

An initial intrusive GI was undertaken in February 2018 for the Rothera Modernisation project. The GI fieldwork was undertaken by BAS, under the supervision of Ramboll. The GI comprised 20 mechanically excavated trial pits including nine in the vicinity of the Site (TP105 to TP113).

The findings from the February 2018 GI, herein referred to as the Ramboll GI, are presented in the Ground Investigation Report (GIR) produced by Ramboll in June 2018[2]. The Ramboll Desk Study and Ramboll GIR should be read in conjunction with this report.

Pertinent information from the Ramboll Desk Study and Ramboll GIR is summarised in the following sections.

2.2 Site Conditions

A summary of the Desk Study information is presented in Table 1.

Current Land Use	• Rothera Research Station is a scientific research station comprising welfare and accommodation buildings, science laboratories, a control tower, runway and hangar, fuel storage and general storage facilities. • The site is a yard area which is currently used for moving plant and vehicles. • The location of the site and the existing site layout is presented in Figure 2.
Surface Conditions	• Rough undulating ground. Cobbles and gravel underfoot. A pre-existing concrete slab/platform in central area of the new building.
Topography	• The land rises to the south east in the general location of the new building.
Surrounding Area	• Rothera Research Station lies at the south eastern part of Adelaide Island. The surrounding area is mountainous and well glaciated.
Site History	• Rothera Research Station was originally established in 1975. By 1980, accommodation buildings, offices, workshops and stores had been built[3].
Published Geology	• The superficial geology is indicated to comprise Raised Beach Deposits[1]. • The solid geology is recorded to comprise granodiorite – gabbro hybrid intrusions belonging to the Adelaide Island Intrusive Suite[3].

Table 1: Site Details

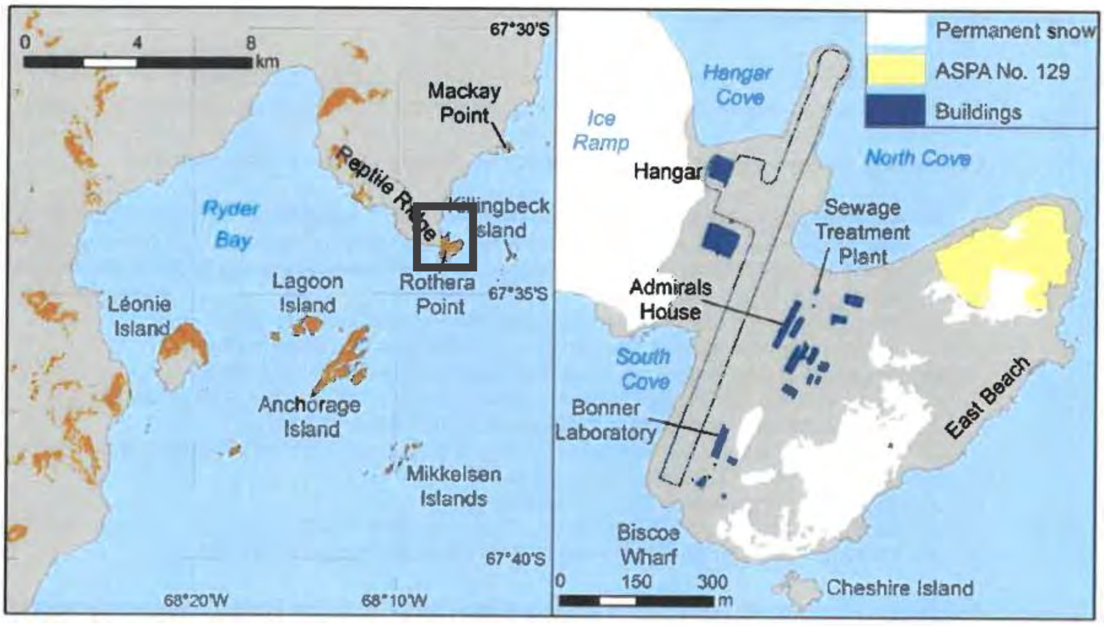


Figure 2: Location of Rothera Point on South-East Coast of Adelaide Island (Left) and Existing Site Layout (Right)[1]

3. Ground Investigation

3.1 Rationale

The Ramboll GI provided limited information on the strength and character of the bedrock underlying the Site. The Sweco GI included rotary drilling to obtain rock core samples. The Sweco GI also included supplementary trial pits and plate load tests to collect soil samples and provide additional information regarding bedrock levels and subgrade stiffness. Selected soil and rock samples were scheduled for geotechnical laboratory testing to inform the assessment of the characteristics and strength of superficial soils and underlying bedrock.

3.2 Fieldworks

The fieldworks were undertaken by BAM between 17th and 26th of January 2019. Table 2 summarises the fieldworks that were undertaken. An as-built Exploratory Hole Location Plan is included in Appendix A. The exploratory holes were logged, and engineering descriptions provided, by Sweco. Reference should be made to the borehole and trial pit exploratory hole records in Appendix B and Appendix C respectively.

Site Work	No.	Exploratory Hole ID	Start Depth (mbgl)	Termination Depth (mbgl)
Trial Pits	5	TP01 – TP05	GL	0.5 – 1.5
Rotary Boreholes	4	R01 – R04	GL	13.1 – 20.65
Plate Load Tests	3	PLTA – PLTC	-	-

Table 2: Summary of GI works (January 2019)
Note: ‘GL’ – Ground Level

3.3 Sampling and Testing

3.3.1 Geotechnical Sampling

The sampling regime was based on the Sweco GI Specification[4]. Small (1kg) disturbed and bulk (25kg) disturbed samples were collected at regular intervals from the trial pits during the GI. Rock cores were obtained from the rotary boreholes.

No geo-environmental sampling or testing was carried out.

3.3.2 Geotechnical Laboratory Testing

Geotechnical testing of selected soil samples will be undertaken by BAM Ritchies. Selected samples were shipped to the BAM Ritchies laboratory in Kilsyth, UK and are expected to be delivered in June 2019. This report will be updated when testing results are received.

4. Encountered Ground Conditions

4.1 Ground Model

The following geotechnical soil sequence has been interpreted based on the findings of the GI:

- Made Ground (0.10 – 0.45m thick) was recorded in all trial pits and typically comprised cobbles and gravel.
- Raised Beach Deposits (0.35 – 1.25m thick) was recorded beneath made ground in all trial pits and typically comprised sandy gravel.
- Granodiorite bedrock (proven up to 18.00m below existing ground level), considered to belong to the Adelaide Island Intrusive Suite[5], was proven to underlie the site at shallow depth (typically <2mbgl).

A detailed ground model, including engineer’s descriptions, is presented in Table 3.

Stratum	Description and Distribution	Top depth (mbgl)	Proven Thickness (m)	Comments
(1) Made Ground	Granodiorite COBBLES with much GRAVEL. Often with silt and clay matrix at base (possible washed out fines). Present across the Site. Recorded in all five trial pits.	0.00	0.10 – 0.45 (in trial pits*)	No extraneous materials/materials of anthropogenic origin were recorded in the made ground. However it is considered likely that the made ground is a surface capping layer from previous construction activities at Rothera Research Station. The thickness of the made ground varied from 0.10m in TP02 in the centre of the site to a maximum of 0.45m in TP04 towards the south of the Site.
(2) Raised Beach Deposits	Brown to brownish grey, slightly silty, slightly sandy to sandy (locally very sandy), GRAVEL with low to medium (locally high) cobble content. Occasional boulders. Cobbles and gravel are predominantly granodiorite. Present across the Site. Recorded in all five trial pits.	0.10 – 0.45	0.35 – 1.25 (in trial pits*)	Raised Beach Deposits were encountered below made ground at all exploratory hole locations. A low to medium cobble content with occasional boulders up to approximately 1m in size was generally noted. This stratum is considered to have been interpreted as Raised Beach Deposits in the Ramboll GIR[2]. A lower layer containing a higher proportion of sand (described as 'very sandy') was identified in TP05. It is likely that this corresponds to the 'Raised Beach Deposits – Fine' strata recorded in Ramboll trial pits TP111 to TP113. In the Sweco GI, there was not considered to be a clear distinction between different layers in the Raised Beach Deposits. The thickest Raised Beach Deposits were encountered in TP04 and TP05 west of the centre of the Site. The thickness of the strata varied from 0.35m in TP03 in the southwest of the site to 1.25m in TP05 in the centre of the site and generally compares well with the findings of the Ramboll GI which reported thicknesses of 0.30m to 1.50m in TP105 to TP113. Details of the superficial deposits were not recorded in the rotary drilled boreholes BHR01 to BHR04 as open hole drilling techniques were used such that no engineering descriptions were recorded.
(3) Granodiorite Bedrock	Grey or greenish grey GRANODIORITE and MICROGRANODIORITE. Frequent branching incipient fractures. Greenish chlorite and epidote staining. Generally strong to very strong in BHR01 and BHR02, locally highly fractured. Generally medium strong to strong in BHR03 and BHR04, often highly fractured. Present across the Site. Recorded in all rotary boreholes.	1.90 – 2.65 (in rotary boreholes)	Up to 18.00 in BHR01	The granodiorite Bedrock is considered to belong to the Adelaide Island Intrusive Suite[5]. Rockhead levels recorded in BHR01 to BHR04 are generally deeper than the termination depths of trial pits in this area. Rotary drilling indicates rockhead at depths of 1.90 to 2.65mbgl whereas it is considered that the trial pits suggest rockhead may be shallower than 1.50mbgl. It is likely that the trial pits could not be progressed further or refused on the weathered surface of the rock mass. Up to 0.80m of weathered bedrock was excavated in nearby trial pits from the Ramboll GI (TP106, TP108 and TP110). It is considered likely that the rotary rig commenced coring in more competent bedrock subject to a lesser degree of weathering and lying below 'true' rockhead. The combined results indicate that bedrock is likely to be shallower than 2mbgl with the rockhead level undulating across the Site. The rock core is generally recorded to be strong to very strong in the east side of the Site, where it is highly fractured in localised zones. To the west, in boreholes BHR03 and BHR04, it is typically described as medium strong to strong and often highly fractured throughout the rock mass. Numerous branching incipient fractures were observed throughout the rock mass. Open fractures were typically dipping at a wide range of orientations and often had greenish surface staining from chlorite or epidote mineralisation. Disseminated pyrite mineralisation was observed in BHR01 and BHR04.

Table 3: Ground Model

Notes: *Only described in trial pits; no soil descriptions obtained from rotary boreholes.

4.2 Geotechnical Test Results

Geotechnical field and laboratory test results are summarised and presented in this section. Plots of geotechnical laboratory testing are included in Appendix G.

4.2.1 In-situ Test Results

Three plate load tests, PLTA to PLTC, were carried out on Raised Beach Deposits (typically a sandy gravel or gravelly sand) at the west side of the Site. The plate load test results are included in Appendix F. In each location the test pressure was applied in five equal increments to 352kPa. A fourth test was aborted due to erroneous results and is not considered further. The total average settlements are summarised in Table 4.

Plate Load Test	Total Average Settlement (mm)
PLTA	3.3
PLTB	3.3
PLTC	1.0

Table 4: Summary of Plate Load Test Results

4.2.2 Summary of Geotechnical Laboratory Test Results

Geotechnical laboratory testing was carried out as part of the Ramboll GI, including Particle Size Distribution tests and geochemical testing. These laboratory results will be discussed alongside those from the Sweco GI.

Testing of samples from the Sweco GI is expected to commence in June 2019. This report will be updated upon receipt of geotechnical laboratory test results.

4.3 Groundwater

Groundwater was encountered in trial pits TP02 to TP05 within the Raised Beach Deposits as detailed in Table 5. The groundwater strikes were generally described as a seepage.

Trial Pit	Termination Depth (mbgl)	Water Strike Depth (mbgl)	Ice/Frozen Ground	Strata
TP01	0.50	-	-	-
TP02	1.00	Seepage at 0.70	-	Raised Beach Deposits
TP03	0.80	Seepage at 0.70	Ice recorded at 0.70mbgl	Raised Beach Deposits
TP04	1.40	Seepage at 1.00	-	Raised Beach Deposits
TP05	1.40	Seepage at 1.00	-	Raised Beach Deposits

Table 5: Groundwater Levels Recorded During Fieldworks

The results indicate that shallow groundwater is present within this stratum. This corresponds with the findings of the 2018 Ramboll GI where water strikes were recorded in four out of nine trial pits at depths of between 0.50m and 1.20m. In the Ramboll GI, the groundwater strikes were generally described as a slow ingress.

Ice fragments were observed in TP03 from the Sweco GI and TP108 from the Ramboll GI.

4.4 Visual and/or Olfactory Evidence of Contamination

No visual or olfactory evidence of contamination was recorded in any of the exploratory holes.

5. Geotechnical Assessment

5.1 General

At the time of writing this report, the proposed development is understood to comprise a building, approximately 100m long by 30m wide, founded at levels of between circa +2.0m and -6.0m from current ground level. Considering the site topography and available GI information, a rock excavation is anticipated to be required at the eastern end of the site while site-won engineered fill is likely to be utilised at the western end of the site.

5.2 Plate Settlement Modulus (E_{PLT})

The total average settlements and the corresponding plate settlement moduli (E_{PLT}) for the three plate load tests, PLTA to PLTC, are summarised in Table 6. Equation 1 was used to calculate the indicative plate settlement moduli.

$$E_{PLT} = \frac{\Delta p}{\Delta s} \times \frac{\pi b}{4}\left(1 - \nu^2\right)$$

(Equation 1)[6]

Δp is the range of applied contact pressure
Δs is the total settlement
b is the diameter of the plate (300mm)
v is Poisson's ratio for the conditions of the test (0.3)

Plate Load Test	Total Average Settlement (mm)	Plate Settlement Moduli (MPa)
PLTA	3.29	22.9
PLTB	3.32	22.7
PLTC	1.01	74.7

Table 6: Summary of Plate Settlement Moduli from Plate Load Tests (January 2019)

These results lie within the expected range of loose to medium dense gravel and dense sand[6].

5.3 Material Properties

Characteristic geotechnical parameters for the soil and rock units identified during the GI are given in Table 7 and Table 8 respectively. In the absence of geotechnical test results from the 2019 GI, values have been assumed from the 2018 Ramboll Ground Investigation Report (GIR)[2]. The characteristic geotechnical parameters will be reviewed following completion of laboratory testing of samples from the Sweco GI in June 2019.

Unit	Unit Weight (kN/m^3)	Angle of shearing resistance (°)	Effective Cohesion (kPa)	Young's Modulus (MPa)
Made Ground	-	-	-	-
Raised Beach Deposits	19	35	0	25

Table 7: Characteristic Geotechnical Parameters – Superficial Deposits (to be updated)

Unit	Unit Weight (kN/m^3)	Intact Rock Strength (MPa)	Rock Mass Effective Angle of Shearing Resistance (°)	Rock Mass Effective Drained Cohesion (kPa)	Rock Mass Global Strength (MPa)	Deformation Modulus (MPa)
Granodiorite Bedrock	27	85	72	610	29	17

Table 8: Characteristic Geotechnical Parameters – Rock (to be updated).

5.4 Foundation Options

The proposed development is anticipated to comprise a multi-storey steel framed structure supported on columns. At the time of writing this report details of the distribution and locations of the columns are unknown. However, the Raised Beach Deposits or Granodiorite Bedrock are likely to provide a suitable bearing horizon for shallow pad foundations for the proposed development. It is also possible that foundations may be placed on engineered granular fill, suitably compacted in layers bearing on these materials.

Made ground is considered unsuitable as a founding bearing horizon due to a variable composition and inherent risk of low bearing capacity and excessive settlement.

5.5 Excavatability / Rippability

The excavatability of the rock depends on the Construction Contractor's chosen construction methodology and available plant. The Construction Contractor should refer to the factual information provided and consider appropriate construction methods to suit the ground conditions at the Site.

It is considered likely that a limited and controlled extent of drilling and blasting may be required to aid the excavation works.

5.6 Earthworks / Material Re-use

The anticipated depth of excavation is such that the arisings are anticipated to comprise largely of granodiorite bedrock material. The obtained rock fragments are generally expected to comprise strong to very strong granodiorite and microgranodiorite.

A high-level review of the anticipated excavation arisings, based on the GI information, against the criteria from the Specification for Highway Works Series 600 – Earthworks[7] has been undertaken. It is considered likely that the excavated rock will be suitable for re-use as a selected granular structural fill, such as Class 6N, following appropriate processing. The material is not considered likely to exhibit frost heave due to the low fines content associated with such a class of material. Further testing should include the appropriate acceptability tests to confirm the suitability of the materials for re-use, including a demonstration that the granular structural fill shall not be susceptible to frost heave. It is likely that the granular superficial deposits, including the Raised Beach Deposits, could be used as a Class 1 general granular fill, following appropriate processing, if they are recovered separately.

5.7 Groundwater

Groundwater was encountered within four out of five trial pits in the Sweco GI and four out of nine of the trial pits in the Ramboll GI close to the new Science and Operations Building. The groundwater ingress was generally recorded as being slow or was described as a seepage. It is therefore likely that shallow groundwater (typically <1mbgl) may be encountered during excavation and construction works. Appropriate drainage and dewatering equipment are likely to be required during the construction phase.

5.8 Buried Concrete

The available geochemical test data from the 2018 Ramboll GI and has been assessed as a brownfield site according to the recommendations of BRE Special Digest 1:2005 Concrete in aggressive ground[8]. Four samples of Raised Beach Deposits and four samples of Granodiorite Bedrock were assessed with the results summarised in Table 9. Further geochemical testing will be undertaken on the Sweco GI samples.

Disseminated pyrite mineralisation was observed in BHR01 and BHR04 in the Sweco GI. The potential for oxidisation of the pyrite following excavation and processing of the bedrock as granular fill will be considered following geochemical testing on samples from the Sweco GI.

In general, the existing data from the Ramboll GI indicates that buried concrete should be designed for Design Sulphate (DS) Class DS-1 and Aggressive Chemical Environment for Concrete (ACEC) AC-1. One measured pH value of 5.4 from a granodiorite bedrock sample indicates an ACEC class of AC-2z should be adopted in this stratum.

These results will be confirmed by further geochemical testing on samples from the Sweco GI in June 2019.

Unit	No. of tests	Sulphate as SO_4 (2:1 water:soil) (mg/l)	pH Value	DS Class	ACEC Class
Made Ground	-	-	-	-	-
Raised Beach Deposits	4	90 – 250	6.8 – 7.2	DS-1	AC-1
Granodiorite Bedrock	4	120 – 130	5.4 -8.1	DS-1	AC-2z

Table 9: Summary of Geochemical Test Results DS and ACEC Class

Note: DC and ACEC Class assessed as brownfield location with mobile groundwater, as defined in Section C5.1.3 of BRE Special Digest 1:2005[8]
It is assumed that the ground materials on the brownfield location do not have oxidizable sulphides

6. Conclusions and Recommendations

6.1 Ground Model

The ground model developed for the site can be summarised as follows:

- Made Ground (0.10 – 0.45m thick) was recorded in all trial pits and typically comprised cobbles and gravel
- Raised Beach Deposits (0.35 – 1.25m thick) was recorded beneath made ground in all trial pits and typically comprised sandy gravel
- Granodiorite bedrock (proven up to 18.00m thick), considered to belong to the Adelaide Island Intrusive Suite[5], was proven to underlie the site at shallow depth (typically <2mbgl).
- Groundwater was recorded at shallow depth (typically <1mbgl) within the Raised Beach Deposits.

6.2 Geotechnical

The following conclusions and recommendations be drawn for the site, based on information obtained from the GI:

- To achieve building levels rock excavation is anticipated to be required at the eastern extents of the site while site-won engineered fill is likely to be utilised at the western extents of the site. The proposed development is thus anticipated to be founded on Engineered Fill in the west of the site, Raised Beach Deposits towards the centre of the site, and on Granodiorite Bedrock in the east of the site.

- The Raised Beach Deposits or Granodiorite Bedrock is likely to provide a suitable bearing horizon for shallow pad foundations for the proposed development, either directly or via engineered granular fill, suitably compacted in layers. Made ground is considered unsuitable as a founding bearing horizon.

- The plate load test results indicate that the granular Raised Beach Deposits have a Plate Settlement Modulus, E_{PLT}, ranging from 23 to 75 MPa.

- The Construction Contractor should consider the details contained within the Sweco and Ramboll GIRs as well as the available factual information to assess the excavatability of the rock based upon appropriate construction methodology. It is considered likely that a limited and controlled amount of blasting may be required to reach formation level.

- The anticipated depth of excavation is such that the arisings are anticipated to largely comprise strong to very strong rock. It is likely that this material could be used as a DMRB SHW Class 6 granular structural fill after appropriate processing. Further testing to be carried out by the Construction Contractor should include the appropriate acceptability tests to confirm the suitability of the materials for re-use, and a demonstration that the granular structural fill shall not be susceptible to frost heave.

- The GI carried out to date indicates that shallow groundwater (typically <1mbgl) will be encountered during excavation and construction works. Appropriate drainage and dewatering measures are likely to be required.

- A DS-1 AC-2z class of concrete is likely to apply.

7. References

The information sources and references used in this report are detailed below:

1. Ramboll Geotechnical Desk Study (Rev P01). Rothera Modernisation Project. Report Ref: 1620002306-RAM-RMORO-RE-CG-001. October 2017.

2. Ramboll Ground Investigation Report (Rev P02). Rothera Modernisation Project. Report Ref: 1620002306-RAM-RMORO-RE-CG-002. June 2018.

3. British Antarctic Survey Website. https://www.bas.ac.uk/about/about-bas/history/british-research-stations-and-refuges/rothera-r/ (Accessed 28.03.19).

4. Sweco Specification and Schedule of Exploratory Holes (Rev C). Rothera Modernisation. November 2018.

5. Riley, T.R., Flowerdew, M.J. and Haselwimmer, C.E. (2011). Geological Map of Adelaide Island, Graham Land (1:200 000 scale). BAS GEOMAP 2 Series, Sheet 2. Cambridge: British Antarctic Survey.

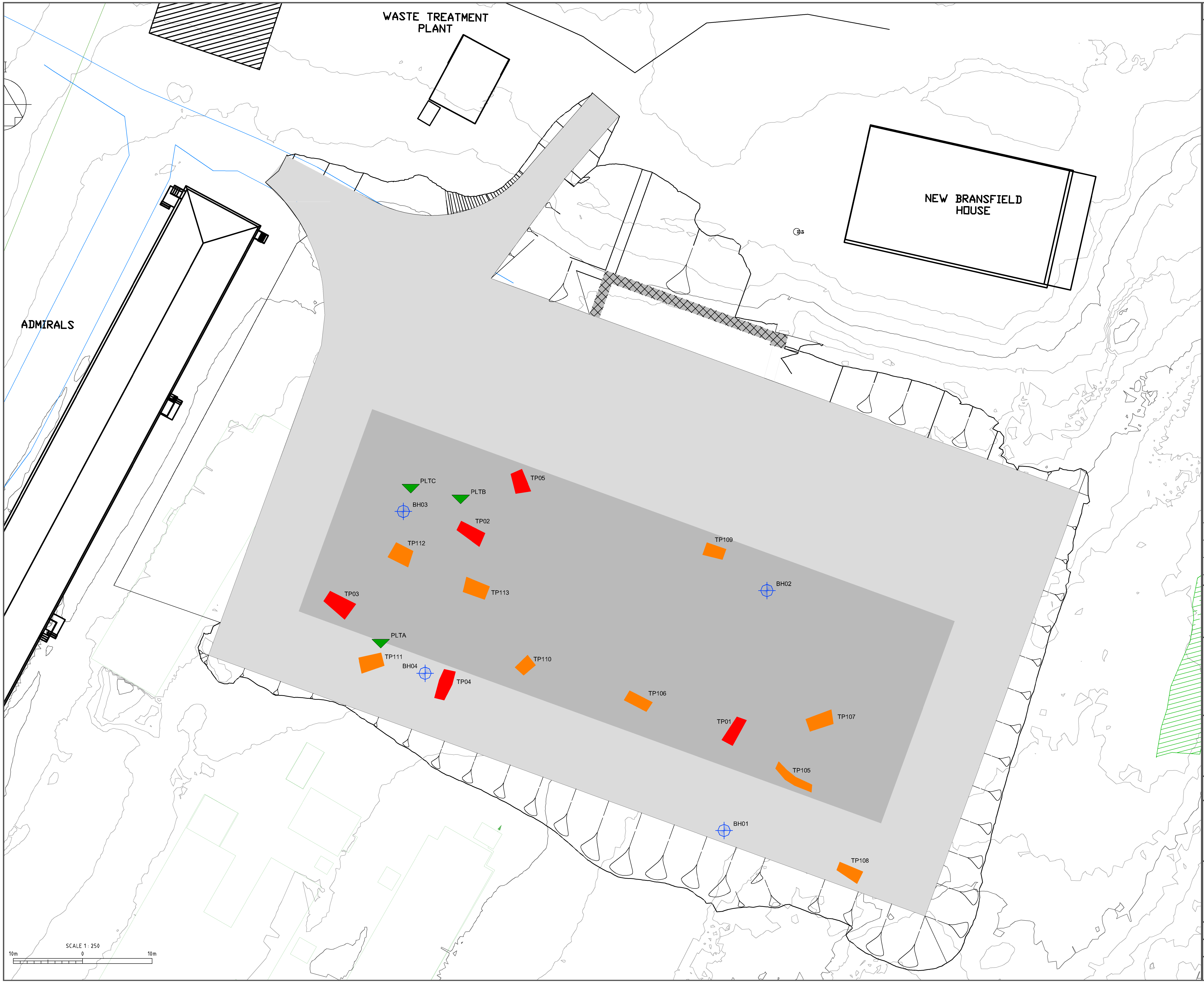
6. Look, B.G. (2007). Handbook of Geotechnical Investigation and Design Tables. London: Taylor & Francis.

7. Manual of Contract Documents for Highway Works (2016). Volume 1 Specification for Highway Works. Series 600 Earthworks. (Amendment February 2016).

8. BRE (2005). Special Digest 1:2005. Concrete in Aggressive Ground. 3rd Edition. Watford: BRE.

Appendices

Appendix A – Exploratory Hole Location Plan



Notes

1 Do not scale from this drawing.

2 Topographical and GI Survey data provided by BAM on 18/02/2019.

Ground Investigation Key

⊕	Rotary Borehole (Sweco GI - 2019)
▼	Plate Load Test (Sweco GI - 2019)
🟥	Trail Pit Sweco GI - (2019)
🟧	Trail Pit (Ramboll GI - 2018)
▨	Footprint of New Science & Ops Compound
▨	Footprint of New Science & Ops Foundations
▨	Footprint of Pedestrian Footpath

Rev.	Date	Amendment Details	Orig	Chk'd	App'd
P01	15/03/2019	First Issue	CK	CDL	NT

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Sweco
Suite 4.2, City Park
368 Alexandra Parade
Glasgow
G31 3AU
Tel: +44 (0)141 414 1700
Web: www.sweco.co.uk

Client

Drawing Status
Draft

Project Title
Rothera Modernisation

Drawing Title
Ground Investigation Site Plan - Science & Operations Building

Scale 1:250@A1	Originator CK	Drawn CK	Checked CDL	Approved NT
Original Size A1	Date 01/03/2019	Date 13/032019	Date 15/03/2019	Suitability 15/03/2019

Drawing Number
BAA4008-SWC-B1-YYY-DR-YG-0100

Revision
P01

Appendix B – Rotary Borehole Logs

SWECO

ROTARY HOLE LOG

ROTARY HOLE No
BHR01

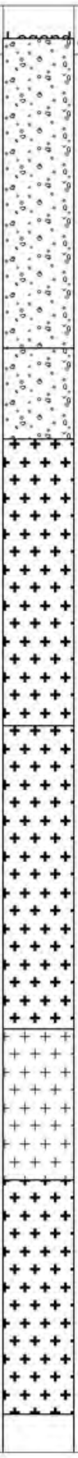
Project	Client	Logged By
Rothera Modernisation	British Antarctic Survey	DRAFT

Job No	Date	Ground Level (m)	Co-ordinates	Checked By
119482	18/01/2019 - 21/01/2019	15.81	2268.85 - 4865.64	CDL

RUN DETAILS

Depth	TCR	SCR	RQD	FI
2.05 - 2.95	33	0	0	NR NI
2.95 - 4.15	100	54	43	11 NI 10
4.15 - 5.65	100	80	57	NI 13 10
5.65 - 7.15	100	90	67	6
7.15 - 8.65	100	87	65	8 12

STRATA



Red'cd Level	Legend	Depth (Thickness)	DESCRIPTION	Instrument Backfill
		(2.05)	Overburden, GRAVELS. (Driller's description). (Open holed).	
13.76		2.05 (0.60)	Overburden, GRAVELS. (Driller's description).	
13.16		2.65 (1.90)	Medium strong greenish grey to grey GRANODIORITE (crystals 1 to 3mm). Partially weathered, evident from fractured zones and greenish chlorite and epidote staining. Locally highly fractured. Abundant branching incipient fractures with greenish epidote mineralisation (<1mm). Fractures at all orientations, very closely spaced (locally very closely), undulating and stepped, smooth. Fractures often have greenish (epidote/chlorite) and some dark orange (iron oxide) surface staining. (Adelaide Island Intrusive Suite). *3.40 - 3.85m: Subvertical fracture.*	
11.26		4.55 (2.00)	Strong to very strong grey GRANODIORITE (crystals 1 to 3mm). Frequent incipient and infilled fractures with greenish chlorite and epidote mineralisation (<2mm). Fractures mostly dipping at 60 to 90 degrees (ocassionally 30 degrees), closely spaced, undulating (locally stepped) and smooth. Fractures often have light green epidote and chlorite surface staining. Occasional drilling induced fractures. (Adelaide Island Intrusive Suite).	
9.26		6.55 (1.00)	Strong to very strong grey MICROGRANODIORITE (crystals <1mm). Frequent large white feldspar phenocrysts (<7 to 5mm). Generally unweathered. Frequent branching incipient fractures with greenish chlorite and epidote mineralisation (<1mm). Fractures dipping at 60 to 90 degrees, generally closely spaced (locally very closely spaced), undulating and smooth. Fractures often have greenish epidote and chlorite surface staining. (Adelaide Island Intrusive Suite).	
8.26		7.55 (7.10)	Strong to very strong grey GRANODIORITE (crystals 1 to 3mm). Frequent large white feldspar phenocrysts (<7mm). Local bands of microgranodiorite. Generally unweathered to slightly weathered. Frequent branching incipient fractures with greenish chlorite and epidote mineralisation (<1mm). Fractures mostly dipping at 60 to 90 degrees (locally 20 to 30 degrees), closely spaced (locally very closely spaced), undulating and stepped, smooth. Fractures often have	

Continued on next sheet

Drilling Progress and Water Observations

Date and Time	Depth	Casing	Core Dia	Strike	Standing
		2.05			

Rotary Flush

From	To	Type	Returns (%)
0.00	2.05	Air	
2.05	20.65	Water	100

Groundwater

Strike Depth: (m)	Rising to: (m)	Groundwater Remarks (m)

General Remarks

Lead driller: T Arnott Jnr. Barrel/Bit: T2101/T57-diamond. Casing/Core(diam.): 152mm/84mm. No visual or olfactory evidence of contamination. Driller recorded rockhead at 2.90m. Borehole not backfilled (requested in Sweco GI specification).

Final Depth **20.65**

Contractor BAM

Method/ Plant Used Casagrande C6

All dimensions in metres Scale 1:50

SWECO ROTARY HOLE LOG

Project Rothera Modernisation		Client British Antarctic Survey			ROTARY HOLE No BHR01
Job No 119482	Date 18/01/2019 - 21/01/2019	Ground Level (m) 15.81	Co-ordinates 2268.85 - 4865.64		Logged By DRAFT
					Checked By CDL

RUN DETAILS

Depth	TCR	SCR	RQD	FI
8.65 - 10.15	100	80	73	4 16
10.15 - 11.65	100	67	43	8 NI
11.65 - 12.85	100	67	52	13 NI 17
12.85 - 13.15	100	100	100	
13.15 - 14.65	100	83	55	10 20
14.65 - 16.15	100	100	91	3
16.15 - 17.65	100	97	91	4

STRATA

Red'cd Level	Legend	Depth (Thickness)	DESCRIPTION	Instrument Backfill
			greenish (epidote/chlorite) or dark orange (iron oxide) surface staining. (Adelaide Island Intrusive Suite). *8.65 - 9.15m: Several drilling induced fractures. Dipping at approximately 0 degrees, undulating, rough.* *At 13.35m, some disseminated pyrite mineralisation.* *14.55 - 15.05m: Subvertical fracture.*	
1.16		14.65 (6.00)	Very strong grey to greenish grey GRANODIORITE (crystals 1 to 4mm). Occasional large white feldspar phenocrysts (<7mm). Generally unweathered (locally slightly weathered, evident from greenish chlorite staining). Frequent branching incipient fractures with greenish chlorite and epidote mineralisation (<1mm). Fractures dipping at 20 to 90 degrees, closely to medium spaced, undulating (locally stepped), smooth. Fractures often have greenish surface staining (epidote/ chlorite). (Adelaide Island Intrusive Suite). *15.00 - 16.00m: Several drilling induced fractures. Dipping at 0 to 25 degrees.*	

Continued on next sheet

Drilling Progress and Water Observations

Date and Time	Depth	Casing	Core Dia	Strike	Standing
		2.05			

Rotary Flush

From	To	Type	Returns (%)
0.00	2.05	Air	
2.05	20.65	Water	100

Groundwater

Strike Depth: (m)	Rising to: (m)	Groundwater Remarks (m)

General Remarks

Lead driller: T Arnott Jnr. Barrel/Bit: T2101/T57-diamond. Casing/Core(diam.): 152mm/84mm. No visual or olfactory evidence of contamination. Driller recorded rockhead at 2.90m. Borehole not backfilled (requested in Sweco GI specification).

Final Depth
20.65

Contractor BAM

Method/ Plant Used Casagrande C6

All dimensions in metres Scale 1:50

SWECO

ROTARY HOLE LOG

ROTARY HOLE No
BHR01

Project Rotherа Modernisation		Client British Antarctic Survey		Logged By DRAFT
Job No 119482	Date 18/01/2019 - 21/01/2019	Ground Level (m) 15.81	Co-ordinates 2268.85 - 4865.64	Checked By CDL

RUN DETAILS					STRATA				
Depth	TCR	SCR	RQD	FI	Red'cd Level	Legend	Depth (Thickness)	DESCRIPTION	Instrument Backfill
17.65 - 19.15	100	100	92	5					
19.15 - 20.65	100	100	100	2				*From 19.15m, fractures are medium spaced. Several drilling induced fractures.*	
					-4.84		20.65	End of core at 20.65 m bgl.	

Drilling Progress and Water Observations

Date and Time	Depth	Casing	Core Dia	Strike	Standing
		2.05			

Rotary Flush

From	To	Type	Returns (%)
0.00	2.05	Air	
2.05	20.65	Water	100

Groundwater

Strike Depth: (m)	Rising to: (m)	Groundwater Remarks (m)

General Remarks

Lead driller: T Arnott Jnr. Barrel/Bit: T2101/T57-diamond. Casing/Core(diam.): 152mm/84mm. No visual or olfactory evidence of contamination. Driller recorded rockhead at 2.90m. Borehole not backfilled (requested in Sweco GI specification).

Final Depth

20.65

Contractor BAM

Method/ Plant Used Casagrande C6

All dimensions in metres Scale 1:50

SWECO

ROTARY HOLE LOG

ROTARY HOLE No
BHR02

Project Rothera Modernisation		Client British Antarctic Survey		Logged By DRAFT
Job No 119482	Date 22/01/2019 - 22/01/2019	Ground Level (m) 11.85	Co-ordinates 2275.03 - 4900.21	Checked By CDL

RUN DETAILS

Depth	TCR	SCR	RQD	FI
2.60 - 4.10	97	83	79	7 NI
4.10 - 5.60	103	85	60	8 NI
5.60 - 7.10	100	100	93	7
7.10 - 8.60	100	100	73	7 NI

STRATA

Red'cd Level	Legend	Depth (Thickness)	DESCRIPTION	Instrument Backfill
		(2.00)	Overburden, GRAVELS (Driller's description). (Open holed).	
9.85		2.00 (0.60)	Weathered ROCK. (Driller's description). (Open holed).	
9.25		2.60 (9.85)	Strong to very strong grey GRANODIORITE (crystals 1 to 3mm). Occasional large white feldspar phenocrysts (approximately 5mm). Generally unweathered. Frequent branching incipient fractures with greenish chlorite and epidote mineralisation (<1mm). Fractures dipping at 20 to 90 degrees (ocassionally 10 degrees), closely to medium spaced (locally very closely spaced), undulating, rough and smooth. Fractures often have greenish (epidote/chlorite) ore dark orange (iron oxide) surface staining. (Adelaide Island Intrusive Suite). *At 2.90m, quartz veinlet (<2mm).*	

Continued on next sheet

Drilling Progress and Water Observations

Date and Time	Depth	Casing	Core Dia	Strike	Standing
		2.30			

Rotary Flush

From	To	Type	Returns (%)
0.00	2.30	Air	
2.30	13.10	Water	100

Groundwater

Strike Depth: (m)	Rising to: (m)	Groundwater Remarks (m)

General Remarks

Lead driller: T Amott Jnr. Barrel/Bit: T2101/T57-diamond. Casing/Core(diam.): 152mm/84mm. No visual or olfactory evidence of contamination. Driller recorded rockhead at 2.00m. Borehole not backfilled (requested in Sweco GI specification).

Final Depth
13.10

Contractor BAM

Method/ Plant Used Casagrande C6

All dimensions in metres Scale 1:50

SWECO

ROTARY HOLE LOG

Project Rothera Modernisation		Client British Antarctic Survey		ROTARY HOLE No BHR02
Job No 119482	Date 22/01/2019 - 22/01/2019	Ground Level (m) 11.85	Co-ordinates 2275.03 - 4900.21	Logged By DRAFT
				Checked By CDL

RUN DETAILS					STRATA				
Depth	TCR	SCR	RQD	~~FI~~	Red'cd Level	Legend	Depth (Thickness)	DESCRIPTION	Instrument Backfill
8.60 - 10.10	100	90	85	5				*9.30 - 9.70m: Undulating subvertical fracture.*	
10.10 - 11.60	93	93	92	5					
11.60 - 12.00	100	23	0	NI				*At 12.00m, pyrite mineralisation on fracture surface.*	
12.00 - 13.10	100	100	87	6	-0.60		12.45 (0.65)	Very strong grey RHYODACITE with phenocrysts of quartz, feldspar and altered hornblende (<1 to 2mm). Unweathered. Several drilling induced fractures. Fracture set 1 dipping at 5 to 10 degrees, closely spaced, stepped and smooth to rough. Fracture set 2 dipping at 60 degrees, closely to medium spaced, undulating and smooth to rough with greenish surface staining (chlorite).	
					-1.25		13.10	End of core at 13.10 m bgl.	

Drilling Progress and Water Observations

Date and Time	Depth	Casing	Core Dia	Strike	Standing
		2.30			

Rotary Flush

From	To	Type	Returns (%)
0.00	2.30	Air	
2.30	13.10	Water	100

Groundwater

Strike Depth: (m)	Rising to: (m)	Groundwater Remarks (m)

General Remarks

Lead driller: T Amott Jnr. Barrel/Bit: T2101/T57-diamond. Casing/Core(diam.): 152mm/84mm. No visual or olfactory evidence of contamination. Driller recorded rockhead at 2.00m. Borehole not backfilled (requested in Sweco GI specification).

Final Depth **13.10**

Contractor BAM

Method/ Plant Used Casagrande C6

All dimensions in metres Scale 1:50

ROTARY HOLE LOG

ROTARY HOLE No
BHR03

Project Rothera Modernisation		Client British Antarctic Survey		Logged By DRAFT
Job No 119482	Date 23/01/2019 - 25/01/2019	Ground Level (m) 11.34	Co-ordinates 2223.78 - 4913.68	Checked By CDL

RUN DETAILS

Depth	TCR	SCR	RQD	FI
2.80 - 3.80	85	42	42	NI 7 NI
3.80 - 5.00	100	75	24	7
5.00 - 6.50	87	43	33	NR NI 6 NI
6.50 - 8.00	100	40	30	11
8.00 - 9.00	80	11	11	NI

STRATA

Red'cd Level	Legend	Depth (Thickness)	DESCRIPTION	Instrument Backfill
		(2.30)	Overburden, GRAVELS (Driller's description). (Open holed).	
9.04		2.30 (0.50)	Weathered ROCK. (Driller's description). (Open holed).	
8.54		2.80 (12.20)	Medium strong to strong green and light grey speckled GRANODIORITE (crystals 1 to 3mm). Partial weathering evident from highly fractured zones and greenish chlorite staining. Some light green epidote staining and mineralisation. Locally highly fractured. Abundant branching incipient fractures and quartz veinlets (<4mm). Fractures dipping at all orientations, closely to very closely spaced, undulating and stepped, smooth to rough. Fractures often have greenish (chlorite) and some dark reddish (possibly haematite) surface staining. (Adelaide Island Intrusive Suite). *At 2.90m, undulating subvertical fracture, smooth to rough with dark orangish brown surface staining.* *2.90 - 3.70m: Strong grey MICROGRANODIORITE (crystals 0.5 to 1.0mm).*	

Continued on next sheet

Drilling Progress and Water Observations

Date and Time	Depth	Casing	Core Dia	Strike	Standing
		2.80			

Rotary Flush

From	To	Type	Returns (%)
0.00	2.80	Air	
2.80	15.00	Water	100

Groundwater

Strike Depth: (m)	Rising to: (m)	Groundwater Remarks (m)

General Remarks

Lead driller: T Arnott Jnr. Barrel/Bit: T2101/T57-diamond. Casing/Core(diam.): 152mm/84mm. No visual or olfactory evidence of contamination. Driller recorded rockhead at 2.30m. Borehole not backfilled (requested in Sweco GI specification).

Final Depth
15.00

Contractor BAM

Method/ Plant Used Casagrande C6

All dimensions in metres Scale 1:50

SWECO

ROTARY HOLE LOG

ROTARY HOLE No	BHR03
Project	Rothera Modernisation
Client	British Antarctic Survey
Logged By	DRAFT
Job No	119482
Date	23/01/2019 - 25/01/2019
Ground Level (m)	11.34
Co-ordinates	2223.78 - 4913.68
Checked By	CDL

RUN DETAILS					STRATA				
Depth	TCR	SCR	RQD	FI	Red'cd Level	Legend	Depth (Thickness)	DESCRIPTION	Instrument Backfill
9.00 - 10.50	100	27	9	20					
10.50 - 12.00	100	51	43	18 NI 3				*11.60 - 12.00m: Pinkish vein of porphyritic RHYOLITE/RHYODACITE with abundant branching incipient fractures.*	
12.00 - 13.50	100	13	10	7 NI					
13.50 - 15.00	100	17	8	16 NI	-3.66		15.00	End of core at 15.00 m bgl.	

Drilling Progress and Water Observations

Date and Time	Depth	Casing	Core Dia	Strike	Standing
		2.80			

Rotary Flush

From	To	Type	Returns (%)
0.00	2.80	Air	
2.80	15.00	Water	100

Groundwater

Strike Depth: (m)	Rising to: (m)	Groundwater Remarks (m)

General Remarks

Lead driller: T Arnott Jnr. Barrel/Bit: T2101/T57-diamond. Casing/Core(diam.): 152mm/84mm. No visual or olfactory evidence of contamination. Driller recorded rockhead at 2.30m. Borehole not backfilled (requested in Sweco GI specification).

Final Depth **15.00**

Contractor BAM

Method/ Plant Used Casagrande C6

All dimensions in metres Scale 1:50

SWECO

ROTARY HOLE LOG

ROTARY HOLE No
BHR04

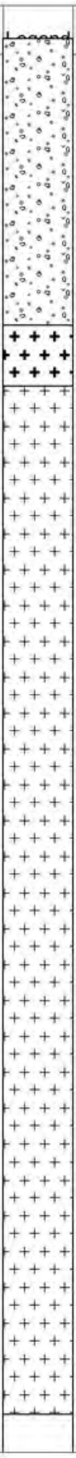
Project	Client	Logged By
Rothera Modernisation	British Antarctic Survey	DRAFT

Job No	Date	Ground Level (m)	Co-ordinates	Checked By
119482	25/01/2019 - 26/01/2019	12.89	2225.77 - 4888.30	CDL

RUN DETAILS

Depth	TCR	SCR	RQD	FI
2.30 - 3.80	100	16	16	NI
3.80 - 5.30	100	37	15	10
5.30 - 6.80	100	9	0	NI
6.80 - 8.30	100	20	7	28
8.30 - 9.80	100	28	14	NI

STRATA



Red'cd Level	Depth (Thickness)	DESCRIPTION	Instrument Backfill
	(1.90)	Overburden, GRAVELS (Driller's description). (Open holed).	
10.99	1.90 (0.40)	Fractured GRANODIORITE. (Driller's description). (Open holed).	
10.59	2.30 (11.70)	Medium strong to strong greenish grey MICROGRANODIORITE (crystals 0.5 to 1mm). Partial weathering evident from weaker fractured zones and greenish chlorite staining. Often highly fractured. Some branching incipient fractures and veinlets (<1mm). Fractures dipping at all orientations, very closely to closely spaced, undulating and stepped, smooth to rough. Fractures often have greenish (chlorite) and dark orange (iron oxide) surface staining. (Adelaide Island Intrusive Suite). *4.70 - 5.30m: Highly fractured zone. Very weak to extremely weak with greenish staining. Possible fault or fracture dipping at 70 to 80 degrees.* *At 5.30m, some pyrite mineralisation (often oxidised).* *From 8.30m, becoming strong.*	

Continued on next sheet

Drilling Progress and Water Observations

Date and Time	Depth	Casing	Core Dia	Strike	Standing
		2.30			

Rotary Flush

From	To	Type	Returns (%)
0.00	1.90	Air	
1.90	14.00	Water	100

Groundwater

Strike Depth: (m)	Rising to: (m)	Groundwater Remarks (m)

General Remarks
Lead driller: T Arnott Jnr. Barrel/Bit: T2101/T57-diamond. Casing/Core(diam.): 152mm/84mm. No visual or olfactory evidence of contamination. Driller recorded rockhead at 1.90m. Borehole not backfilled (requested in Sweco GI specification).

Final Depth
14.00

Contractor BAM

Method/ Plant Used Casagrande C6

All dimensions in metres Scale 1:50

SWECO

ROTARY HOLE LOG

ROTARY HOLE No
BHR04

Project Rothera Modernisation		Client British Antarctic Survey	Logged By DRAFT
Job No 119482	Date 25/01/2019 - 26/01/2019	Ground Level (m) 12.89	Co-ordinates 2225.77 - 4888.30
			Checked By CDL

RUN DETAILS					STRATA				
Depth	TCR	SCR	RQD	FI	Red'cd Level	Legend	Depth (Thickness)	DESCRIPTION	Instrument Backfill
				20					
				NI					
9.80 - 11.00	100	28	28	12					
11.00 - 12.50	100	93	21	12 9					
12.50 - 14.00	100	88	65	10 NI 7	-1.11		14.00	End of core at 14.00 m bgl.	

Drilling Progress and Water Observations

Date and Time	Depth	Casing	Core Dia	Strike	Standing
		2.30			

Rotary Flush

From	To	Type	Returns (%)
0.00	1.90	Air	
1.90	14.00	Water	100

Groundwater

Strike Depth: (m)	Rising to: (m)	Groundwater Remarks (m)

General Remarks

Lead driller: T Arnott Jnr. Barrel/Bit: T2101/T57-diamond. Casing/Core(diam.): 152mm/84mm. No visual or olfactory evidence of contamination. Driller recorded rockhead at 1.90m. Borehole not backfilled (requested in Sweco GI specification).

Final Depth
14.00

Contractor BAM

Method/
Plant Used Casagrande C6

All dimensions in metres Scale 1:50

Appendix C – Trial Pit Logs

SWECO

TRIAL PIT LOG

Trial Pit No.
TP01

Project	**Client**	**Logged By**
Rothera Modernisation	British Antarctic Survey	DRAFT

Job No.	**Date Started**	**Date Finished**	**Ground Level (mAOD)**	**Co-ordinates**	**Checked By**
119482	22/01/2019	22/01/2019			CDL

SAMPLES & TESTS			**Water**	**STRATA**				
Depth (mbgl)	**Type**	**PID Result**		**Level (mAOD)**	**Legend**	**Depth (mbgl)**	**DESCRIPTION**	**Backfill**
0.20	B				▨	(0.15) 0.15	Grey COBBLES with much GRAVEL. Cobbles are angular and subangular of granodiorite. Gravel is angular and subangular and mostly coarse of granodiorite. (Made Ground).	▨
0.20	D				▨	(0.35) 0.50	Brown sandy slightly silty subrounded to subangular fine to coarse GRAVEL of granite and granodiorite. Medium to high cobble content. Cobbles are subangular and angular of granodiorite. (Possible Raised Beach Deposits). *At 0.20m, south end, several large angular boulders of coarse grained granodiorite (up to 1.00m).*	▨
							Trial pit completed at 0.50 mbgl	

Stability: Stable

Shoring: None

Groundwater

Strike Depth (mbgl)	Rising To (mbgl)	Remarks

General Remarks

Trial pit dry.
No visual or olfactory evidence of contamination.
Trial pit terminated at 0.50m, due to encountering unknown earthing cable (reported to BAS).
Trial pit backfilled with arisings.

Length (sides A and C): 4.50
Width (sides B and D): 1.80
Orientation (bearing of side A): 217

Final Depth
0.50 mbgl

Contractor BAS/BAM

Method/ Plant Used 13t tracked excavator (JCB JS130 LC)

All dimensions in metres. Scale: 1:50

SWECO

TRIAL PIT LOG

Trial Pit No.
TP02

Project	**Client**	**Logged By**
Rothera Modernisation	British Antarctic Survey	DRAFT

Job No.	**Date Started**	**Date Finished**	**Ground Level (mAOD)**	**Co-ordinates**	**Checked By**
119482	22/01/2019	22/01/2019			CDL

SAMPLES & TESTS

Depth (mbgl)	Type	PID Result	Water
0.40	B		
0.40	D		
0.70	B		▼
0.70	D		
0.75	B		

STRATA

Level (mAOD)	Legend	Depth (mbgl)	DESCRIPTION	Backfill
		(0.10) 0.10	Grey COBBLES with much GRAVEL. Cobbles are angular and subangular of granodiorite. Gravel is angular and subangular and mostly coarse of granodiorite. (Made Ground).	
		(0.40) 0.50	Brownish grey slightly sandy slightly silty subangular and angular, fine to coarse GRAVEL of granodiorite. Medium cobble content. Cobbles are subangular and angular of granodiorite. (Possible Raised Beach Deposits). *0.10 - 0.20m: Silt and clay matrix (possible washed out fines).*	
		(0.50) 1.00	Brownish grey sandy slightly silty, generally subrounded, fine to coarse GRAVEL of mostly granodiorite and some granite. Low cobble content. Cobbles are subrounded to subangular of granodiorite. (Possible Raised Beach Deposits).	

Trial pit completed at 1.00 mbgl

1
2
3
4
5
6
7
8

Stability: Stable

Shoring: None

General Remarks

No visual or olfactory evidence of contamination.
Trial pit terminated at 1.00m, scraping on presumed bedrock.
Trial pit backfilled with arisings.

Groundwater

Strike Depth (mbgl)	Rising To (mbgl)	Remarks
0.70		Seepage at 0.70m. Final depth of 0.20m.

Length (sides A and C): 4.40

Width (sides B and D): 1.50

Orientation (bearing of side A): 120

Final Depth

1.00 mbgl

Contractor BAS/BAM

Method/ Plant Used 13t tracked excavator (JCB JS130 LC)

All dimensions in metres. Scale: 1:50

SWECO

TRIAL PIT LOG

Trial Pit No.
TP03

Project	**Client**	**Logged By**
Rothera Modernisation	British Antarctic Survey	DRAFT

Job No.	**Date Started**	**Date Finished**	**Ground Level (mAOD)**	**Co-ordinates**	**Checked By**
119482	23/01/2019	23/01/2019			CDL

SAMPLES & TESTS			**Water**	**STRATA**				
Depth (mbgl)	**Type**	**PID Result**		**Level (mAOD)**	**Legend**	**Depth (mbgl)**	**DESCRIPTION**	**Backfill**
					⁘	(0.45) 0.45	Grey COBBLES with much GRAVEL. Cobbles are angular and subangular of granodiorite. Gravel is angular to subangular of mostly granodiorite. (Made Ground). *0.10 - 0.20m: Silt and clay matrix (possible washed out fines).*	▨
0.40	B							
0.70	B		▼		⁘	(0.35) 0.80	Brown sandy slightly silty subangular fine to coarse GRAVEL of various lithologies. Low to medium cobble content. Cobbles are subangular of various lithologies. (Possible Raised Beach Deposits). *At 0.60m, sandy pocket observed at base of pit (E side).* *At 0.70m, large boulder or bedrock at base of pit (SE corner).*	▨
							Trial pit completed at 0.80 mbgl	

Stability:	Stable
Shoring:	None

General Remarks

No visual or olfactory evidence of contamination.
Trial pit terminated at 0.80m, scraping on cobbles and boulders or possible bedrock.
Trial pit backfilled with arisings.

Groundwater

Strike Depth (mbgl)	Rising To (mbgl)	Remarks
0.70		Slight seepage at 0.70m and some ice. Final depth of 0.12m.

Length (sides A and C):	4.40
Width (sides B and D):	2.50
Orientation (bearing of side A):	128

Final Depth

0.80 mbgl

Contractor	BAS/BAM	**Method/ Plant Used**	13t tracked excavator (JCB JS130 LC)

All dimensions in metres. Scale: 1:50

SWECO

TRIAL PIT LOG

Trial Pit No. TP04

Project	**Client**	**Logged By**
Rothera Modernisation	British Antarctic Survey	DRAFT

Job No.	**Date Started**	**Date Finished**	**Ground Level (mAOD)**	**Co-ordinates**	**Checked By**
119482	23/01/2019	23/01/2019			CDL

SAMPLES & TESTS				STRATA				
Depth (mbgl)	**Type**	**PID Result**	**Water**	**Level (mAOD)**	**Legend**	**Depth (mbgl)**	**DESCRIPTION**	**Backfill**
					▒	(0.25) 0.25	Grey COBBLES with much GRAVEL. Cobbles are angular and subangular of granodiorite. Gravel is angular to subangular of granodiorite. (Made Ground). *0.15 - 0.25m: Silt and clay matrix (possible washed out fines).*	▨
0.50	B				▒	(1.15)	Brown slightly silty sandy subangular fine to coarse GRAVEL of mostly granodiorite. Low to medium cobble content. Cobbles are subangular of mostly granodiorite. Locally very sandy. Occasional subrounded boulders of granite and granodiorite (up to 0.50m). (Possible Raised Beach Deposits). *At 0.60m, encountered 6 inch iron pipe (rusted) at N end of pit (0.60m depth, strike 068 degrees).*	▨
1.00	B		▼					
						1.40	Trial pit completed at 1.40 mbgl	

Stability:	Stable
Shoring:	None

Groundwater

Strike Depth (mbgl)	**Rising To (mbgl)**	**Remarks**
1.00		Seepage at 1.00m.

General Remarks

No visual or olfactory evidence of contamination.
Trial pit terminated at 1.40m, scraping on cobbles and boulders or possible bedrock.
Trial pit backfilled with arisings.

Length (sides A and C):	3.80
Width (sides B and D):	1.50
Orientation (bearing of side A):	30

Final Depth

1.40 mbgl

Contractor	BAS/BAM	**Method/ Plant Used**	13t tracked excavator (JCB JS130 LC)

All dimensions in metres. Scale: 1:50

TRIAL PIT LOG

Trial Pit No.	**TP05**
Project	Rothera Modernisation
Client	British Antarctic Survey
Logged By	DRAFT
Job No.	119482
Date Started	25/01/2019
Date Finished	25/01/2019
Ground Level (mAOD)	
Co-ordinates	
Checked By	CDL

SAMPLES & TESTS			Water	STRATA				
Depth (mbgl)	**Type**	**PID Result**		**Level (mAOD)**	**Legend**	**Depth (mbgl)**	**DESCRIPTION**	**Backfill**
					▨	(0.15) 0.15	Grey COBBLES with much GRAVEL. Cobbles are angular and subangular of granodiorite. Gravel is angular to subangular of granodiorite. (Made Ground). *0.10 - 0.15m: Silt and clay matrix (possible washed out fines).*	▨
0.70	B				▨	(0.65) 0.80	Greyish brown sandy slightly silty subangular to subrounded fine to coarse GRAVEL of mostly granite and granodiorite. Low to medium cobble content. Cobbles are subangular to angular of mostly granite and granodiorite. (Possible Raised Beach Deposits).	▨
1.00	B		▼		▨	(0.60) 1.40	Brownish grey very sandy slightly silty subangular to subrounded fine to coarse GRAVEL of various lithologies. Low cobble content. Cobbles are subrounded to subangular of granodiorite and various other lithologies. (Possible Raised Beach Deposits).	▨

Trial pit completed at 1.40 mbgl

Stability: Stable

Shoring: None

General Remarks

No visual or olfactory evidence of contamination.
Trial pit terminated at 1.40m, scraping on cobbles and boulders or possible bedrock.
Trial pit backfilled with arisings.

Groundwater

Strike Depth (mbgl)	Rising To (mbgl)	Remarks
1.00		Seepage at 1.00m. Final depth of 0.25m.

Length (sides A and C): 4.10

Width (sides B and D): 1.50

Orientation (bearing of side A): 160

Final Depth **1.40** mbgl

Contractor BAS/BAM

Method/ Plant Used 13t tracked excavator (JCB JS130 LC)

All dimensions in metres. Scale: 1:50

Appendix D – Photographs – Rock Core

Photo 1 – BHR01 2.65 to 4.15m.

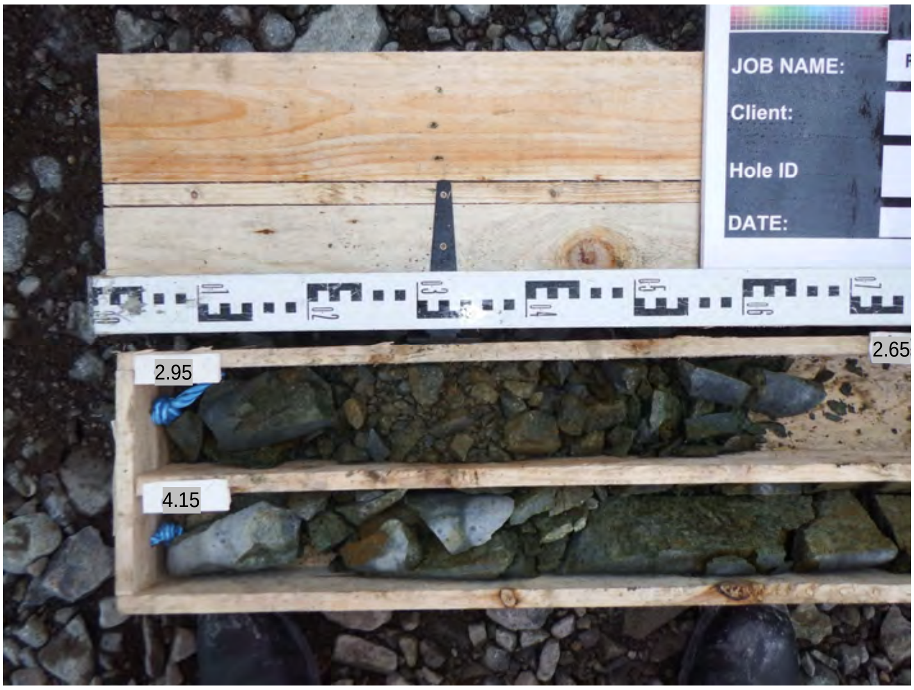


Photo 2 – BHR01 2.65 to 2.95m.

Photo 3 – BHR01 2.65 to 4.15m.

Photo 4 – BHR01 2.65 to 2.95m. Incipient fractures.

Photo 5 – BHR01 4.15 to 7.15m.

Photo 6 – BHR01 4.15 to 7.15m.

Photo 7 – BHR01 4.15 to 7.15m.

Photo 8 – BHR01 7.15 to 10.15m.

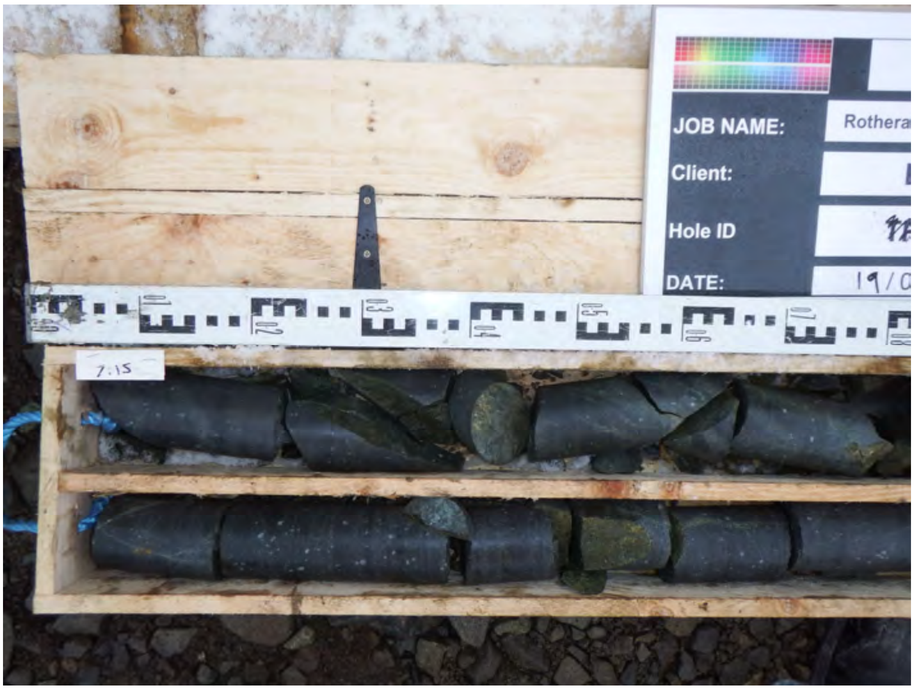


Photo 9 – BHR01 7.15 to 10.15m.

Photo 10 – BHR01 7.15 to 10.15m.

Photo 11 – BHR01 10.15 to 13.15m.

Photo 12 – BHR01 10.15 to 13.15m.

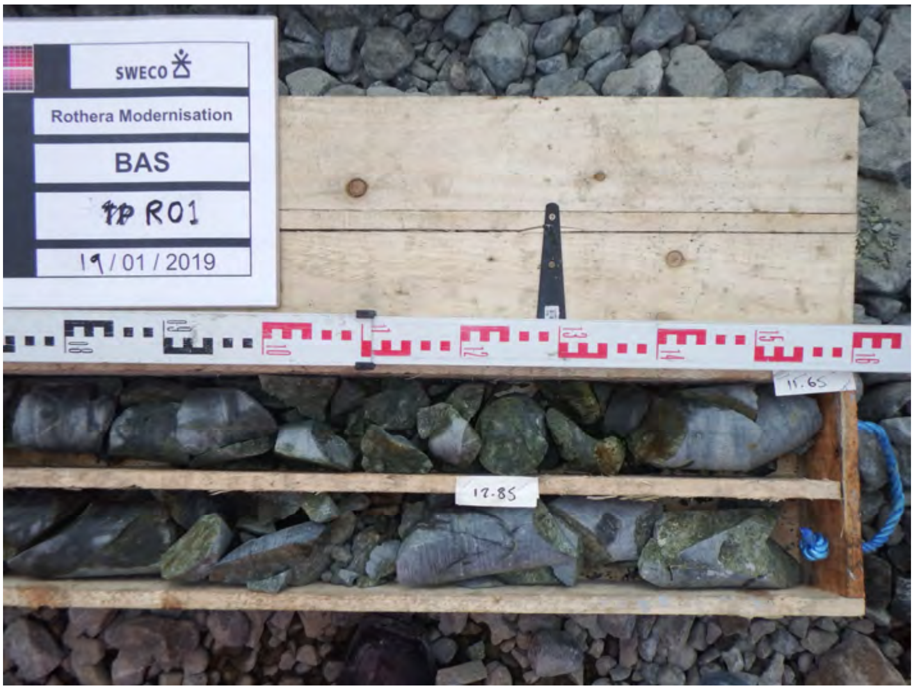


Photo 13 – BHR01 10.15 to 13.15m.

Photo 14 – BHR01 13.15 to 16.15m.

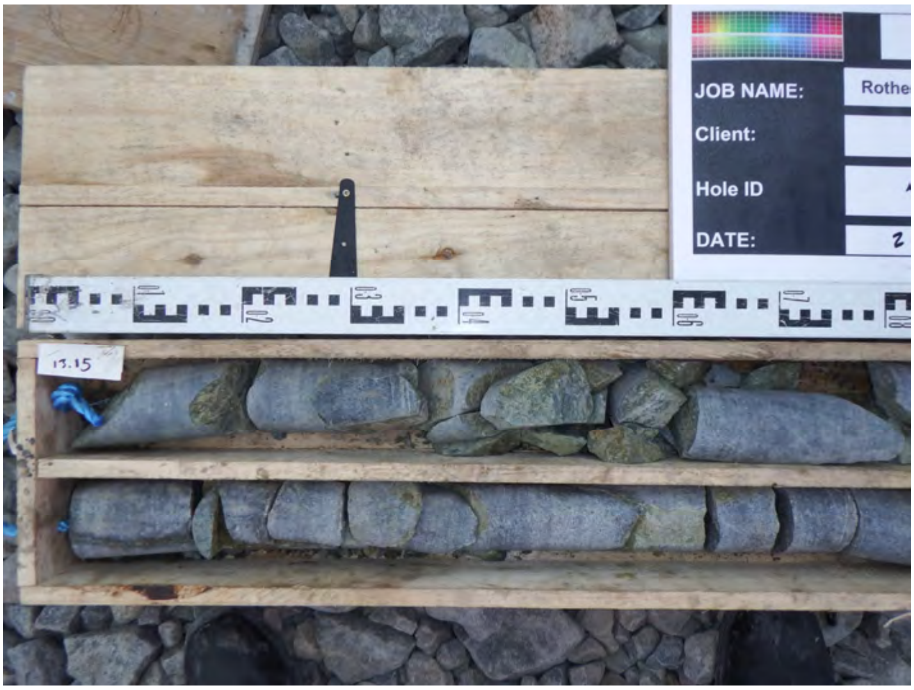


Photo 15 – BHR01 13.15 to 16.15m.

Photo16 – BHR01 13.15 to 16.15m.

Photo 17 – BHR01 16.15 to 19.15m.

Photo 18 – BHR01 16.15 to 19.15m.

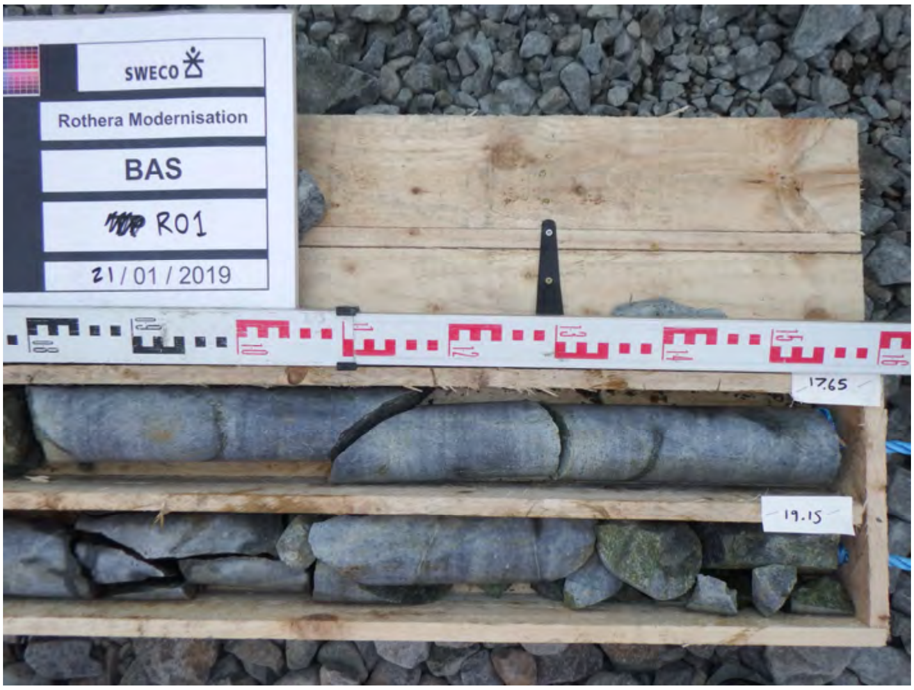


Photo 19 – BHR01 16.15 to 19.15m..

Photo 20 – BHR01 19.15 to 20.65m.

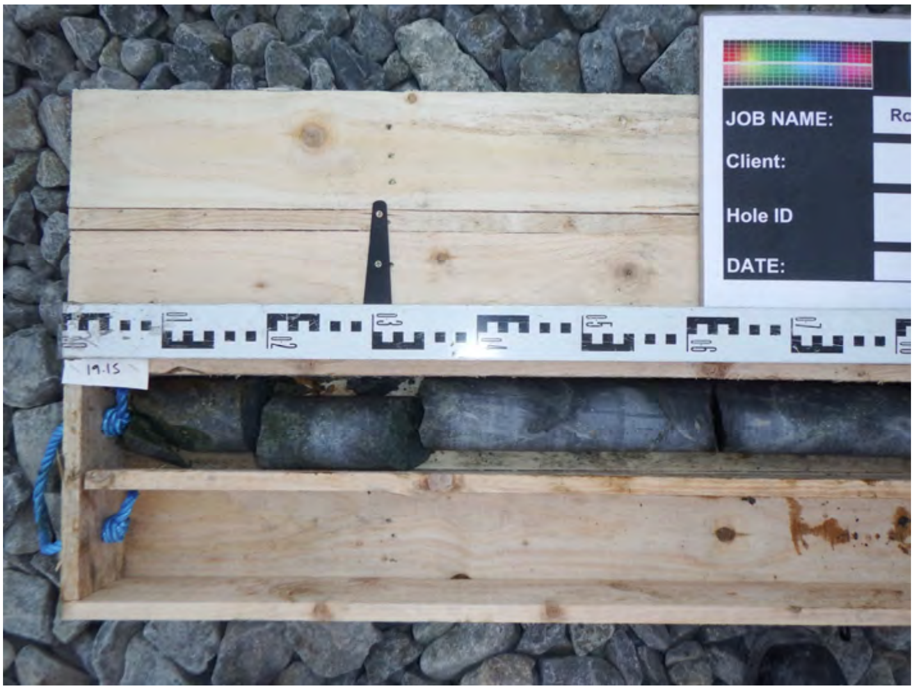


Photo 21 – BHR01 19.15 to 20.65m.

Photo 22 – BHR01 19.15 to 20.65m.

Photo 23 – BHR02 2.60 to 5.60m.

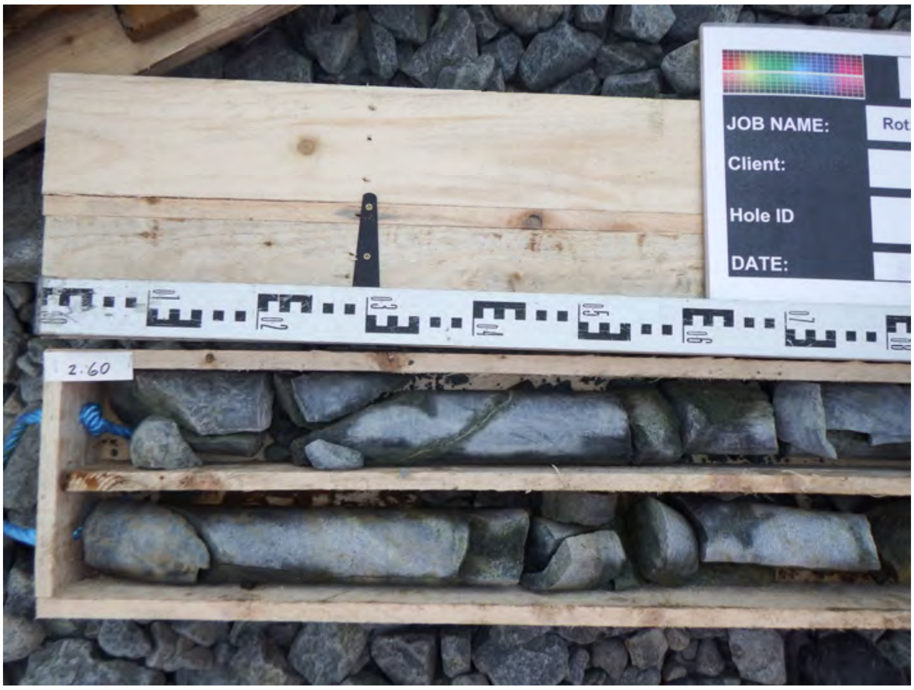


Photo 24 – BHR02 2.60 to 5.60m.

Photo 25 – BHR02 2.60 to 5.60m.

Photo 26 – BHR02 5.60 to 8.60m.

Photo 27 – BHR02 5.60 to 8.60m.

Photo 28 – BHR02 5.60 to 8.60m.

Photo 29 – BHR02 8.60 to 11.60m.

Photo 30 – BHR02 8.60 to 11.60m

Photo 31 – BHR02 8.60 to 11.60m.

Photo 32 – BHR02 11.60 to 13.10m.

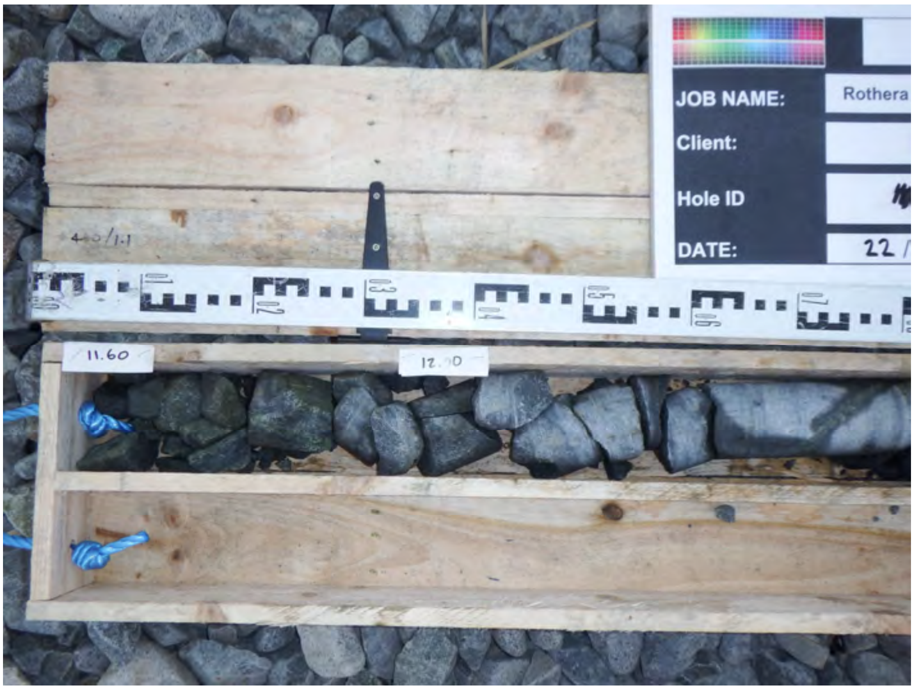


Photo 33 – BHR02 11.60 to 13.10m.

Photo 34 – BHR02 11.60 to 13.10m.

Photo 35 – BHR03 2.80 to 5.00m.

Photo 36 – BHR03 2.80 to 5.00m.

Photo 37 – BHR03 2.80 to 5.00m.

Photo 38 – BHR03 5.00 to 8.00m.

Photo 39 – BHR03 5.00 to 8.00m.

Photo 40 – BHR03 5.00 to 8.00m.

Photo 41 – BHR03 8.00 to 10.50m.

Photo 42 – BHR03 8.00 to 10.50m.

Photo 43 – BHR03 8.00 to 10.50m.

Photo 44 – BHR03 10.50 to 13.50m.

Photo 45 – BHR03 10.50 to 13.50m.

Photo 46 – BHR03 10.50 to 13.50m.

Photo 47 – BHR03 13.50 to 15.00m.

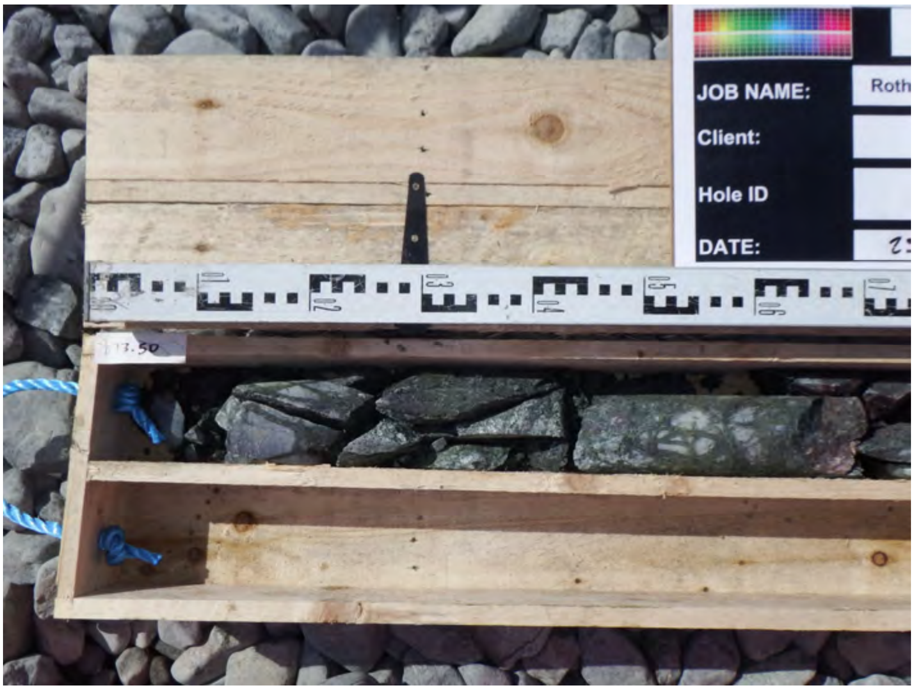


Photo 48 – BHR03 13.50 to 15.00m.

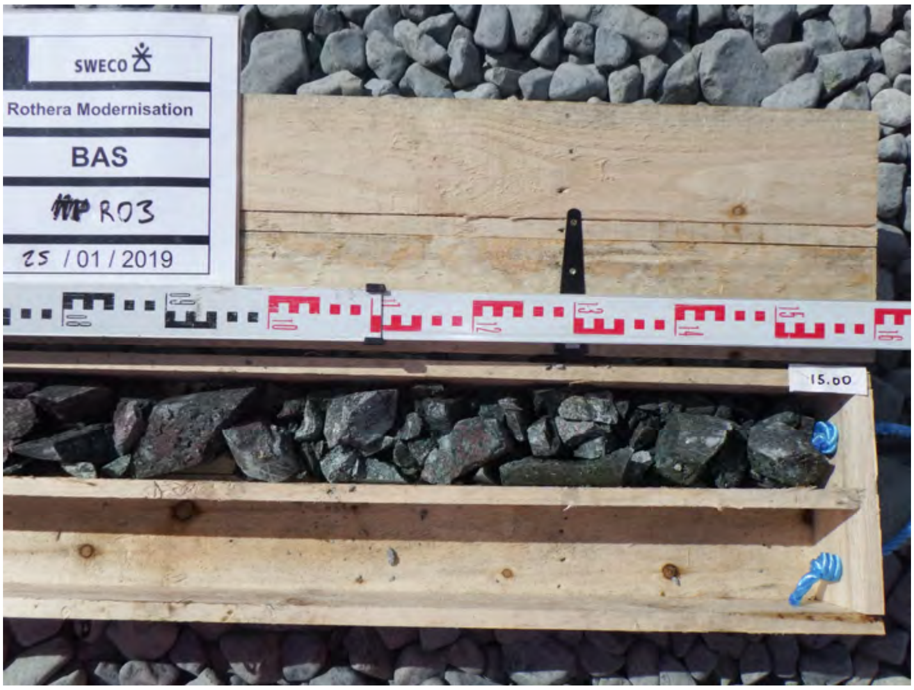


Photo 49 – BHR03 13.50 to 15.00m.

Photo 50 – BHR04 2.30 to 5.30m.

Photo 51 – BHR04 2.30 to 5.30m.

Photo 52 – BHR04 2.30 to 5.30m.

Photo 53 – BHR04 5.30 to 8.30m.

Photo 54 – BHR04 5.30 to 8.30m.

Photo 55 – BHR04 5.30 to 8.30m.

Photo 56 – BHR04 8.30 to 11.00m.

Photo 57 – BHR04 8.30 to 11.00m. .

Photo 58 – BHR04 8.30 to 11.00m.

Photo 59 – BHR04 11.00 to 14.00m.

Photo 60 – BHR04 11.00 to 14.00m.

Photo 61 – BHR04 11.00 to 14.00m.

Appendix E – Photographs – Trial Pits

Photo 1 – TP01.

Photo 2 – TP01.

Photo 3 – TP01.

Photo 4 – TP02.

Photo 5 – TP02.

Photo 6 – TP02.

Photo 7 – TP02.

Photo 8 – TP02.

Photo 9 – TP03.

Photo 10 – TP03.

Photo 11 – TP03.

Photo 12 – TP03.

Photo 13 – TP04.

Photo 14 – TP04.

Photo 15 – TP04.

Photo 16 – TP04.

Photo 17 – TP04.

Photo 18 – TP04.

Photo 19 – TP05.


Photo 20 – TP05.


Photo 21 – TP05.

Photo 22 – TP05.

Appendix F – Plate Load Test Results

Plate Load Test Worksheet

Client:	BAM	Job No:	119482	Date:	23/01/2019
Site:	Rothera Modernisation	Grid Ref.:	2219.375, 4892.758	Depth:	0.10m
Location:	**PLTA**	Test No: 1	Cycle No: 1	Engineer:	CDL
Material:	Sandy gravel / gravelly sand at 0.10m (under cobbles)				
Weather:	Dry/cloudy, +0.6◦C air temp	Guage No:	-		
Plate Diameter (mm):	300	Area m2: 0.071	Guage No:	-	

Load (KN/m2):		**70**	Applied Load (KN):		**5**
Time	1	2	3	4	Ave
	0	0	0	0	
0.30	0.74	0.00			0.37
1.00	0.74	0.00			0.37
1.30	0.74	0.00			0.37
2.00	0.76	0.00			0.38
2.30	0.76	0.00			0.38
3.00	0.76	0.00			0.38
3.30	0.76	0.00			0.38
4.00	0.76	0.00			0.38
4.30	0.76	0.00			0.38
5.00	0.76	0.00			0.38

Load (KN/m2):		**141**	Applied Load (KN):		**10**
Time	1	2	3	4	Ave
	0	0	0	0	
0.30	1.48	0.60			1.04
1.00	1.50	0.60			1.05
1.30	1.50	0.60			1.05
2.00	1.50	0.60			1.05
2.30	1.50	0.60			1.05
3.00	1.50	0.60			1.05
3.30	1.50	0.60			1.05
4.00	1.50	0.60			1.05
4.30	1.50	0.60			1.05
5.00	1.50	0.60			1.05

Load (KN/m2):		**211**	Applied Load (KN):		**15**
Time	1	2	3	4	Ave
	0	0	0	0	
0.30	2.28	1.46			1.87
1.00	2.28	1.46			1.87
1.30	2.28	1.46			1.87
2.00	2.28	1.47			1.88
2.30	2.28	1.47			1.88
3.00	2.28	1.47			1.88
3.30	2.31	1.53			1.92
4.00	2.31	1.54			1.93
4.30	2.31	1.55			1.93
5.00	2.31	1.55			1.93

Load (KN/m2):		**282**	Applied Load (KN):		**20**
Time	1	2	3	4	Ave
	0	0	0	0	
0.30	2.91	2.59			2.75
1.00	2.91	2.59			2.75
1.30	2.91	2.59			2.75
2.00	2.91	2.59			2.75
2.30	2.91	2.59			2.75
3.00	2.91	2.59			2.75
3.30	2.91	2.59			2.75
4.00	2.91	2.59			2.75
4.30	2.91	2.59			2.75
5.00	2.91	2.59			2.75

Load (KN/m2):		**352**	Applied Load (KN):		**25**
Time	1	2	3	4	Ave
	0	0	0	0	
0.30	3.44	3.11			3.28
1.00	3.44	3.13			3.29
1.30	3.44	3.13			3.29
2.00	3.44	3.13			3.29
2.30	3.44	3.13			3.29
3.00	3.44	3.13			3.29
3.30	3.44	3.13			3.29
4.00	3.44	3.13			3.29
4.30	3.44	3.13			3.29
5.00	3.44	3.13			3.29

Load (KN/m2):		**0**	Applied Load (KN):		**0**
Time	1	2	3	4	Ave
	0	0	0	0	
0.30	3.02	2.74			2.88
1.00	3.02	2.73			2.88
1.30	3.01	2.73			2.87
2.00					
2.30					
3.00					
3.30					
4.00					
4.30					
5.00					

Plate Load Test Worksheet

Client: BAM
Job No: 119482
Date: 24/01/2019
Site: Rothera Modernisation
Grid Ref.: 2230.903, 4913.547
Depth: 0.50m
Location: **PLTB**
Test No: 1
Cycle No: 1
Engineer: CDL
Material: Sandy gravel at 0.50m
Weather: Sunny/windy, +1.7°C air temp
Guage No: -
Plate Diameter (mm): 300
Area m2: 0.071
Guage No: -

Load (KN/m2):		**70**	Applied Load (KN):		**5**
Time	1	2	3	4	Ave
	0	0	0	0	
0.30	1.04	0.96			1.00
1.00	1.05	0.99			1.02
1.30	1.05	0.99			1.02
2.00	1.05	0.99			1.02
2.30	1.06	0.99			1.03
3.00	1.06	0.99			1.03
3.30	1.06	0.99			1.03
4.00	1.06	0.99			1.03
4.30	1.06	0.99			1.03
5.00	1.06	0.99			1.03

Load (KN/m2):		**141**	Applied Load (KN):		**10**
Time	1	2	3	4	Ave
	0	0	0	0	
0.30	1.78	1.62			1.70
1.00	1.79	1.65			1.72
1.30	1.79	1.65			1.72
2.00	1.79	1.65			1.72
2.30	1.80	1.65			1.73
3.00	1.80	1.65			1.73
3.30	1.80	1.65			1.73
4.00	1.80	1.65			1.73
4.30	1.80	1.65			1.73
5.00	1.80	1.65			1.73

Load (KN/m2):		**211**	Applied Load (KN):		**15**
Time	1	2	3	4	Ave
	0	0	0	0	
0.30	2.46	2.20			2.33
1.00	2.47	2.21			2.34
1.30	2.47	2.21			2.34
2.00	2.47	2.21			2.34
2.30	2.47	2.22			2.35
3.00	2.47	2.22			2.35
3.30	2.47	2.23			2.35
4.00	2.47	2.22			2.35
4.30	2.47	2.22			2.35
5.00	2.47	2.22			2.35

Load (KN/m2):		**282**	Applied Load (KN):		**20**
Time	1	2	3	4	Ave
	0	0	0	0	
0.30	3.03	2.81			2.92
1.00	3.04	2.83			2.94
1.30	3.04	2.83			2.94
2.00	3.05	2.83			2.94
2.30	3.05	2.83			2.94
3.00	3.05	2.83			2.94
3.30	3.05	2.83			2.94
4.00	3.05	2.83			2.94
4.30	3.05	2.84			2.95
5.00	3.05	2.84			2.95

Load (KN/m2):		**352**	Applied Load (KN):		**25**
Time	1	2	3	4	Ave
	0	0	0	0	
0.30	3.39	3.20			3.30
1.00	3.40	3.20			3.30
1.30	3.41	3.21			3.31
2.00	3.41	3.21			3.31
2.30	3.42	3.21			3.32
3.00	3.42	3.21			3.32
3.30	3.42	3.21			3.32
4.00	3.42	3.21			3.32
4.30	3.42	3.21			3.32
5.00	3.42	3.21			3.32

Load (KN/m2):		**0**	Applied Load (KN):		**0**
Time	1	2	3	4	Ave
	0	0	0	0	
0.30	3.03	2.84			2.94
1.00	3.02	2.83			2.93
1.30	3.02	2.83			2.93
2.00					
2.30					
3.00					
3.30					
4.00					
4.30					
5.00					

Plate Load Test Worksheet

SWECO

Client:	BAM		Job No:	119482		Date:	25/01/2019
Site:	Rothera Modernisation		Grid Ref.:	2223.693, 4915.098		Depth:	0.10m
Location:	**PLTC**		Test No:	1	Cycle No: 1	Engineer:	CDL
Material:	Slightly silty gravelly sand at 0.10m (under cobbles)						
Weather:	Sunny, +2.0◦C air temp		Guage No:	-			
Plate Diameter (mm):	300	Area m2: 0.071	Guage No:	-			

Load (KN/m2):		**70**	Applied Load (KN):		**5**
Time	1	2	3	4	Ave
	0	0	0	0	
0.30	0.11	0.13			0.12
1.00	0.11	0.13			0.12
1.30	0.11	0.13			0.12
2.00	0.12	0.14			0.13
2.30	0.12	0.14			0.13
3.00	0.12	0.14			0.13
3.30	0.12	0.14			0.13
4.00	0.12	0.14			0.13
4.30	0.12	0.14			0.13
5.00	0.12	0.14			0.13

Load (KN/m2):		**141**	Applied Load (KN):		**10**
Time	1	2	3	4	Ave
	0	0	0	0	
0.30	0.20	0.29			0.25
1.00	0.21	0.29			0.25
1.30	0.21	0.29			0.25
2.00	0.21	0.30			0.26
2.30	0.22	0.30			0.26
3.00	0.22	0.30			0.26
3.30	0.22	0.30			0.26
4.00	0.22	0.30			0.26
4.30	0.23	0.30			0.27
5.00	0.23	0.30			0.27

Load (KN/m2):		**211**	Applied Load (KN):		**15**
Time	1	2	3	4	Ave
	0	0	0	0	
0.30	0.42	0.59			0.51
1.00	0.43	0.59			0.51
1.30	0.43	0.60			0.52
2.00	0.43	0.60			0.52
2.30	0.44	0.60			0.52
3.00	0.44	0.60			0.52
3.30	0.44	0.60			0.52
4.00	0.44	0.60			0.52
4.30	0.44	0.60			0.52
5.00	0.44	0.60			0.52

Load (KN/m2):		**282**	Applied Load (KN):		**20**
Time	1	2	3	4	Ave
	0	0	0	0	
0.30	0.61	0.83			0.72
1.00	0.62	0.85			0.74
1.30	0.63	0.85			0.74
2.00	0.62	0.85			0.74
2.30	0.63	0.85			0.74
3.00	0.64	0.85			0.75
3.30	0.64	0.85			0.75
4.00	0.64	0.86			0.75
4.30	0.64	0.85			0.75
5.00	0.64	0.86			0.75

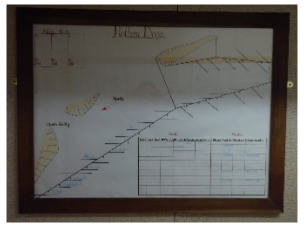
Load (KN/m2):		**352**	Applied Load (KN):		**25**
Time	1	2	3	4	Ave
	0	0	0	0	
0.30	0.84	1.08			0.96
1.00	0.86	1.09			0.98
1.30	0.86	1.09			0.98
2.00	0.87	1.10			0.99
2.30	0.87	1.10			0.99
3.00	0.88	1.11			1.00
3.30	0.88	1.11			1.00
4.00	0.88	1.12			1.00
4.30	0.88	1.12			1.00
5.00	0.89	1.12			1.01

Load (KN/m2):		**0**	Applied Load (KN):		**0**
Time	1	2	3	4	Ave
	0	0	0	0	
0.30	0.32	0.64			0.48
1.00	0.31	0.64			0.48
1.30	0.31	0.64			0.48
2.00					
2.30					
3.00					
3.30					
4.00					
4.30					
5.00					

Appendix G – Laboratory Test Results

Geotechnical testing of selected soil samples will be undertaken by BAM Ritchies. Selected samples were shipped to the BAM Ritchies laboratory in Kilsyth, UK and are expected to be delivered in June 2019. This report will be updated when testing results are received.

Appendix E: Heritage Survey Results

Location Building	Location Room	Location Specific	Item ref.	Object name / description	Image		Instruction
Carpenter / Electrical workshop	Electrical Workshop	Ceiling		Electrical Workshop Ceiling		Photograph, then dispose of in accordance with waste management handbook. Destroy	Record photographically (with images and dimensions of ceiling to be sent to BAS Archives) and remove. BAS Archives can provide guidance on type of images if required.
Carpenter / Electrical workshop	Small corridor at S end	In use as door between corridor and small store room.		Dog pen door - door, painted red and cut in two to form 'stable door' arrangement, re-joined using small wood panel. Heavily marked with dog scratches.		Retain at Rothera	To be carefully removed and safely stored at Rothera for re-display in new building. Care should be taken to preserve the scratches on the paintwork as these are the source of the heritage value. Note that a management plan will be produced in due course, in conjunction with a conservator) for ongoing preservation of this item at Rothera.
Carpenter / Electrical workshop				Rothera Ninety Minute Club - wooden plaque	284 	Retain at Rothera OR if not required return to BAS Archives	
Old Bransfield House	Corridor adjacent to the Surgery			Rothera Dog genealogies - 2 genealogies on paper, currently mounted on wall within a frame. Large genealogy (2070x720) titled 'British Antarctic Sledge Dogs'. Small genealogy (480x300) titled 'Dog Chart Rothera Base July 1982'.		Retain at Rothera OR if not required return to BAS Archives	Paper genealogies to be taken down, rolled and stored safely in cardboard tube or similar at Rothera. If required for display at Rothera, items to be re-sited in new building. If not required, items to be returned to BAS Archives. There is no requirement to retain the wooden frame.
Old Bransfield House	Corridor adjacent to the Surgery			Dog photos		Retain at Rothera OR if not required return to BAS Archives	
Old Bransfield House	Corridor adjacent to the Surgery			Dog Span diagram - paper and perspex sheet with (chinagraph?) writing, the whole surrounded by wooden frame.		Return to BAS Archives	Paper and perspex sheet to be removed and returned to UK (BAS Archives Service). It is imperative that the surface of the perspex with the chinagraph writing is not rubbed or otherwise cleaned i.e. that the writing on the surface is preserved as is. Transport will require a crate that preserves this surface. There is no requirement to retain the wooden frame.

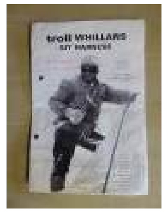
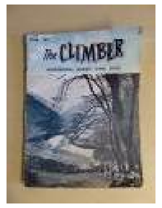
Old Bransfield House	Surgery			List of doctors - engraved wooden plaques	269 	Retain in Surgery at Rothera	
Old Bransfield House	Surgery			Old medical supplies	270 	Dispose of in accordance with waste management handbook.	
Old Bransfield House	?			Panoramas x3: 1982-83, 1987-88, 2005	244, 254  	Retain at Rothera OR if not required return to BAS Archives	
Old Bransfield House	unknown			The Skua - photo in wooden frame		Retain at Rothera OR if not required return to BAS Archives	

Old Bransfield House	unknown			Photo in wooden frame - scientist with twin otter in background		Retain at Rothera OR if not required return to BAS Archives	
Old Bransfield House	unknown			Photo in wooden frame - Twin Otter over Rothera		Retain at Rothera OR if not required return to BAS Archives	
Old Bransfield House	unknown			Framed aerial photographs, Rothera Point	  	Retain at Rothera OR Dispose of in accordance with waste management handbook.	Image already held by Archives

Old Bransfield House	unknown			Framed maps	   	Dispose of in accordance with waste management handbook.	
Old Bransfield House	unknown			Framed display (map of Rothera area, 7 aerial photographs and text re. travelling on sea ice)		Photograph	To be recorded photographically, in line with guidance from BAS Archives regarding associated metadata, and images sent to BAS Archives.
Old Bransfield House				Film collection		Dispose of in accordance with waste management handbook.	BAS Archives hold a list of the films on station - the films themselves are not required as could be retrieved from other archives if needed.
Old Bransfield House	unknown			Framed painting		Retain at Rothera OR if not required return to BAS Archives	

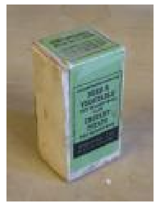
Old Bransfield House	Various			Signed / presented pictures / photographs		Retain at Rothera OR if not required return to BAS Archives	
Fuchs House	Kit room opposite GAs' Office	Mounted on central wall.		Dog Trace hooks - wooden pegs mounted on wooden backboard, the word 'Traces' in black paint, and names of teams above each hook.		Retain at Rothera	To be carefully removed and safely stored at Rothera for re-display in new building.
Fuchs House	Kit room adjacent to (N of) GAs' Office	Mounted on central wall.		Dog Harness hooks - wooden pegs mounted on wooden backboard, the word 'Harnesses' in black paint, and names of teams above each hook.	As above	Retain at Rothera	To be carefully removed and safely stored at Rothera for re-display in new building.
Fuchs House	GAs' Clothing/Equipment store			Travel store wooden sign		Retain at Rothera OR if not required return to BAS Archives	
Fuchs House	GAs' Clothing/Equipment store			Gentleman's Outfitters wooden sign		Retain at Rothera OR if not required return to BAS Archives	
Fuchs House	GAs' Workshop			Vet Box	16 	Retain at Rothera OR if not required return to BAS Archives	
Fuchs House	GAs' Workshop			Sledge Books		Retain at Rothera - When no longer required, to be returned to BAS Archives for permanent preservation.	

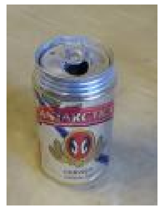
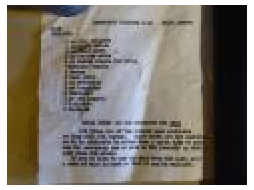
Fuchs House	GA's Office	Mounted on N wall behind door.	50	Adelaide Island Aerial Photo Map - Composite map, produced by mounting individual aerial photographic prints, with paper labels overlaid showing features, introductory panel and scale on paper also overlaid. The whole mounted on wall behind a layer of perspex.		Retain at Rothera OR if not required return to BAS Archives	Return to archives if not required at Rothera. To be transported whole i.e. retain on back board with perspex front to ensure preservation of constituent parts.
Fuchs House	GA's Office			Framed photos - 3	153-154  	Retain at Rothera OR if not required return to BAS Archives	
Fuchs House	GA's Office	N wall bookcase, top	47	1 x pair leather boots - Black leather upper with rubber and wood sole, brown cord laces and metal eyelets, felt and leather tongue		Dispose of in accordance with waste management handbook.	
Fuchs House	GA's Office	N wall bookcase, top	1	Crampons (1 pair) - Metal with leather bindings		Pending	
Fuchs House	GA's Office	N wall bookcase, top	2	Crampons (1 pair) - Metal, no bindings		Pending	
Fuchs House	GA's Office	N wall bookcase, top	3	Crampon - Metal with rubber bindings		Pending	
Fuchs House	GA's Office	N wall bookcase, top	4	Crampon - Metal, with plate on front portion		Pending	

Fuchs House	GA's Office	N wall bookcase, 2nd shelf	5	Flanallete roll - White with red stripes, bound in paper		Pending	
Fuchs House	GA's Office	N wall bookcase, 2nd shelf	6	Barbour's linen thread x2 - bound with paper		Pending	
Fuchs House	GA's Office	N wall bookcase, 2nd shelf	7	Box of flannelette patches - Brown and cream cardboard box containing 50 patches, with diamond opening at top.		Pending	
Fuchs House	GA's Office	N wall bookcase, 2nd shelf	8	Box of flannelette patches - Red cardboard box with white lettering containing 100 flannelette patches		Pending	
Fuchs House	GA's Office	N wall bookcase, 2nd shelf	9	2 rolls linen thread - 6 cord thread on wooden bobbins		Pending	
Fuchs House	GA's Office	N wall bookcase, 2nd shelf	10	Sales brochure - Troll Whillans sit harness, printed paper		Dispose of in accordance with waste management handbook.	
Fuchs House	GA's Office	N wall bookcase, 2nd shelf	11	Magazine - The Climber, October 1964, printed paper		Dispose of in accordance with waste management handbook.	
Fuchs House	GA's Office	N wall bookcase, 2nd shelf	12	Goggles - White plastic frame with yellow tinted plastic lens and black and white checked acrylic strap		Pending	

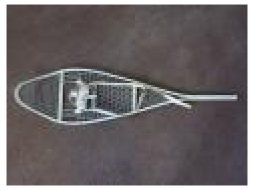
Fuchs House	GA's Office	N wall bookcase, 2nd shelf	13	Photographic paper (3 boxes)		Dispose of in accordance with waste management handbook.	
Fuchs House	GA's Office	N wall bookcase, 2nd shelf	14	Standard BAS negative wallet		Dispose of in accordance with waste management handbook.	
Fuchs House	GA's Office	N wall bookcase, 2nd shelf	15	2 bars Lifebuoy soap with cardboard box		Pending	
Fuchs House	GA's Office	N wall bookcase, 2nd shelf	16	Metal box containing food flavourings		Dispose of in accordance with waste management handbook.	
Fuchs House	GA's Office	N wall bookcase, 2nd shelf, in metal box	17	11 glass bottles of food flavouring - Glass bottles, most labelled, containing lemon, strawberry, pineapple and raspberry food flavourings		Dispose of in accordance with waste management handbook.	
Fuchs House	GA's Office	N wall bookcase, 2nd shelf, in metal box	18	2 x meat bars wrapped in silver paper, one with German labelling		Dispose of in accordance with waste management handbook.	
Fuchs House	GA's Office	N wall bookcase, 2nd shelf, in metal box	19	2 x steak and kidney bar - Freeze dried block wrapped in waxed paper with printed instructions on preparation	 	Dispose of in accordance with waste management handbook.	

Fuchs House	GA's Office	N wall bookcase, 2nd shelf, in metal box	20	2 x Bar of Cadbury Bournville dark chocolate		Dispose of in accordance with waste management handbook.	
Fuchs House	GA's Office	N wall bookcase, 3rd shelf	21	Photographic filters		Dispose of in accordance with waste management handbook.	
Fuchs House	GA's Office	N wall bookcase, 3rd shelf	22	1 box filter papers - Chemically prepared circular filter papers in labelled cardboard box		Dispose of in accordance with waste management handbook.	
Fuchs House	GA's Office	N wall bookcase, 3rd shelf	23	Bottle of gun cleaner - Metal bottle with screw top cap containing 'Young's 303 cleaner rust preventer and nitro powder solvent		Dispose of in accordance with waste management handbook.	
Fuchs House	GA's Office	N wall bookcase, 3rd shelf	24	Tin of 'Nespray' powdered milk		Dispose of in accordance with waste management handbook.	
Fuchs House	GA's Office	N wall bookcase, 3rd shelf	25	Tin of Ovaltine		Dispose of in accordance with waste management handbook.	Badly corroded lid
Fuchs House	GA's Office	N wall bookcase, 3rd shelf	26	meat bar 6oz		Dispose of in accordance with waste management handbook.	
Fuchs House	GA's Office	N wall bookcase, 3rd shelf	27	Metal tea caddy with tea bags		Dispose of in accordance with waste management handbook.	

Fuchs House	GA's Office	N wall bookcase, 3rd shelf	28	Pack of biscuits, foil wrapped		Dispose of in accordance with waste management handbook.	
Fuchs House	GA's Office	N wall bookcase, 3rd shelf	29	Geological instrument - Made by Stanley, used to measure angle of dip on rocks. Metal, with built-in spirit level		Pending	
Fuchs House	GA's Office	N wall bookcase, 4th shelf	30	Concentrated food bar - beef and vegetable with instant potato, in card box with label including instructions		Dispose of in accordance with waste management handbook.	
Fuchs House	GA's Office	N wall bookcase, 4th shelf	31	Nutrican - 2 blocks, in paper and plastic packaging		Dispose of in accordance with waste management handbook.	
Fuchs House	GA's Office	N wall bookcase, 4th shelf	32	food bar, wrapped in silver foil - no labelling		Dispose of in accordance with waste management handbook.	
Fuchs House	GA's Office	N wall bookcase, 4th shelf	33	2 x tinned bacon	 	Dispose of in accordance with waste management handbook.	badly corroded base - recommend disposal
Fuchs House	GA's Office	N wall bookcase, 4th shelf	34	1 x tin NIDO full cream powdered milk		Dispose of in accordance with waste management handbook.	

Fuchs House	GA's Office	N wall bookcase, 4th shelf	35	beer can - empty - 'Antarctica cerveja'		Dispose of in accordance with waste management handbook.	
Fuchs House	GA's Office	N wall bookcase, 4th shelf	36	Metal box containing packs of cube loaf sugar, plus 1 additional card box of cubed loaf sugar		Dispose of in accordance with waste management handbook.	metal box badly corroded, 1 box of sugar opened
Fuchs House	GA's Office	N wall bookcase, 4th shelf	37	1 x tin of butter		Dispose of in accordance with waste management handbook.	base showing some corrosion
Fuchs House	GA's Office	N wall bookcase, 5th shelf	38	List of emergency clothing pack contents		Dispose of in accordance with waste management handbook.	
Fuchs House	GA's Office	N wall bookcase, 5th shelf	39	2 x packs of Wolsey briefs - Cotton, in plastic packaging		Return to BAS Archives	
Fuchs House	GA's Office	N wall bookcase, 5th shelf	40	2 x pair of eye shields - Metal and felt rims and spacers, with mesh side wings, yellow acetate/plastic visor and grey elastic straps		Pending	

Fuchs House	GA's Office	N wall bookcase, 5th shelf	41	4 x ski pole ends - Metal rings, with leather spans - various designs		Pending	
Fuchs House	GA's Office	N wall bookcase, 5th shelf	42	1 x brown woollen balaclava		Pending	
Fuchs House	GA's Office	N wall bookcase, 5th shelf	43	1 x blue woollen balaclava		Pending	
Fuchs House	GA's Office	N wall bookcase, 5th shelf	44	2 x pairs leather over gloves - Leather outer, with felt inners, linen strap with metal buckle. One pair named 'Whitaker'. Manufactured by Compass		Pending	
Fuchs House	GA's Office	N wall bookcase, 5th shelf	45	1 x pair leather over gloves - No inner or straps, marked 'Dick'.		Pending	

Fuchs House	GA's Office	N wall bookcase, 6th shelf	46	1 x pair leather over gloves - Leather outer mitten with sheepskin pad on upper with canvas (?) sleeve and cotton strap with metal buckle and leather loop. Cotton inner, felted.		Pending	
Fuchs House	GA's Office	Mounted on N and W wall of office	48	1 x pair metal snow shoes - White-painted metal frame with metal wire stringing and white cotton strapping with white-painted metal buckles		Pending	
Fuchs House	GA's Office	Mounted on end of built-in blue bookcases	49	5 pieces of metal climbing equipment		Pending	
Fuchs House	GAs' Workshop	On wall above workbench		Walkers in snow		Photograph	To be recorded photographically, in line with guidance from BAS Archives regarding associated metadata, and images sent to BAS Archives.

Various				Other examples of images painted directly onto surfaces	 	Photograph	To be recorded photographically, in line with guidance from BAS Archives regarding associated metadata, and images sent to BAS Archives.
Various				Pub signs		Photograph	To be recorded photographically, in line with guidance from BAS Archives regarding associated metadata, and images sent to BAS Archives.
Various				Team photos (e.g. Met Team)		Retain at Rothera OR Return to BAS Archives	

Appendix F: Heritage Selection Process Forms

Heritage Selection Process Cover sheet

Name of Object: Bingham House

Overview

This process aims to provide a systematic and consistent methodology for the identification of those objects[1] with heritage value.

Heritage is here defined as all inherited resources which people value for reasons beyond mere utility.[2] This definition includes the widest range of physical 'things'. It also encompasses the range of emotional and intellectual values attached to them.

This methodology is scalable. It can be used to assess the heritage value of single, hand-held objects through to complete heritage sites and structures (a compass found on an abandoned base, through to the abandoned base itself and the area surrounding it).

Methodology

The methodology is in 3 stages:

Stage 1: The initial identification and recording of the object.
Stage 2: A statement of the significance of the object, arrived at by considering factors contributing to heritage value, the potential for different stakeholder groups to attach different heritage values to the same object, and the relationship of the object under consideration to comparable objects.
Stage 3: A series of pragmatic decisions, based upon the information in Stages 1 and 2.

There are 5 possible outcomes to this process:

- The object is designated as non-heritage and removed according to standard environmental procedures;
- The object is appropriately recorded as a heritage object prior to removal/destruction;
- The removal and transfer of the heritage object to an appropriate repository for ongoing management;
- The initiation of ongoing management in situ of the heritage object;
- The appropriate recording of the heritage object and initiation of periodic monitoring in situ pending the opportunity or decision to undertake one of the above.

Progress

	Completed by	Date completed
Stage 1	I Hopkins	Sept 2017
Stage 2	I Hopkins	Sept 2017
Stage 3	I Hopkins	N/A

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[1] Within this document, 'object' is taken to mean either an artefact, building or site.
[2] 'Conservation Principles, Policy and Guidance'. Historic England, 2008

Stage 1 – Initial Identification Form

Name of Object: Bingham House

The Initial Documentation Form should be completed as fully as possible – this will form the basis for subsequent decisions relating to the significance and ongoing management of the object.

Once Part A has been completed , the Initial Documentation Form should be sent to the BAS Environment Office, whose responsibility it will be to complete the subsequent steps in Part 1 and to liaise, as appropriate, with one or more of the following:

- BAS Archives Service;
- United Kingdom Antarctic Heritage Trust;
- The equivalent for other national operators;
- Antarctic Treaty parties.

Further information regarding the object may be sought from the individual named on the Initial Documentation Form.

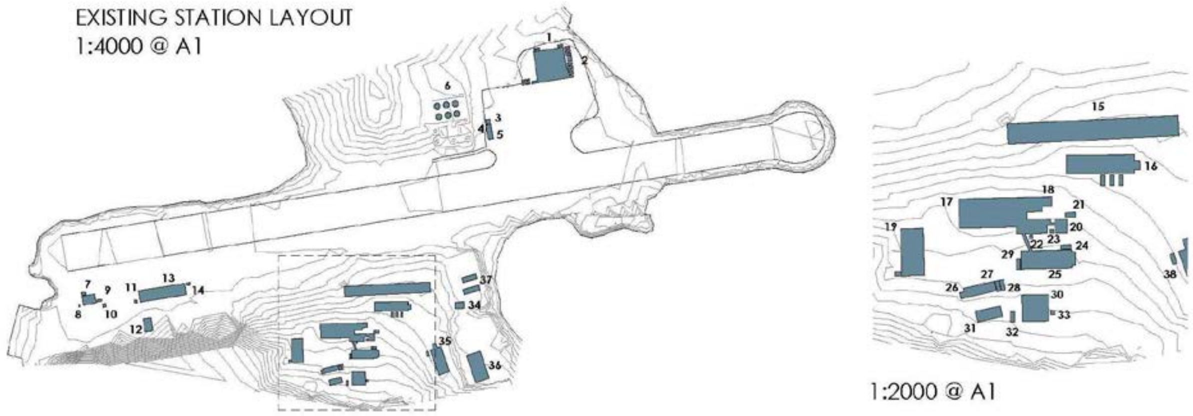
Part A - Please complete this form as fully as possible – each object / site requires a separate form, as appropriate.

	Section 1	
1.1	Item / site (brief description	Technical Services Store / Bingham's (Bingham House) is a building used as a store.
1.2	Date found	Assessed as part of the Rothera heritage review, Dec 2016, by Ieuan Hopkins, BAS Archives Manager.
1.3	Found by (name of person)	See above
1.4	Local event / ref. number (if multiple objects / sites are being recorded)	n/a
1.5	How was the object / site found?	n/a
	Section 2 - Location	
2.1	Where was the object / site found – GPS reference (if known)	n/a
2.2	Map	If possible, indicate position found on a map and attach to this form. See image below.
2.3	Where was the object / site found – further details	Include: • A description of the location • Situation of the object / site (e.g. is the object windblown debris, has it been placed in position deliberately etc.) • Identification aids to help relocate the object/site Bingham's is situated to the E of the Carpenters and Electrical Workshop, Rothera Station.
2.4	Is the object / site associated with others nearby? If so, provide brief details and include relevant event / ref. numbers for the respective Initial documentation forms.	n/a

	Section 3 - Description	
3.1	Full description of object	Include: • The type of object • Materials used (if the presence of hazardous materials is suspected, please also complete section 4.4) • Markings (symbols or writing on the object), in particular manufacturer or makers marks • Is the object comprised of a number of parts? Bingham's is a storage shed / technical services store. It is constructed of wooden frames, bolted together with a trussed roof and metal sheeting on the walls and roof, with wooden floor. The whole sits on concrete footings. The interior is divided into two, and used for the storage of wood and other materials, with some carpentry machinery installed. The walls are lined with shelving / racking.
3.2	Size of the object / site (e.g. cm, m^2 as appropriate)	Unknown – not measured
3.3	Age of the object / site (if known)	Bingham's was originally pre-fabricated at Stanley by the Crown Agents in 1974/75 before being transported to Adelaide (Base T), where it was constructed in Feb. 1975. It was subsequently transported to and rebuilt at Rothera in the 1976/77 season.
3.4	Origin	Please indicate if the object / site appears to be of UK origin, or if other countries been involved in the creation / placement of the object. See above – of UK origin, with no involvement of other countries in the construction / maintenance.
	Section 4 - Condition	
4.1	Condition – select one of the following	As new Some wear Moderate deterioration [✓ **Significant deterioration**] Extreme deterioration
4.2	Condition – further explanatory notes as appropriate	For example: • How much of the original object remains? • Is the object intact? • Does the object show alterations or repairs? • Is it suitable for continued use? The building has undergone maintenance throughout its life, such as recladding of the external roof and walls. Steps to the entrance and associated concrete pad were constructed in the 1990/91 season. The interior has also been reconfigured over time. Originally two separate rooms, a doorway was cut between what was at the time a carpenter's workshop and store in 1979/80. The carpentry workshop was moved out in 1980/81, with Bingham's becoming exclusively used for storage. The original interior lining of the walls was stripped off in 1981/82, to be used as packing material, and this was not replaced. Further internal reconfiguration of workbenches and shelving continued up to the present. (Information from Adelaide and Rothera construction reports, BAS Archives, AD6/2 series).

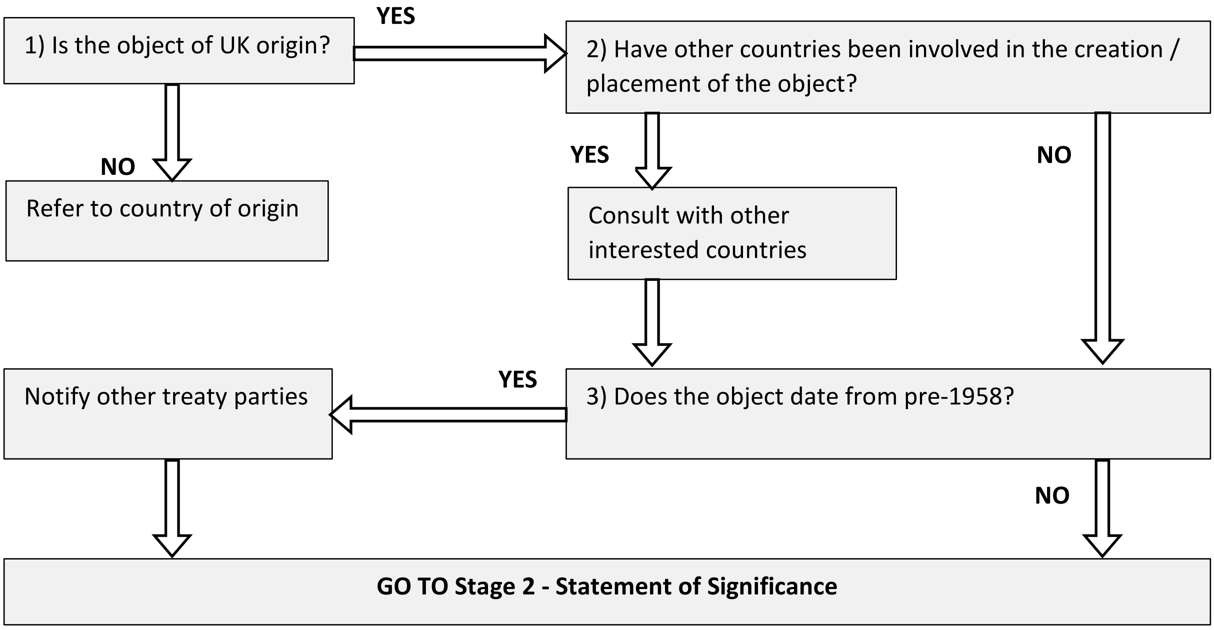
		Disregarding these changes, the interior still 'feels' like an old hut - much of the original construction is visible, especially in the roof, and original markings (such as serial numbers etc.) are apparent.
4.3	Are there any apparent threats to the integrity of the object / site	These could include: • Human or other animal activity, including uncontrolled visitation. • Environmental conditions / sustained exposure to the elements / potential extreme weather conditions. • Longer-term environmental change. The Rothera redevelopment will necessitate the removal of this building.
4.4	Does the object pose a risk to safety or the environment?	Currently unknown, although BAM will be carrying out an asbestos survey in Feb. 2019 to confirm that the structure does not pose a risk to the environment or H&S.
	Section 5 – Further Information	
5.1	Any other information	As appropriate, please record any other information about the object / site that you feel would be of use and which is not already covered.
5.2	Images	Please attach images to this form. If possible include: • images in close-up taken from multiple angles • distance shots showing the objects/site in context • an indication of scale • an indication of the direction the photograph was taken i.e. looking North. Please label all images with the event / ref. number at the top of this form, and include the name of the photographer.

Plan of existing buildings at Rothera - Bingham House is identified as no. 31.



Signed by:	Ieuan Hopkins (Archives Manager)	**Date:** Sept. 2017

Part B - To be completed by BAS Environment Office



		Further details
1)	Is the object of UK Origin?: (Y/N) If No, please refer to the country of origin.	Yes
2)	Have other countries been involved in the creation / placement of the object?: (Y/N) If Yes, consult with other interested countries.	No
3)	Does the object date from pre-1958?: (Y/N) If yes, notify other Treaty Parties.	No

Signed by:	Ieuan Hopkins (on behalf of BAS EO)	**Date: 19/09/2017**

Stage 2: Statement of Significance

Name of Object: Bingham House

Stage 2 should be undertaken by the BAS Archives Service / Environment Office / UKAHT, in liaison with other parties as appropriate.

The following questions relate to factors contributing to heritage value. Please provide comprehensive answers where relevant, as decisions in stage 3 of the methodology relating to the ongoing management of the objects draw directly from the information provided here.

Please note that the responses should be appropriate and proportionate to the site/object under consideration – a compass does not require the same level of response as an abandoned base.

2.1 Context / History

Describe the history of the object:

- *When was it first built / taken to the site?*
- *What was its original purpose?*
- *How has it been used since? Has its use changed over time?*

Bingham House is named after E.W Bingham, Director of FIDS 1945-48, although has no connection with him other than the name.

It was originally used as a store at Adelaide, (Base T), to cope with the demands of an increase in personnel, and was designed and partially built by the Crown Agents, Stanley, before being shipped to Adelaide and constructed in February 1975. It was located on the N edge of the Adelaide site, near to another building, Peril.

At the time, Adelaide was the main BAS station for summer air operations. However, after 13 years of activity, the snow runway and ramp being used had deteriorated and operations became more difficult. In May 1975, it was decided to build a new base at Rothera Point.

Construction on the first building at Rothera (Phase I, now the Carpenter and Electrical Workshop) began on 1st February 1976. Bingham's was transferred to Rothera from Adelaide the following season (1976/77), to provide additional space at the new station. (Note: no further information on this move can be found in the archives).

Initially, it was used as a carpenter's workshop and store, but became predominantly storage space in the 1980/81 season when the carpenters workshop was moved to the Phase I building (AD6/2R/1980/C). It has been used as storage since, and is currently the technical services store housing mostly wood.

The building is of portal frame and panel construction – with wooden frames bolted together, a trussed roof and the whole placed on a concrete footing (at both Adelaide and Rothera). When first constructed, Weyroc (flooring-grade chipboard) was used on the floor and Plastibol sheeting on the roof and walls.

Due to its use as a store (rather than accommodation) the building has undergone only minimal maintenance throughout its life. This has included the recladding of the external roof and walls and the addition of steps to the entrance and associated concrete pad, constructed in the 1990/91 season.

	The interior has also been reconfigured over time. Originally two separate rooms, a doorway was cut between what was at the time a carpenter’s workshop and store in 1979/80. The original interior lining of the walls was stripped off in 1981/82, to be used as packing material, and this was not replaced. Further internal reconfiguration of workbenches and shelving has continued up to the present.
2.2	**Heritage Values**
2.2.1	**Historical Significance**
i.	*Is the object associated with important events or activities relating to exploration and discovery?* No.
ii.	*Is the object associated with significant people?* No – there is no connection with E.W. Bingham other than the name.
iii.	*Does the object accurately and effectively invoke past conditions? Does it contribute to our understanding of a time, place or event? If so, how?* No
iv.	*Is the object evidence of the how, when, where or why of a significant past activity?* No
v.	*Does the object contribute to an understanding of the history of science, exploration or politics in Antarctica more broadly?* No
2.2.3	**Scientific Significance**
i.	*Is the object associated with important events or activities relating to scientific research?* No
ii.	*Is the object of current scientific interest or value? Is it likely to be so in the future?* No
2.2.4	**Technological Significance**
i.	*Does the object have historical importance in terms of architectural or technological interest? Will this value increase in the future as similar objects disappear?* This building was designed for simplicity of construction and low cost and this, in addition to its basic use as a store, meant that only a basic, standard structure was required. It therefore has no architectural or technological interest in terms of innovation of form.

This building is of a type (portal frame and panel construction) that has been widely used by FIDS and BAS over a number of years, and when built differed in its construction from other buildings at Adelaide (Base T) only in its use of Plastibol.

There are many well-preserved examples of this type of construction still extant and in use and/or managed as heritage, including those at Adelaide, now Teniente Luis Carvajal Villaroel Antarctic Base. It is therefore neither unique nor unusual.

The construction (i.e. the architectural and technological aspects) of FIDS/BAS buildings is documented in detail in the BAS Archives, through architectural/construction plans (series AD/11/1) and construction reports (series AD6/2) and visually through photographic and film material.

ii. *Is the object of unique or unusual design?* ***OR*** *Is the object a particularly good example of a technology common to the Antarctic?*

No – see comments above. This is an example of a construction method common in the Antarctic, although due to its basic construction does not demonstrate this method well.

iii. *Does the object have aesthetic value, either through conscious design or as the outcome of the way it has evolved and/or been used over time?*

Bingham's, as a purely utilitarian building, was not designed with aesthetics in mind, and its continued use as a store has not enhanced it aesthetically. Externally, its presence does nothing to enhance the aesthetics of the environment.

The 'feel' and attraction of being in Bingham's has been commented on by several staff – this may be due to the presence of original marks on the internal walls, and possibly the smell of wood, and the fact that, although not particularly old when compared to other buildings around the Peninsula, Bingham's contrasts with the newer buildings at Rothera, which have a very different look and feel. However, this was not an aspect that came through in discussions with current personnel at Rothera during the heritage review, Dec. 2016.

See further comments at 2.2.5.

2.2.5 Social / Cultural Significance

i. *Is the object of significance to a particular group of people?*
Note: *Different stakeholder groups / communities may value the same object in different ways, and to different degrees. If these differences are present, it is important to indicate them here. Stakeholder groups to consider may include:*

- *former FIDS/BAS staff;*
- *current personnel (station- and/or Cambridge-based);*
- *historians and other heritage professionals (e.g. UKAHT)*
- *the general public*
- *Government*

For the reasons discussed above, Bingham's is not significant to the stakeholder groups listed.

With regards current station personnel, Bingham's was not felt to be a particularly significant part of the experience of Rothera, and many had not been inside.

During the staff discussion on heritage that was undertaken in Dec. 2016, the importance of a sense of connection/continuity with the past was strongly communicated. This connection was

	felt to be most effectively preserved through the continuing use of objects and the continuation of traditions – i.e. an active method of re-inscription and reconnection. With regards buildings, there was little desire to see the station frozen in time, or to attempt to recreate the past with a new-build, which was felt would be impossible. Many commented that the current look and feel of the station did not happen overnight, but represents layers of time built up gradually by different individuals. There was a sense that new buildings were important from a pragmatic / operational point of view, and that progress was necessary, but that over time, the new buildings could become the heritage of the future, and what was most important was the ability / space to allow this accumulation of statements of identity to occur, whilst providing a link to the past.
2.2.6	**Comparative Significance**
i.	*Is the object well-documented in published and/or archival sources?* No
ii.	*Is the object rare or unique? Is it likely to become more so?* No
iii.	*Is the object a particularly good example of its type?* No
iv.	*Is the object typical of that used in the Antarctic, of which few examples remain?* No
	Has Heritage Value been Identified? (if Yes go to stage 3; if No add recommendation below) No
	RECOMMENDATION
	This building does not have any heritage value for the reasons described above. After consultation with the Environment Office and UK Antarctic Heritage Trust, we would therefore recommend that it is removed in accordance with Annexe 3 of the Environmental Protocol and as part of the broader Rothera redevelopment. Before removal, the internal and external aspects of the building should be recorded photographically.

Signed by:	Ieuan Hopkins (Archives Manager)	**Date: Sept. 2017**

Signed by:	Camilla Nichol Chief Executive, UK Antarctic Heritage Trust	**Date: 07/01/2019**
Signed by:	Rachel Clarke, Head of Environment Office	**Date: January 2019**

Heritage Selection Process Cover sheet

Name of Object: Rothera ceiling

Overview

This process aims to provide a systematic and consistent methodology for the identification of those objects[1] with heritage value.

Heritage is here defined as all inherited resources which people value for reasons beyond mere utility.[2] This definition includes the widest range of physical 'things'. It also encompasses the range of emotional and intellectual values attached to them.

This methodology is scalable. It can be used to assess the heritage value of single, hand-held objects through to complete heritage sites and structures (a compass found on an abandoned base, through to the abandoned base itself and the area surrounding it).

Methodology

The methodology is in 3 stages:

Stage 1: The initial identification and recording of the object.
Stage 2: A statement of the significance of the object, arrived at by considering factors contributing to heritage value, the potential for different stakeholder groups to attach different heritage values to the same object, and the relationship of the object under consideration to comparable objects.
Stage 3: A series of pragmatic decisions, based upon the information in Stages 1 and 2.

There are 5 possible outcomes to this process:

- The object is designated as non-heritage and removed according to standard environmental procedures;
- The object is appropriately recorded as a heritage object prior to removal/destruction;
- The removal and transfer of the heritage object to an appropriate repository for ongoing management;
- The initiation of ongoing management in situ of the heritage object;
- The appropriate recording of the heritage object and initiation of periodic monitoring in situ pending the opportunity or decision to undertake one of the above.

Progress

	Completed by	Date completed
Stage 1	I Hopkins	Feb 2017
Stage 2	I Hopkins	Sept 2017
Stage 3	I Hopkins	Sept 2017

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[1] Within this document, 'object' is taken to mean either an artefact, building or site.
[2] 'Conservation Principles, Policy and Guidance'. Historic England, 2008

Stage 1 – Initial Identification Form

Name of Object: Rothera ceiling

The Initial Documentation Form should be completed as fully as possible – this will form the basis for subsequent decisions relating to the significance and ongoing management of the object.

Once Part A has been completed , the Initial Documentation Form should be sent to the BAS Environment Office, whose responsibility it will be to complete the subsequent steps in Part 1 and to liaise, as appropriate, with one or more of the following:

- BAS Archives Service;
- United Kingdom Antarctic Heritage Trust;
- The equivalent for other national operators;
- Antarctic Treaty parties.

Further information regarding the object may be sought from the individual named on the Initial Documentation Form.

Part A - Please complete this form as fully as possible – each object / site requires a separate form, as appropriate.

	Section 1	
1.1	Item / site (brief description	Ceiling in Electrical workshop signed and written on by station personnel and visitors to Rothera.
1.2	Date found	Assessed as part of the Rothera heritage review, Dec 2016, by Ieuan Hopkins, BAS Archives Manager.
1.3	Found by (name of person)	See above
1.4	Local event / ref. number (if multiple objects / sites are being recorded)	n/a
1.5	How was the object / site found?	n/a
	Section 2 - Location	
2.1	Where was the object / site found – GPS reference (if known)	Object is located at Rothera Station – the ceiling of the Electrical workshop, N end of the Carpenter and Electrical workshop.
2.2	Map	If possible, indicate position found on a map and attach to this form. n/a
2.3	Where was the object / site found – further details	Include: • A description of the location • Situation of the object / site (e.g. is the object windblown debris, has it been placed in position deliberately etc.) • Identification aids to help relocate the object/site No further information (see 2.1)
2.4	Is the object / site associated with others nearby? If so, provide brief details and include relevant event / ref. numbers for the respective Initial documentation forms.	No similar objects exist at Rothera. Other objects at Rothera commemorate previous personnel – Winterers' photographs, other team photographs, wooden plaques listing previous station doctors etc.
	Section 3 - Description	

<table>
<tr><td>3.1</td><td>Full description of object</td><td colspan="5">Ceiling, made from sheets of wood painted white, with names, dates and short messages written on it in a variety of (mostly) marker pens.

Text appears to start in the centre of the ceiling, on a wooden boss, and roughly spirals out from this, covering most of the ceiling.

It contains the names and nicknames of station personnel, the dates they were at Rothera and, in some cases, small drawings or comments. Also included are the names of visitors to Rothera.

The earliest name appears to be from the 98/99 season, and the signing of the ceiling is a tradition that continues until the present, with new names being added every season.</td></tr>
<tr><td>3.2</td><td>Size of the object / site (e.g. cm, m^2 as appropriate)</td><td colspan="5">Unknown – the writing covers most of the ceiling.</td></tr>
<tr><td>3.3</td><td>Age of the object / site (if known)</td><td colspan="5">The Carpenter and Electrical workshop was constructed as Phase I of Rothera, in Feb. 1976. It was the first building to be erected on the site, and was constructed to be a fully-equipped temporary building to accommodate 15 men under field conditions.

Its interior has been reconfigured over time. The Electrician’s Office, in which this ceiling is found, was partitioned off from the carpenter workshop in the 1986/87 season. It is not known if the ceiling was replaced at that time, but it appears to be original, and matches that in other parts of the building.

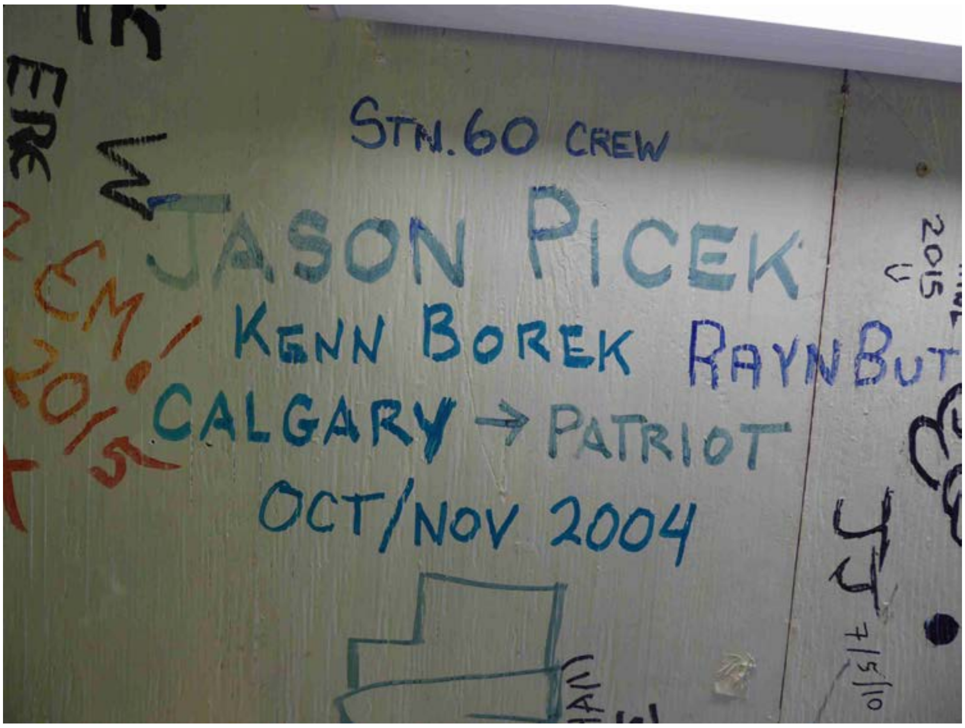
The earliest text dates from 1998/99 season, the latest from the current season.</td></tr>
<tr><td>3.4</td><td>Origin</td><td colspan="5">Please indicate if the object / site appears to be of UK origin, or if other countries been involved in the creation / placement of the object.

This is part of the fabric of Rothera.</td></tr>
<tr><td></td><td colspan="6">Section 4 - Condition</td></tr>
<tr><td>4.1</td><td>Condition – select one of the following</td><td>As new</td><td>Some wear</td><td>Moderate deterioration</td><td>Significant deterioration</td><td>Extreme deterioration</td></tr>
<tr><td>4.2</td><td>Condition – further explanatory notes as appropriate</td><td colspan="5">For example:
• How much of the original object remains?
• Is the object intact?
• Does the object show alterations or repairs?
• Is it suitable for continued use?</td></tr>
<tr><td>4.3</td><td>Are there any apparent threats to the integrity of the object / site</td><td colspan="5">These could include:
• Human or other animal activity, including uncontrolled visitation.
• Environmental conditions / sustained exposure to the elements / potential extreme weather conditions.
• Longer-term environmental change.</td></tr>
</table>

		The Carpenter and Electrical Workshop is potentially being demolished as part of the Rothera redevelopment. The object is therefore at risk from disposal if its significance is not understood and it is not removed from its current location.
4.4	Does the object pose a risk to safety or the environment?	Currently assumed not - although BAM will be carrying out an asbestos survey in Feb. 2019 to confirm that the structure does not pose a risk to the environment or H&S.
	Section 5 – Further Information	
5.1	Any other information	As appropriate, please record any other information about the object / site that you feel would be of use and which is not already covered.
5.2	Images	Please attach images to this form. If possible include: • images in close-up taken from multiple angles • distance shots showing the objects/site in context • an indication of scale • an indication of the direction the photograph was taken i.e. looking North. Please label all images with the event / ref. number at the top of this form, and include the name of the photographer. **Note: High-res tiffs of all images are held in the BAS Archives, ref. 2017/1**

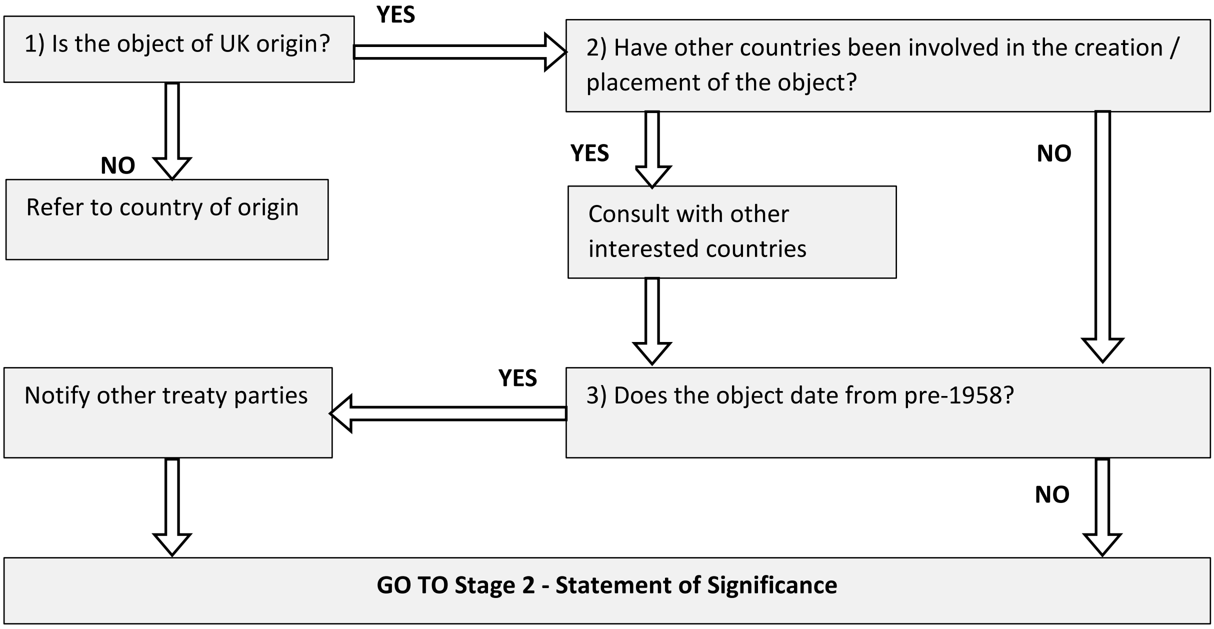

11-01-86
Nicky '07 x
SPENT A YEAR
HERE ONE MONTH
DICK SYMON 2004
Mark M 2006


2011 / 13
FGA
INDAHOUSE
2005
2007
MATT B - FUCK ME, I NEED A BETTER JOB.
ROSSOTRON
2010-2012
ELECTRONIC
FUNGINEER



Signed by:	Ieuan Hopkins (Archives Manager) I. Hopkins	**Date:** Feb 2017

Part B - To be completed by BAS Environment Office



		Further details
1)	Is the object of UK Origin?: (Y/N) If No, please refer to the country of origin.	Yes – produced at Rothera
2)	Have other countries been involved in the creation / placement of the object?: (Y/N) If Yes, consult with other interested countries.	No
3)	Does the object date from pre-1958?: (Y/N) If yes, notify other Treaty Parties.	No

Signed by:	Ieuan Hopkins (on behalf of BAS EO)	**Date: Feb 2017**

Stage 2: Statement of Significance

Name of Object: Rothera ceiling

Stage 2 should be undertaken by the BAS Archives Service / Environment Office / UKAHT, in liaison with other parties as appropriate.

The following questions relate to factors contributing to heritage value. Please provide comprehensive answers where relevant, as decisions in stage 3 of the methodology relating to the ongoing management of the objects draw directly from the information provided here.

Please note that the responses should be appropriate and proportionate to the site/object under consideration – a compass does not require the same level of response as an abandoned base.

2.1	**Context / History** *Describe the history of the object:* • *When was it first built / taken to the site?* • *What was its original purpose?* • *How has it been used since? Has its use changed over time?* The Carpenter and Electrical workshop was constructed as Phase I of Rothera, in Feb. 1976. It was the first building to be erected on the site, and was constructed to be a fully-equipped temporary building to accommodate 15 men under field conditions. Its interior has been reconfigured over time. The Electrician's Office, in which this ceiling is found, was partitioned off from the carpenter workshop in the 1986/87 season. It is not known if the ceiling was replaced at that time, but it appears to be original, and matches that in other parts of the building. The earliest text dates from 1998/99 season, the latest from the current season. The signing of the ceiling is well-known at Rothera, and it appears that a large proportion of personnel on station, as well as visitors to Rothera, have done so (both current and past). A number of names have multiple dates next to them, which have been added over time as staff return. Adding a signature has become a tradition at Rothera.
2.2	**Heritage Values**
2.2.1	**Historical Significance**
i.	*Is the object associated with important events or activities relating to exploration and discovery?* No
ii.	*Is the object associated with significant people?* No
iii.	*Does the object accurately and effectively invoke past conditions? Does it contribute to our understanding of a time, place or event? If so, how?*

	No
iv.	*Is the object evidence of the how, when, where or why of a significant past activity?* No
v.	*Does the object contribute to an understanding of the history of science, exploration or politics in Antarctica more broadly?* No
2.2.3	**Scientific Significance**
i.	*Is the object associated with important events or activities relating to scientific research?* No
ii.	*Is the object of current scientific interest or value? Is it likely to be so in the future?* No
2.2.4	**Technological Significance**
i.	*Does the object have historical importance in terms of architectural or technological interest? Will this value increase in the future as similar objects disappear?* No
ii.	*Is the object of unique or unusual design?* ***OR*** *Is the object a particularly good example of a technology common to the Antarctic?* No
iii.	*Does the object have aesthetic value, either through conscious design or as the outcome of the way it has evolved and/or been used over time?* No
2.2.5	**Social / Cultural Significance**
i.	*Is the object of significance to a particular group of people?* ***Note:*** *Different stakeholder groups / communities may value the same object in different ways, and to different degrees. If these differences are present, it is important to indicate them here. Stakeholder groups to consider may include:* • *former FIDS/BAS staff;* • *current personnel (station- and/or Cambridge-based);* • *historians and other heritage professionals (e.g. UKAHT)* • *the general public* • *Government*

	This ceiling has significance to current, previous and potentially future personnel at Rothera. It is an excellent and tangible example of the way that the importance of heritage is understood at Rothera: • The importance of a sense of continuity and connection with the past was an aspect of heritage that was repeatedly voiced during discussions with staff held during the heritage review visit in Dec. 2016. So too were concerns that, over time, this connection is weakened. The signatures on this ceiling provide a record of previous staff, as one member of staff suggested, 'somebody's footprint, and is an important way in which a sense of continuity and connection is maintained. • The continuing of tradition, in which this ceiling plays an important role, is another important means of keeping the past alive. A sense of trusteeship and respect for previous ideas of heritage was also apparent during discussions. This ceiling, as well as other hand-painted signs and images around the station were specifically mentioned in this context. There was a sense that everyone wants to leave a mark, and that this desire continues – all those present during the discussion (most of the personnel on station) had both seen and added to the signatures. The fact that previous personnel had decided not to paint over or destroy these was an important consideration - the present staff did not want to be the ones to bring this tradition to an end.
2.2.6	**Comparative Significance**
i.	*Is the object well-documented in published and/or archival sources?* No
ii.	*Is the object rare or unique? Is it likely to become more so?* Unique.
iii.	*Is the object a particularly good example of its type?* This is a particularly good example of an ongoing tradition, originating on an Antarctic station. It has persisted for c.20 years (the earliest dates recorded on it are from the 1998/99 season), with returning staff re-signing the ceiling, and all who live and work at the station are encouraged to do so. It records a long pedigree of visitors to Rothera.
iv.	*Is the object typical of that used in the Antarctic, of which few examples remain?* *N/A*
	Has Heritage Value been Identified? (if Yes go to stage 3; if No add recommendation below) Yes
	RECOMMENDATION N/A

Signed by:	Ieuan Hopkins (Archives Manager)	**Date:** Sept. 2017

Stage 3 Heritage Management Flowchart Guidance Notes and Comments

Name of Object: Ceiling signatures

Stage 3 to be undertaken by the BAS Archives Service / Environment Office / UKAHT, in liaison with other parties as appropriate.

The following questions and guidance should be read in conjunction with the Heritage Management Flowchart, below. The comments provided will document the decisions made with regard ongoing heritage management.

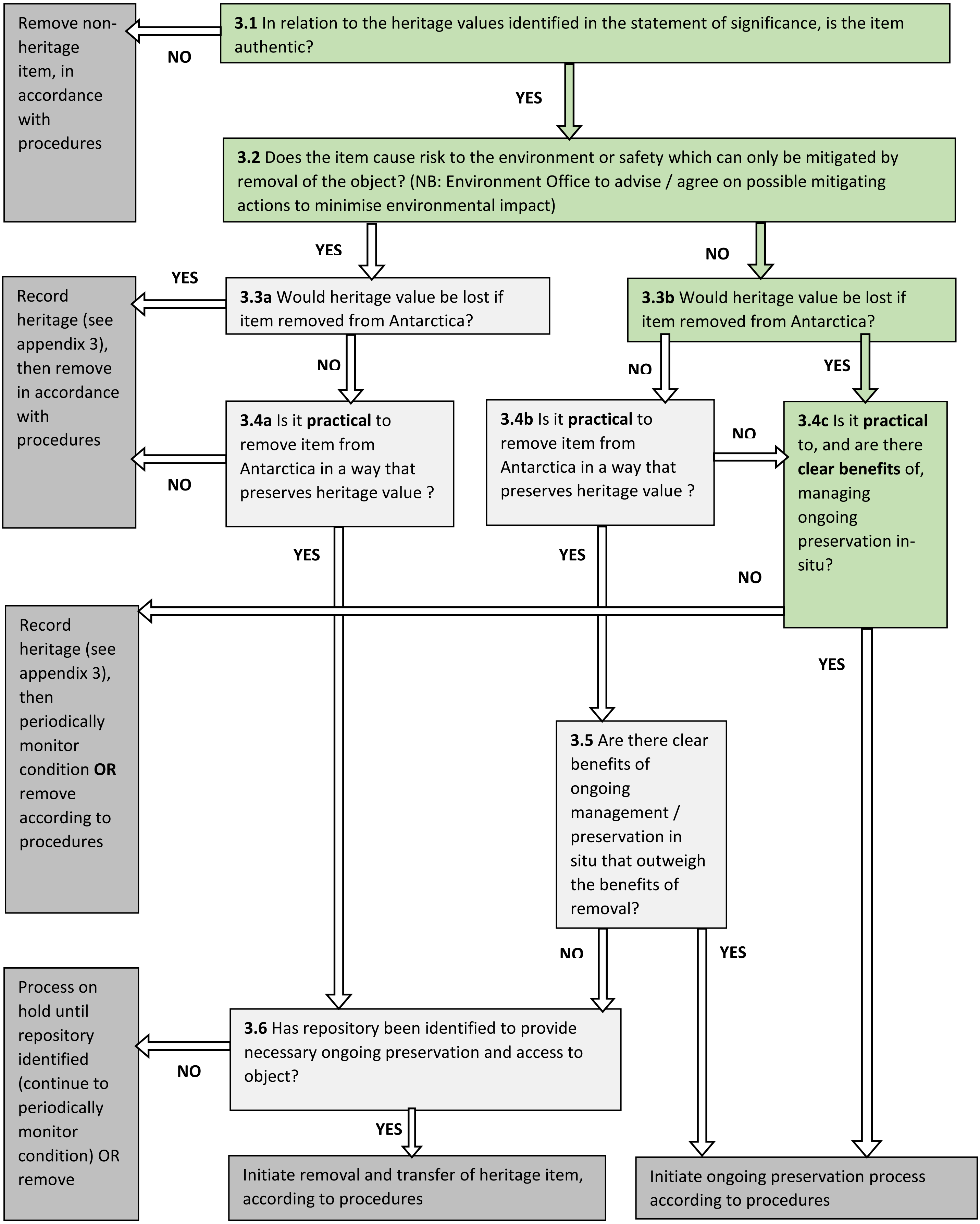
3.1	*Authenticity relates to the 'truthfulness' or credibility of the item, in particular in relation to the heritage values stated in Stage 2.* **Please comment:** This item is authentic, as described in sections 1 and 2.
3.2	**Please comment:** Link to Environment Office guidelines to be included. It is assumed that the ceiling does not cause any risk to the environment or safety. This is being confirmed by an asbestos survey, to be carried out by BAM in February 2019.
3.3	*Consider whether the heritage values reside solely in the object, or are dependent upon the object's location.* **Please comment, in relation to the heritage values stated in Stage 2:** The heritage value of this object is due to its social significance through use in an ongoing tradition at Rothera Station i.e. it has no significance once removed from Rothera, or for groups or stakeholders other than previous, current and potentially future station personnel. As such, its heritage value would be lost if transferred from Rothera.
3.4a/b	*Consider the practicalities of the specific physical removal required to retain the heritage values stated in Stage 2.* **Please comment:** n/a – see 3.4c
3.4c	*Consider (in relation to practicalities):* • *The current condition of the site / object;* • *Resource implications of preservation / conservation – is the resource and expertise available to prevent significant deterioration?* • *Resource implications of continuing maintenance / management, including the ongoing security and protection of the site/object and management of controlled visitation;* • *The impact of preservation work on wildlife.*

	Specify the benefits of managing the object in situ. **Please comment:** It is not possible to manage the ongoing preservation of this object in its current location in the Carpenter and Electrical Workshop as this is being removed as part of the Rothera redevelopment. The practicalities of retaining the ceiling as is at Rothera would entail installation in some form in a new building. Note that to retain the heritage value of the object, ongoing preservation means allowing the continued signing of the wall, rather than preserving as is. It is understood that installing the ceiling as may be impractical. The clear benefits of maintaining this object at Rothera relate to, and are dependent upon, the importance placed upon the continuity of tradition expressed by personnel, and the way this enhances their experience of Rothera. These benefits could be achieved by retaining a version or representation of the original, allowing the tradition to continue without installing the original ceiling.
3.5	*Consider:* • *The accessibility of the site, in particular to those stakeholder groups identified in Stage 2 as valuing the heritage;* • *The potential to increase accessibility in the future, to engage/educate new stakeholder groups.* • *The aesthetic quality of the base and/or its setting in the landscape.* **Please comment:** n/a
3.6	**Please comment:** n/a
	RECOMMENDATIONS
	As an object embodying an important tradition at Rothera, if incorporation of the ceiling into the new building is not practical, it is to be fully recorded and reproduced in a form that allows the continuation of the tradition of personnel to sign their name.

Signed by:	Ieuan Hopkins (Archives Manager)	**Date:** Sept. 2017

Signed by:	Camilla Nichol Chief Executive, UK Antarctic Heritage Trust	**Date: 07/01/2019**
Signed by:	Rachel Clarke, Head of Environment Office Rachel Clarke	**Date: Jan 19**

Stage 3: Heritage Management Flowchart



3.1 In relation to the heritage values identified in the statement of significance, is the item authentic?

Remove non-heritage item, in accordance with procedures

3.2 Does the item cause risk to the environment or safety which can only be mitigated by removal of the object? (NB: Environment Office to advise / agree on possible mitigating actions to minimise environmental impact)

3.3a Would heritage value be lost if item removed from Antarctica?

3.3b Would heritage value be lost if item removed from Antarctica?

Record heritage (see appendix 3), then remove in accordance with procedures

3.4a Is it **practical** to remove item from Antarctica in a way that preserves heritage value ?

3.4b Is it **practical** to remove item from Antarctica in a way that preserves heritage value ?

3.4c Is it **practical** to, and are there **clear benefits** of, managing ongoing preservation in-situ?

Record heritage (see appendix 3), then periodically monitor condition **OR** remove according to procedures

3.5 Are there clear benefits of ongoing management / preservation in situ that outweigh the benefits of removal?

3.6 Has repository been identified to provide necessary ongoing preservation and access to object?

Process on hold until repository identified (continue to periodically monitor condition) OR remove

Initiate removal and transfer of heritage item, according to procedures

Initiate ongoing preservation process according to procedures

Heritage Selection Process Cover sheet

Name of Object: Rothera Dog Genealogies

Overview

This process aims to provide a systematic and consistent methodology for the identification of those objects[1] with heritage value.

Heritage is here defined as all inherited resources which people value for reasons beyond mere utility.[2] This definition includes the widest range of physical 'things'. It also encompasses the range of emotional and intellectual values attached to them.

This methodology is scalable. It can be used to assess the heritage value of single, hand-held objects through to complete heritage sites and structures (a compass found on an abandoned base, through to the abandoned base itself and the area surrounding it).

Methodology

The methodology is in 3 stages:

Stage 1: The initial identification and recording of the object.
Stage 2: A statement of the significance of the object, arrived at by considering factors contributing to heritage value, the potential for different stakeholder groups to attach different heritage values to the same object, and the relationship of the object under consideration to comparable objects.
Stage 3: A series of pragmatic decisions, based upon the information in Stages 1 and 2.

There are 5 possible outcomes to this process:

- The object is designated as non-heritage and removed according to standard environmental procedures;
- The object is appropriately recorded as a heritage object prior to removal/destruction;
- The removal and transfer of the heritage object to an appropriate repository for ongoing management;
- The initiation of ongoing management in situ of the heritage object;
- The appropriate recording of the heritage object and initiation of periodic monitoring in situ pending the opportunity or decision to undertake one of the above.

Progress

	Completed by	Date completed
Stage 1	Ieuan Hopkins	08/09/2017
Stage 2	I Hopkins	Sept 2017
Stage 3	I Hopkins	Sept 2017

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[1] Within this document, 'object' is taken to mean either an artefact, building or site.

[2] 'Conservation Principles, Policy and Guidance'. Historic England, 2008

Stage 1 – Initial Identification Form

Name of Object: Rothera Dog Genealogies

The Initial Documentation Form should be completed as fully as possible – this will form the basis for subsequent decisions relating to the significance and ongoing management of the object.

Once Part A has been completed , the Initial Documentation Form should be sent to the BAS Environment Office, whose responsibility it will be to complete the subsequent steps in Part 1 and to liaise, as appropriate, with one or more of the following:

- BAS Archives Service;
- United Kingdom Antarctic Heritage Trust;
- The equivalent for other national operators;
- Antarctic Treaty parties.

Further information regarding the object may be sought from the individual named on the Initial Documentation Form.

Part A - Please complete this form as fully as possible – each object / site requires a separate form, as appropriate.

	Section 1	
1.1	Item / site (brief description	2 dog genealogies on paper, framed and mounted on wall.
1.2	Date found	Assessed as part of the Rothera heritage review, Dec 2016, by Ieuan Hopkins, BAS Archives Manager.
1.3	Found by (name of person)	See above
1.4	Local event / ref. number (if multiple objects / sites are being recorded)	n/a
1.5	How was the object / site found?	n/a
	Section 2 - Location	
2.1	Where was the object / site found – GPS reference (if known)	Object is located at Rothera Station, Old Bransfield House, mounted on wall in corridor adjacent to the surgery, on the surgery wall.
2.2	Map	If possible, indicate position found on a map and attach to this form. n/a
2.3	Where was the object / site found – further details	Include: • A description of the location • Situation of the object / site (e.g. is the object windblown debris, has it been placed in position deliberately etc.) • Identification aids to help relocate the object/site No further information (see 2.1)
2.4	Is the object / site associated with others nearby? If so, provide brief details and include relevant event / ref. numbers for the respective Initial documentation forms.	Not associated with others nearby, but similar documents / records are held in the BAS Archives, Cambridge.
	Section 3 - Description	

<table>
<tr><td>3.1</td><td>Full description of object</td><td colspan="5">2 dog genealogies:

One large scale diagram in coloured ink on paper with title ‘British Antarctic Sledge Dogs’ and key, which includes symbols for:
• Mating
• Offspring
• Connects male to family of origin
• Separating generations
• Born at Halley Bay
• Born at base on Penninsula
• Parentage unknown
• Dog extraneous to BAS
• Transferred to Halley Bay
• Severe entropion
• Mild entropion
• Proven haemophilia
• Tendency to bleed – haemophilia not proven
Also:
• Greenland
• Labrador
• U Kingdom
• New Zealand
• Canada
• Argentine

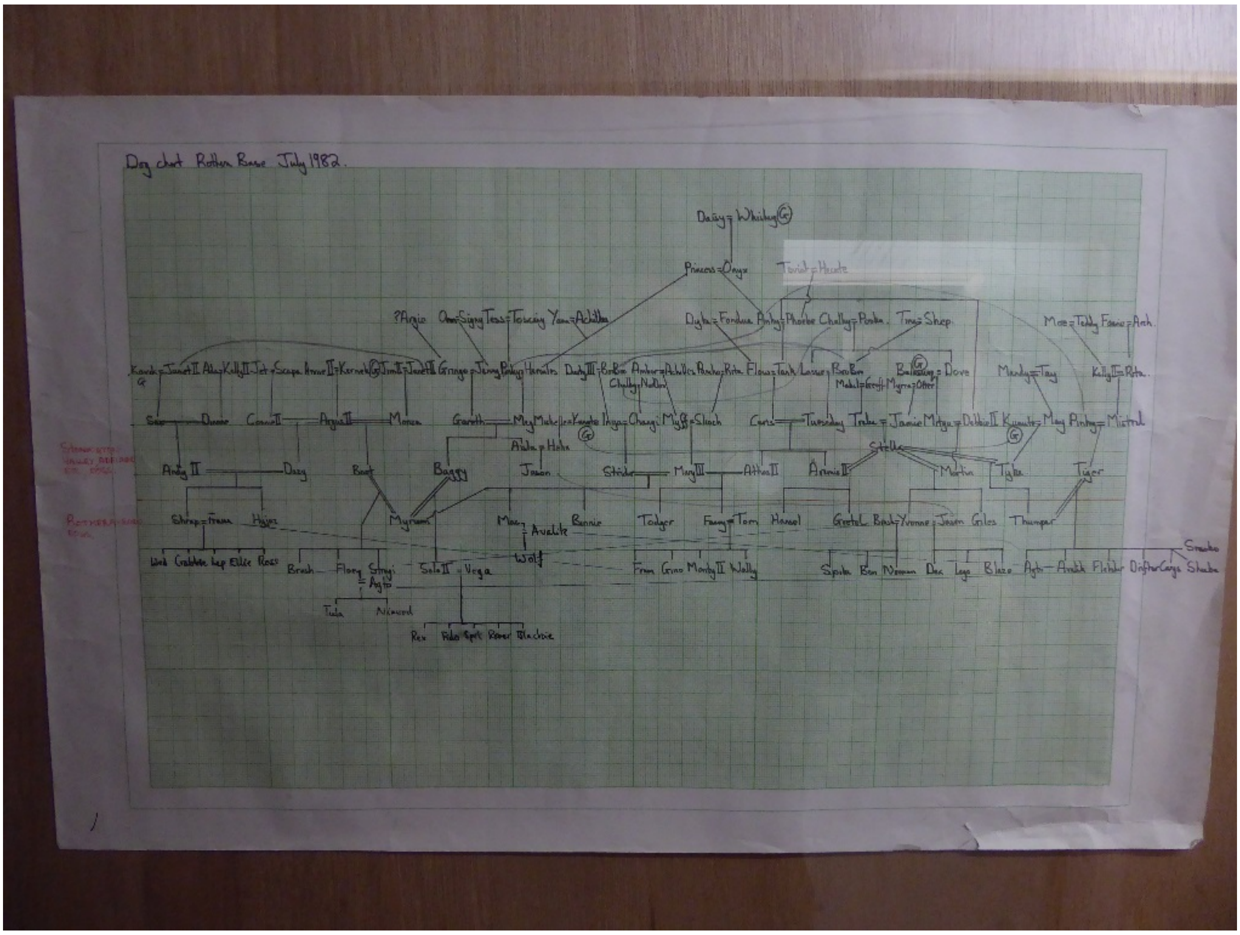
One smaller genealogy in ink on graph paper, with title ‘Dog Chart Rothera Base July 1982’.

Both are in a varnished wood frame, with Perspex glazing (the Perspex being in two sections). The whole is backed with wood (possibly a notice board) around which a frame has been constructed – it does not appear that the frame is attached to the back board but is sitting over it.</td></tr>
<tr><td>3.2</td><td>Size of the object / site (e.g. cm, m^2 as appropriate)</td><td colspan="5">305cm x 82cm x 2.5cm (extent of frame).
296cm 71cm (back board)
207cm x 72cm (large dog genealogy)
48cm x 30cm (small dog genealogy)</td></tr>
<tr><td>3.3</td><td>Age of the object / site (if known)</td><td colspan="5">Small genealogy is dated July 1982.
Larger genealogy is undated, although presumed of a similar date to AD7/R/8/1/1 held in the BAS Archives (see sec.5.1).</td></tr>
<tr><td>3.4</td><td>Origin</td><td colspan="5">Please indicate if the object / site appears to be of UK origin, or if other countries been involved in the creation / placement of the object.

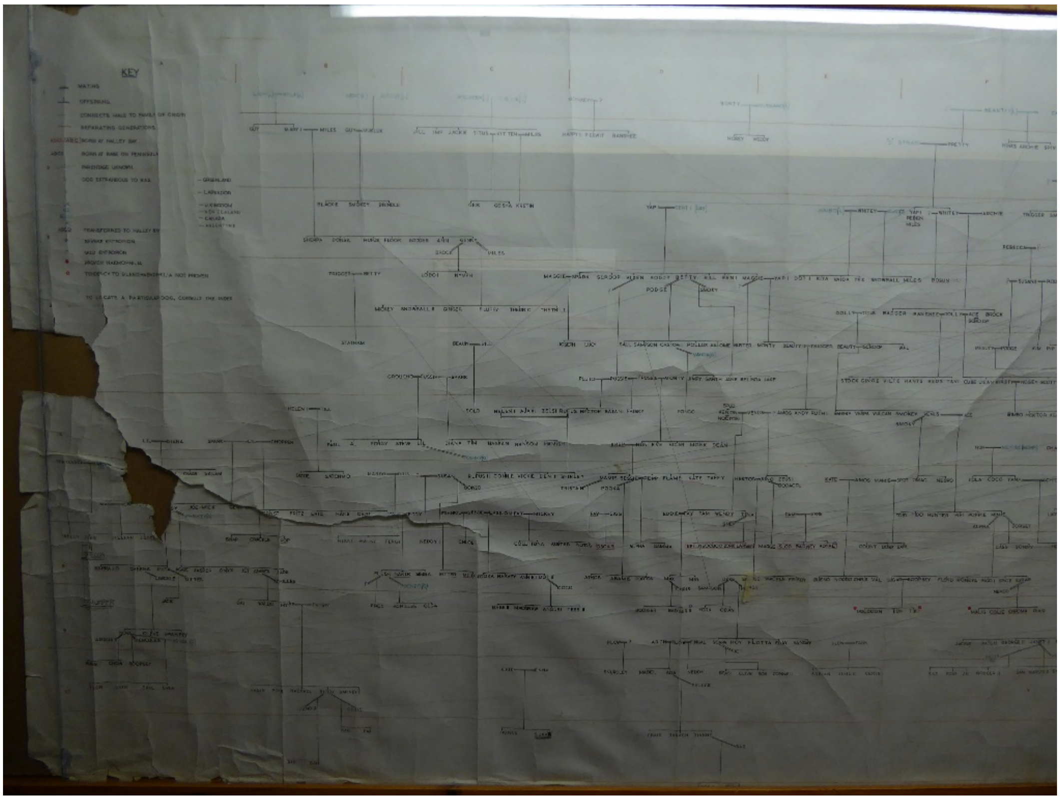
Assumed to have been made at Rothera, for use on station.</td></tr>
<tr><td></td><td colspan="6">Section 4 - Condition</td></tr>
<tr><td>4.1</td><td>Condition – select one of the following</td><td>As new</td><td>Some wear</td><td>Moderate deterioration</td><td>Significant deterioration</td><td>Extreme deterioration</td></tr>
<tr><td>4.2</td><td>Condition – further explanatory notes as appropriate</td><td colspan="5">For example:
• How much of the original object remains?
• Is the object intact?
• Does the object show alterations or repairs?</td></tr>
</table>

		- Is it suitable for continued use? **Small genealogy**: no fading of the text is apparent, but a small amount of creasing is present, as is a small tear. There is possibly blu-tack on the reverse. **Large genealogy**: Extensive tears on the left and right edges, extending inwards by c.50cm and 100cm respectively. There are also areas missing towards the edges of the paper, but these are not impinging on information. The whole is very creased. There is possible slight fading of the blue ink, but all other ink colours appear unfaded. **Frame:** in good condition
4.3	Are there any apparent threats to the integrity of the object / site	These could include: - Human or other animal activity, including uncontrolled visitation. - Environmental conditions / sustained exposure to the elements / potential extreme weather conditions. - Longer-term environmental change. Old Bransfield House is being demolished as part of the Rothera redevelopment. The object is therefore at risk of loss if its significance is not understood and it is not removed from its current location.
4.4	Does the object pose a risk to safety or the environment?	No
	Section 5 – Further Information	
5.1	Any other information	As appropriate, please record any other information about the object / site that you feel would be of use and which is not already covered. There is some crossover of information between the two genealogies, although the larger genealogy contains more information. There are several examples of dog genealogies already in BAS archives: **AD7/R/8/1/1:** 'British Antarctic Sledge Dogs' – genealogical chart compiled by Peter Marquis in 1988 using previous genealogical lines and dog records at Rothera. This was originally displayed at Rothera but was returned to the BAS archives in May 1996 as the lettering had begun to fade. It begins with the dogs brought to the Antarctic during Operation Tabarin and concludes with those which were either put down or transported to Canada in 1994. It covers only dogs from which the Rothera population originated, including those from Stonington Island and Adelaide stations. In addition to hard copy, it is available as digital files (.tif and .pdf). The large genealogical chart is very similar to this – the earliest and latest dogs listed are the same in both (although not every detail has been checked). It's possible that the example currently at Rothera replaced the version now in archives when it was removed. It's unclear if these two copies were produced at a

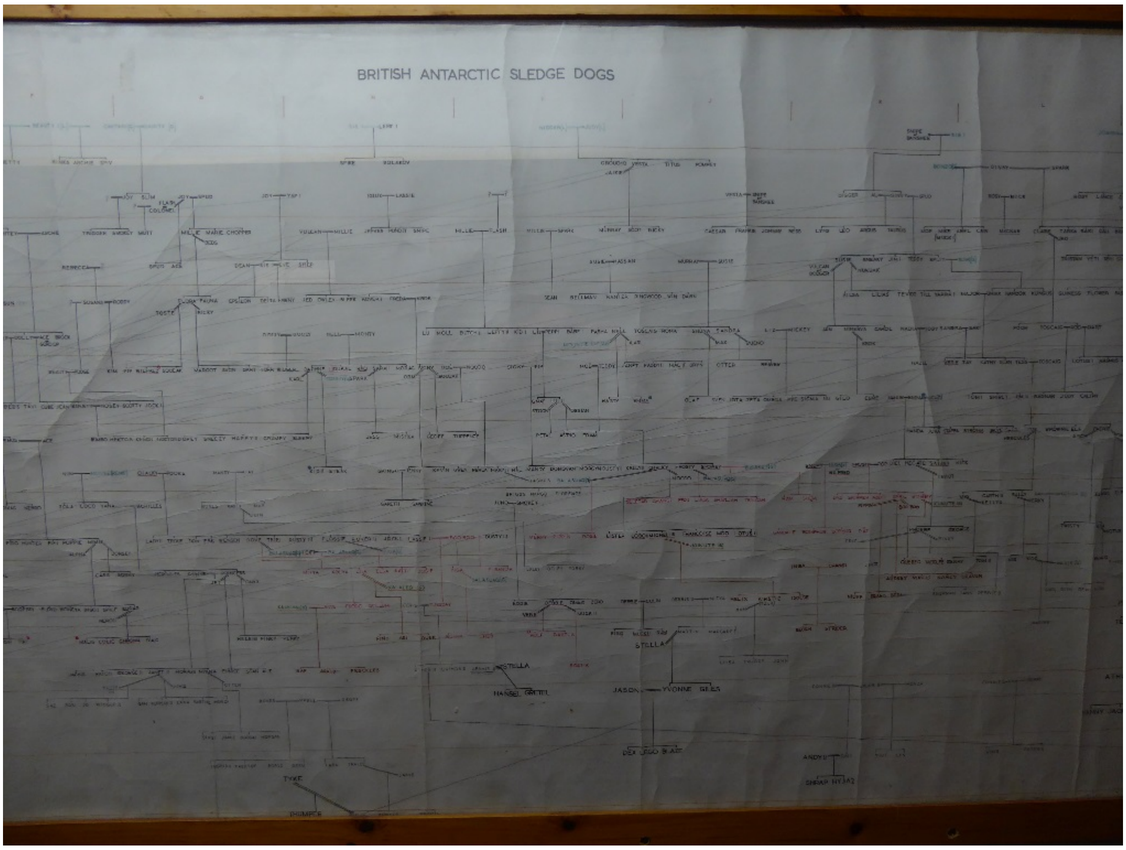
		similar time, or if the Rothera example pre-dates the archives example, and was used as a basis for it. **AD7/R/8/1/19-20**: ‘British Antarctic Survey dogs. Ancestry of Stonington dogs. Simplified’. Unknown compiler and date. **LS/BL14/Review**: ‘British Antarctic Sledge dog chart’, produced by Andrew Bellars c.1964-68. This appears to have been produced before the Rothera genealogy as the Rothera chart contains later dogs.
5.2	Images	Please attach images to this form. If possible include: • images in close-up taken from multiple angles • distance shots showing the objects/site in context • an indication of scale • an indication of the direction the photograph was taken i.e. looking North. Please label all images with the event / ref. number at the top of this form, and include the name of the photographer. **Note: High-res tiffs of all images are held in the BAS Archives, ref. 2017/1**



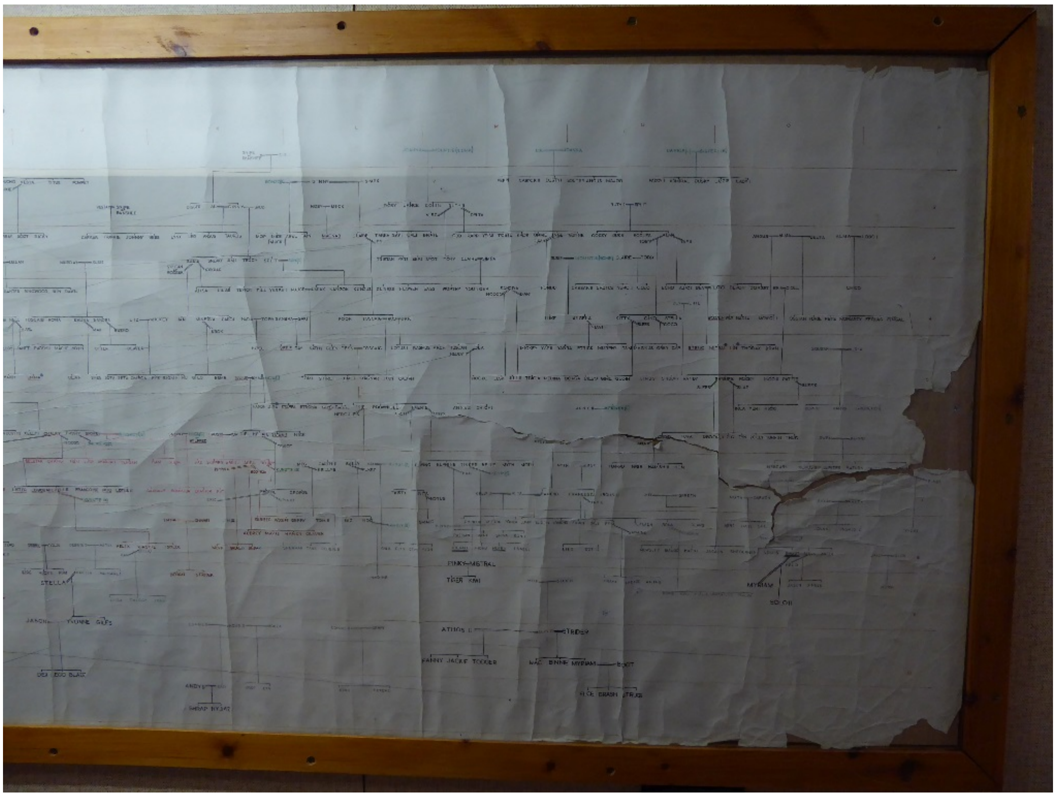
Small genealogy



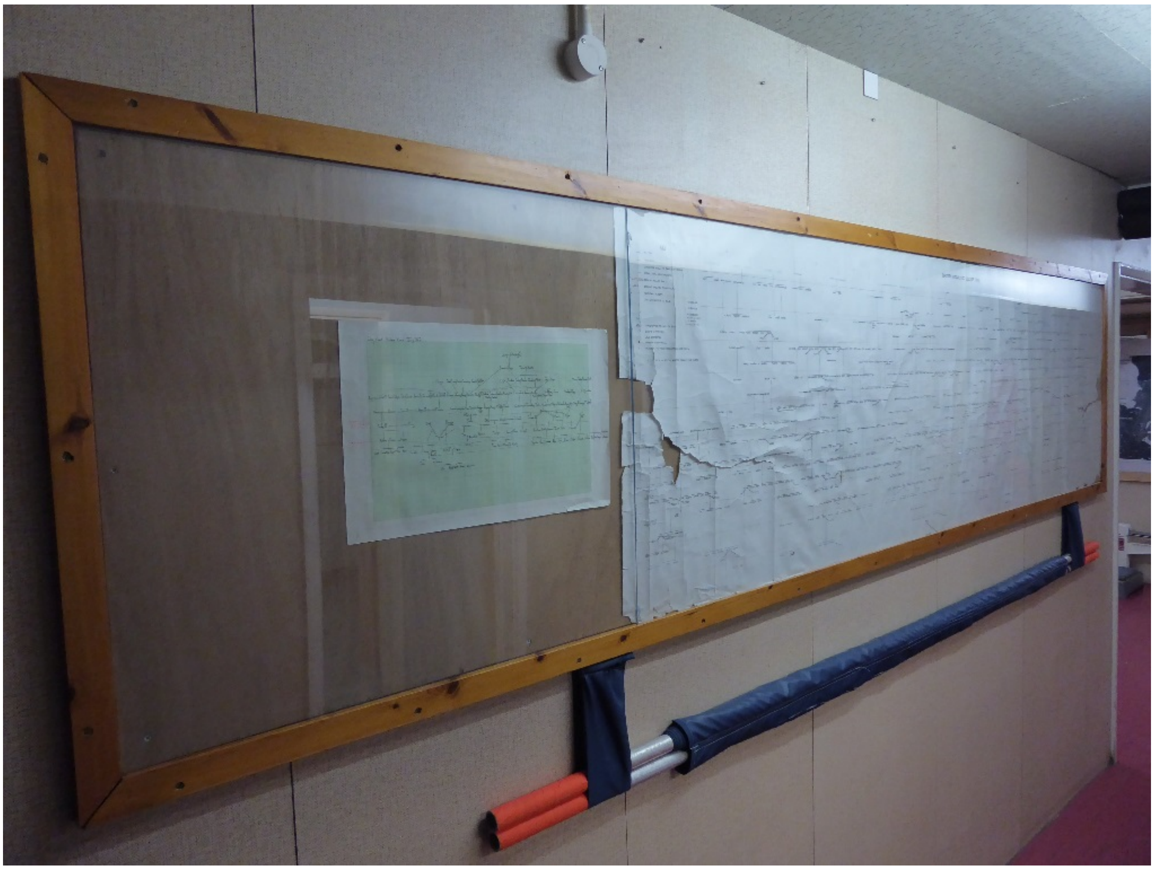
Large genealogy (left)



Large genealogy (middle)

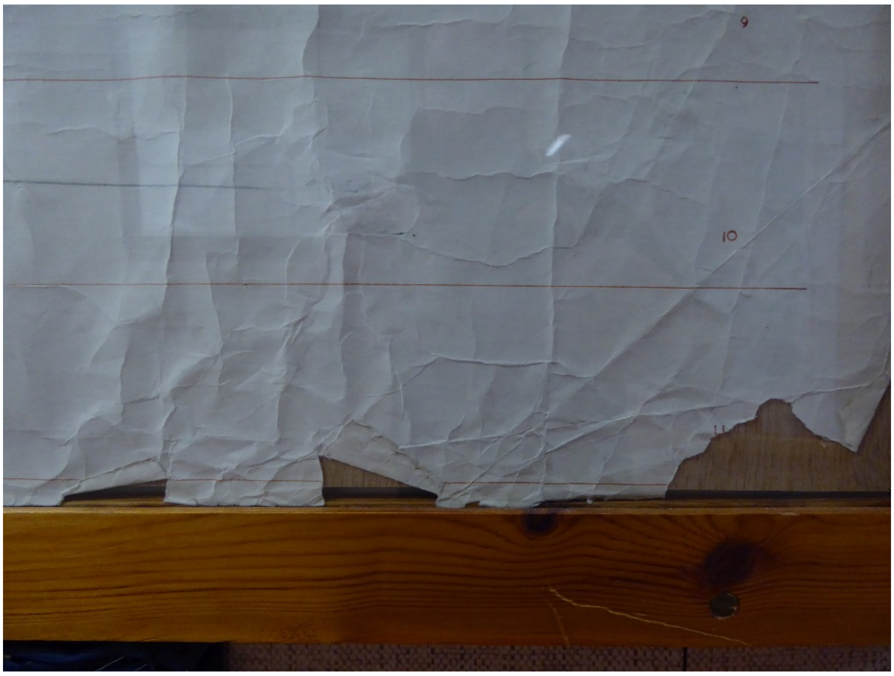


Large genealogy (right)

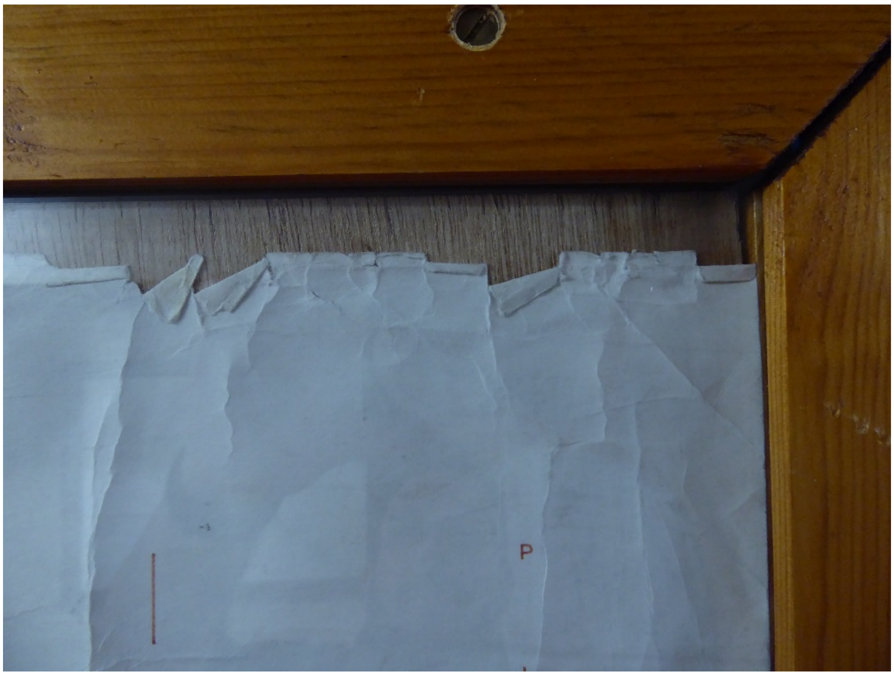


In situ

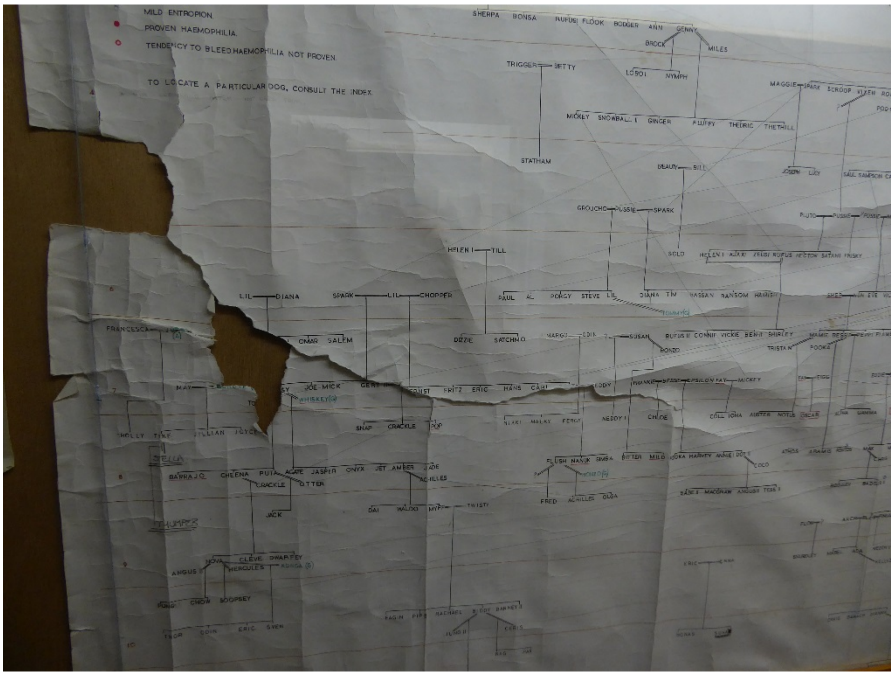
In Situ



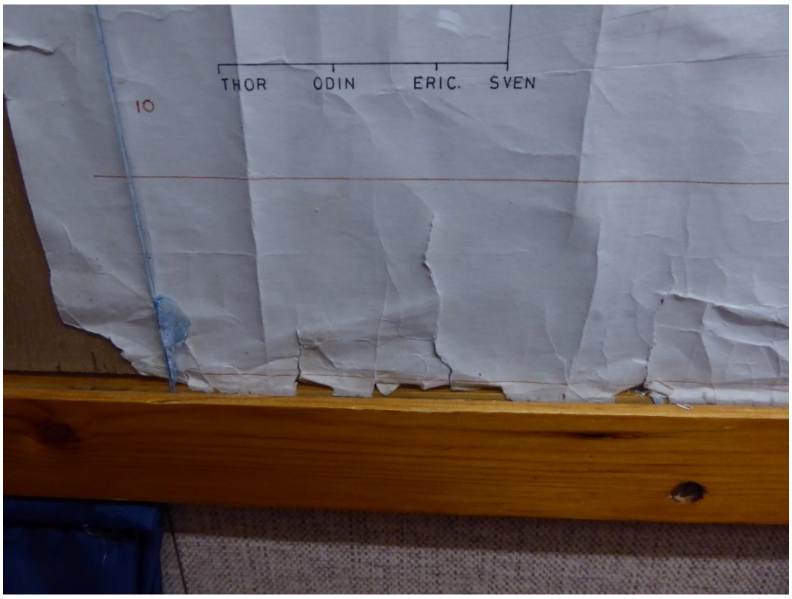
Large genealogy (damage- bottom detail)



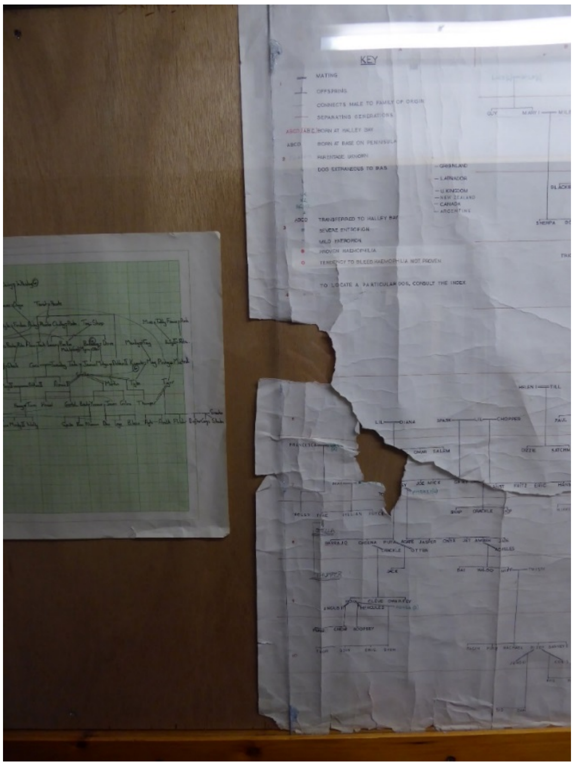
Large genealogy (damage- top detail)



Large genealogy (damage- left edge)



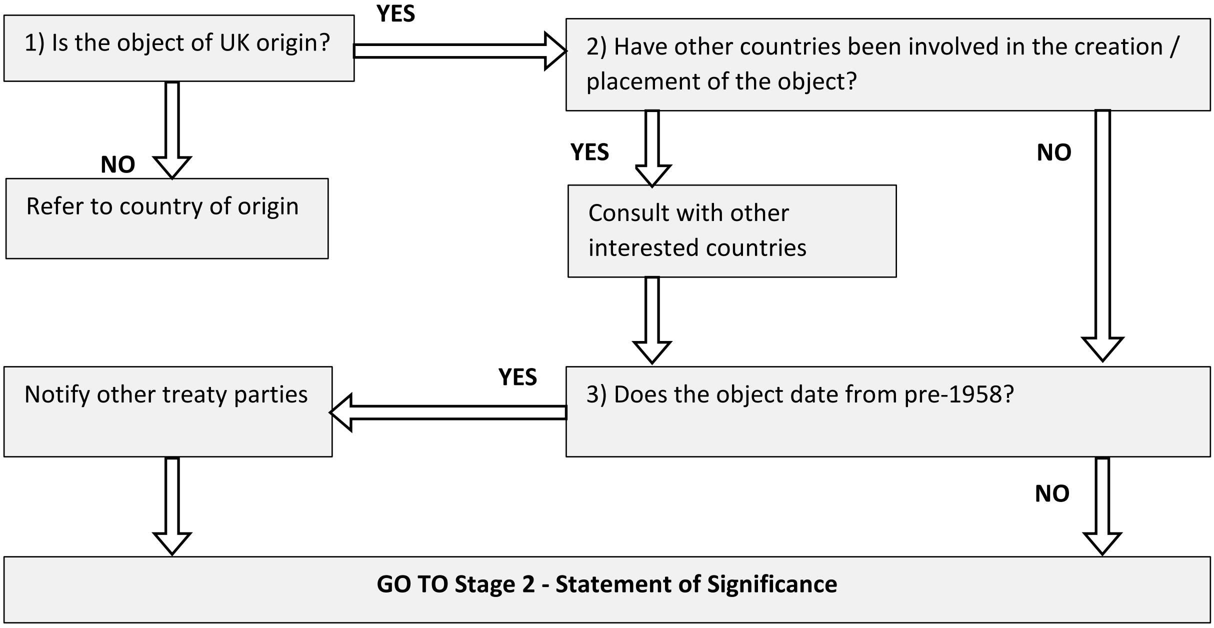
Large genealogy (damage- bottom left detail)



Large genealogy (damage- left detail)

Signed by:	Ieuan Hopkins (Archives Manager)	**Date:** Feb 2017

Part B - To be completed by BAS Environment Office



		Further details
1)	Is the object of UK Origin?: (Y/N) If No, please refer to the country of origin.	Yes – produced at Rothera
2)	Have other countries been involved in the creation / placement of the object?: (Y/N) If Yes, consult with other interested countries.	No
3)	Does the object date from pre-1958?: (Y/N) If yes, notify other Treaty Parties.	No

Signed by:	Ieuan Hopkins (on behalf of BAS EO)	**Date: 08/09/2017**

Stage 2: Statement of Significance

Name of Object: Rothera Dog Genealogies

Stage 2 should be undertaken by the BAS Archives Service / Environment Office / UKAHT, in liaison with other parties as appropriate.

The following questions relate to factors contributing to heritage value. Please provide comprehensive answers where relevant, as decisions in stage 3 of the methodology relating to the ongoing management of the objects draw directly from the information provided here.

Please note that the responses should be appropriate and proportionate to the site/object under consideration – a compass does not require the same level of response as an abandoned base.

2.1	**Context / History** *Describe the history of the object:* • *When was it first built / taken to the site?* • *What was its original purpose?* • *How has it been used since? Has its use changed over time?* See sec. 2.1 in Stage 1 for further information. Assumed that the large chart was produced at Rothera by a member of station personnel at or before 1988. The smaller genealogy was produced at Rothera in 1982. Both were produced as a means of capturing the genealogical information of the Rothera dogs. It is not clear if the information was used for management purposes, or the production of the chart was a winter activity, or to preserve what was considered important historical information. The chart, and a second version of the larger chart now in the BAS Archives, has been on display at Rothera for a number of years (the version in the archives was returned to Cambridge in 1996 when the lettering had started to fade). Since the removal of dogs in 1994, the charts have been used to commemorate an important aspect of the history of the station, and British Antarctic endeavour in general.
2.2	**Heritage Values**
2.2.1	**Historical Significance**
i.	*Is the object associated with important events or activities relating to exploration and discovery?* The objects contain information relating to the history of dogs in Antarctica, although this information is replicated in records in BAS Archives. The specific objects are not associated with important events or activities.
ii.	*Is the object associated with significant people?* No

iii.	*Does the object accurately and effectively invoke past conditions? Does it contribute to our understanding of a time, place or event? If so, how?* No – n/a
iv.	*Is the object evidence of the how, when, where or why of a significant past activity?* No
v.	*Does the object contribute to an understanding of the history of science, exploration or politics in Antarctica more broadly?* No – the objects add nothing to information already in BAS Archives.
2.2.3	**Scientific Significance**
i.	*Is the object associated with important events or activities relating to scientific research?* No
ii.	*Is the object of current scientific interest or value? Is it likely to be so in the future?* No
2.2.4	**Technological Significance**
i.	*Does the object have historical importance in terms of architectural or technological interest? Will this value increase in the future as similar objects disappear?* No
ii.	*Is the object of unique or unusual design?* ***OR*** *Is the object a particularly good example of a technology common to the Antarctic?* No
iii.	*Does the object have aesthetic value, either through conscious design or as the outcome of the way it has evolved and/or been used over time?* No
2.2.5	**Social / Cultural Significance**
i.	*Is the object of significance to a particular group of people?* ***Note:*** *Different stakeholder groups / communities may value the same object in different ways, and to different degrees. If these differences are present, it is important to indicate them here. Stakeholder groups to consider may include:* • *former FIDS/BAS staff;* • *current personnel (station- and/or Cambridge-based);* • *historians and other heritage professionals (e.g. UKAHT)* • *the general public* • *Government* **Current Station Personnel:**

	These specific objects were not flagged up as being of particular significance to current station personnel. However, their continued presence and use on station should be regarded as feeding into the importance of a sense of continuity and connection with the past, an aspect of heritage that was repeatedly voiced in discussions with staff at Rothera. As noted in the heritage documentation dealing with the dog pen doors, current station personnel seem to attach greater significance to those objects which relate to a shared experience of being South – the material relating to dogs is perhaps less significant, as there is no shared experience for the majority of staff on station. However, the fact that the charts have been on continuous display for a long period, and in conjunction with other associated dog material (a display of dog photos next to the genealogies, for example), and the fact that a version of the chart was previously sent to Archives, would indicate that some significance is accorded these.
2.2.6	**Comparative Significance**
i.	*Is the object well-documented in published and/or archival sources?* See sec. 2.1 in Stage 1 – multiple, similar objects are already held in BAS Archives.
ii.	*Is the object rare or unique? Is it likely to become more so?* See sec. 2.2.6i.
iii.	*Is the object a particularly good example of its type?* A similar object already exists
iv.	*Is the object typical of that used in the Antarctic, of which few examples remain?* *n/a*
	Has Heritage Value been Identified? (if Yes go to stage 3; if No add recommendation below) Yes
	RECOMMENDATION **N/A**

Signed by:	Ieuan Hopkins (Archives Manager)	**Date:** Sept. 2017

Stage 3 Heritage Management Flowchart Guidance Notes and Comments

Name of Object: Rothera Dog Genealogies

Stage 3 to be undertaken by the BAS Archives Service / Environment Office / UKAHT, in liaison with other parties as appropriate.

The following questions and guidance should be read in conjunction with the Heritage Management Flowchart, below. The comments provided will document the decisions made with regard ongoing heritage management.

3.1	*Authenticity relates to the 'truthfulness' or credibility of the item, in particular in relation to the heritage values stated in Stage 2.* **Please comment:** These items are authentic and accurate
3.2	**Please comment:** These objects pose no risk to the environment.
3.3	*Consider whether the heritage values reside solely in the object, or are dependent upon the object's location.* **Please comment, in relation to the heritage values stated in Stage 2:** The significance of these objects is related to their interest to station personnel, in that the objects provide a continuing connection with the past at Rothera. These specific objects, as duplicates (or near-duplicates) of items already held in BAS Archives, have little heritage significance off station - they do not further enhance understanding of the historical, technological or scientific activities in Antarctica beyond what is already available in the UK.
3.4a/b	*Consider the practicalities of the specific physical removal required to retain the heritage values stated in Stage 2.* **Please comment:** N/A – see 3.4c.
3.4c	*Consider (in relation to practicalities):* • *The current condition of the site / object;* • *Resource implications of preservation / conservation – is the resource and expertise available to prevent significant deterioration?* • *Resource implications of continuing maintenance / management, including the ongoing security and protection of the site/object and management of controlled visitation;* • *The impact of preservation work on wildlife.* *Specify the benefits of managing the object in situ.* **Please comment:** These objects are relatively small and easy to move / rehang. There should therefore be no issues with retaining them at Rothera.

Due to their low level of historical significance and near-duplication in objects already in BAS Archives, any specialist conservation work would be difficult to justify and unnecessary. Although the larger genealogy is torn in places, both are currently protected from further damage by their frame.

The benefits of managing in situ relate to their significance to current station personnel already noted.

3.5 *Consider:*

- *The accessibility of the site, in particular to those stakeholder groups identified in Stage 1 as valuing the heritage;*
- *The potential to increase accessibility in the future, to engage/educate new stakeholder groups.*
- *The aesthetic quality of the base and/or its setting in the landscape.*

Please comment: N/A (see 3.4c)

3.6 **Please comment:** N/A

Recommendations

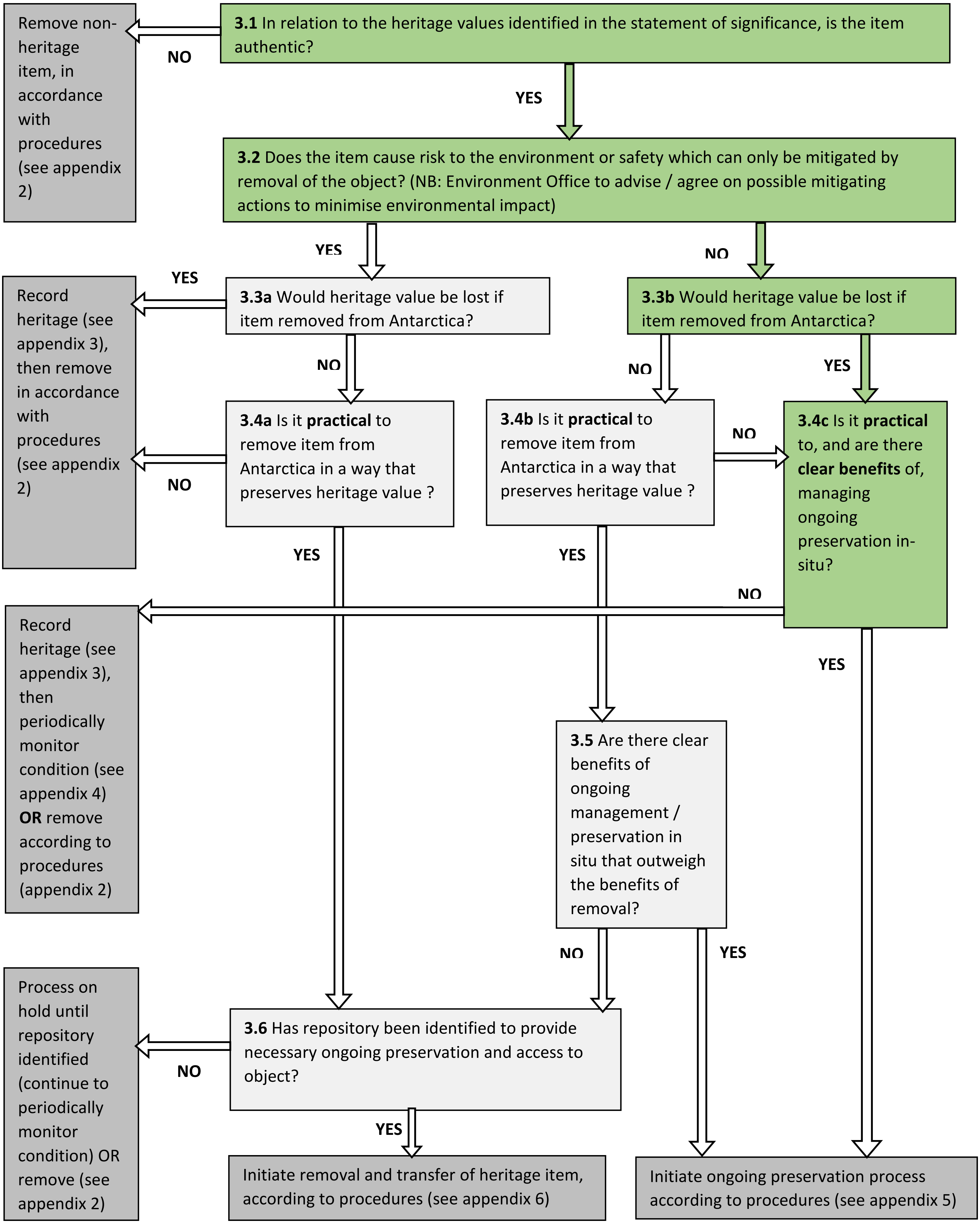
Station personnel to be consulted on the retention of these charts.

If thought desirable to retain at Rothera, the objects should be re-sited once redevelopment work is complete.

If the objects are not required at Rothera they should be returned to BAS Archives Service to check that all information contained within them has been captured. The objects themselves could then be disposed of.

Signed by:	Ieuan Hopkins (Archives Manager)	**Date:** Sept. 2017
Signed by:	Camilla Nichol Chief Executive, UK Antarctic Heritage Trust	**Date: 07/01/2019**
Signed by:	Rachel Clarke, Head of Environment Office	**Date: Jan 19 2019**

Stage 3: Heritage Management Flowchart



3.1 In relation to the heritage values identified in the statement of significance, is the item authentic?

Remove non-heritage item, in accordance with procedures (see appendix 2)

3.2 Does the item cause risk to the environment or safety which can only be mitigated by removal of the object? (NB: Environment Office to advise / agree on possible mitigating actions to minimise environmental impact)

3.3a Would heritage value be lost if item removed from Antarctica?

3.3b Would heritage value be lost if item removed from Antarctica?

Record heritage (see appendix 3), then remove in accordance with procedures (see appendix 2)

3.4a Is it **practical** to remove item from Antarctica in a way that preserves heritage value ?

3.4b Is it **practical** to remove item from Antarctica in a way that preserves heritage value ?

3.4c Is it **practical** to, and are there **clear benefits** of, managing ongoing preservation in-situ?

Record heritage (see appendix 3), then periodically monitor condition (see appendix 4) **OR** remove according to procedures (appendix 2)

3.5 Are there clear benefits of ongoing management / preservation in situ that outweigh the benefits of removal?

3.6 Has repository been identified to provide necessary ongoing preservation and access to object?

Process on hold until repository identified (continue to periodically monitor condition) OR remove (see appendix 2)

Initiate removal and transfer of heritage item, according to procedures (see appendix 6)

Initiate ongoing preservation process according to procedures (see appendix 5)

Heritage Selection Process Cover sheet

Name of Object: Rothera Dog Pen Doors

Overview

This process aims to provide a systematic and consistent methodology for the identification of those objects[1] with heritage value.

Heritage is here defined as all inherited resources which people value for reasons beyond mere utility.[2] This definition includes the widest range of physical 'things'. It also encompasses the range of emotional and intellectual values attached to them.

This methodology is scalable. It can be used to assess the heritage value of single, hand-held objects through to complete heritage sites and structures (a compass found on an abandoned base, through to the abandoned base itself and the area surrounding it).

Methodology

The methodology is in 3 stages:

Stage 1: The initial identification and recording of the object.
Stage 2: A statement of the significance of the object, arrived at by considering factors contributing to heritage value, the potential for different stakeholder groups to attach different heritage values to the same object, and the relationship of the object under consideration to comparable objects.
Stage 3: A series of pragmatic decisions, based upon the information in Stages 1 and 2.

There are 5 possible outcomes to this process:

- The object is designated as non-heritage and removed according to standard environmental procedures;
- The object is appropriately recorded as a heritage object prior to removal/destruction;
- The removal and transfer of the heritage object to an appropriate repository for ongoing management;
- The initiation of ongoing management in situ of the heritage object;
- The appropriate recording of the heritage object and initiation of periodic monitoring in situ pending the opportunity or decision to undertake one of the above.

Progress

	Completed by	Date completed
Stage 1	I Hopkins	Feb 2017
Stage 2	I Hopkins	Sept 2017
Stage 3	I Hopkins	Sept 2017

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[1] Within this document, 'object' is taken to mean either an artefact, building or site.
[2] 'Conservation Principles, Policy and Guidance'. Historic England, 2008

Stage 1 – Initial Identification Form

Name of Object: Rothera Dog Pen Doors

The Initial Documentation Form should be completed as fully as possible – this will form the basis for subsequent decisions relating to the significance and ongoing management of the object.

Once Part A has been completed , the Initial Documentation Form should be sent to the BAS Environment Office, whose responsibility it will be to complete the subsequent steps in Part 1 and to liaise, as appropriate, with one or more of the following:

- BAS Archives Service;
- United Kingdom Antarctic Heritage Trust;
- The equivalent for other national operators;
- Antarctic Treaty parties.

Further information regarding the object may be sought from the individual named on the Initial Documentation Form.

Part A - Please complete this form as fully as possible – each object / site requires a separate form, as appropriate.

	Section 1	
1.1	Item / site (brief description	Red stable-like door, heavily scratched by dogs, in Carpenter and Electrical workshop.
1.2	Date found	Assessed as part of the Rothera heritage review, Dec 2016, by Ieuan Hopkins, BAS Archives Manager.
1.3	Found by (name of person)	See above
1.4	Local event / ref. number (if multiple objects / sites are being recorded)	n/a
1.5	How was the object / site found?	n/a
	Section 2 - Location	
2.1	Where was the object / site found – GPS reference (if known)	Object is located at Rothera Station, at rear (S end) of Carpenter and Electrical workshop – still in use as a door between corridor and small store room.
2.2	Map	If possible, indicate position found on a map and attach to this form. n/a
2.3	Where was the object / site found – further details	Include: • A description of the location • Situation of the object / site (e.g. is the object windblown debris, has it been placed in position deliberately etc.) • Identification aids to help relocate the object/site No further information (see 2.1)
2.4	Is the object / site associated with others nearby? If so, provide brief details and include relevant event / ref. numbers for the respective Initial documentation forms.	No similar objects exist at Rothera – this was a door used to separate 'kennels' for bitches and pups from main hut, and was the only such area at Rothera. Other objects at Rothera relate to the previous use of dogs on station (for example, harness and trace hooks), although none have the direct physical link with the dogs themselves. Other dog pens still exist on the Antarctic Peninsula (e.g. at Stonington).
	Section 3 - Description	

<table>
<tr><td>3.1</td><td>Full description of object</td><td colspan="5">One door, painted red and cut in two to form a ‘stable door’ arrangement (although now re-joined using small wood panel and screws on reverse of door), with a window of reinforced glass.

The reverse of the door is heavily marked and gouged, particularly on the lower portion and in the centre of the door under the window. These marks have been made by dogs scratching at the wood. The marks in the centre of the door are linear, and clearly made by dogs on their hind legs scratching downwards against the door with their front paws.

The front of the door (facing into the workshop) also has linear scratches, caused in the same way, in the centre of the door just below the glass panel, although not to the same extent as the reverse.

The surrounding wooden door posts are also heavily scratched.</td></tr>
<tr><td>3.2</td><td>Size of the object / site (e.g. cm, m^2 as appropriate)</td><td colspan="5">Approx. 200 x 80 cm in total.

Cut in two approx. 70cm from base.</td></tr>
<tr><td>3.3</td><td>Age of the object / site (if known)</td><td colspan="5">Although nothing specific regarding the door is included in the Rothera building reports until 1986 (see AD6/2R/1986/C1), the door is in Phase 1, built in 1976, and appears to have been the door into the pup pens or dog surgery. The door would have been put in place either at the time of the original building, or soon after – it was cut in two to form stable doors in 1986, and had been in use for some time before then.</td></tr>
<tr><td>3.4</td><td>Origin</td><td colspan="5">Please indicate if the object / site appears to be of UK origin, or if other countries been involved in the creation / placement of the object.

These were installed at Rothera as part of the station construction.</td></tr>
<tr><td></td><td colspan="6">Section 4 - Condition</td></tr>
<tr><td>4.1</td><td>Condition – select one of the following</td><td>As new</td><td>Some wear</td><td>Moderate deterioration</td><td>Significant deterioration</td><td>Extreme deterioration</td></tr>
<tr><td>4.2</td><td>Condition – further explanatory notes as appropriate</td><td colspan="5">For example:
• How much of the original object remains?
• Is the object intact?
• Does the object show alterations or repairs?
• Is it suitable for continued use?

The original door is solid, but heavily marked. The deterioration through scratching is what gives this door potential heritage value. The scratches themselves are well-defined and highly visible – there has been no attempt to paint over them or repair them in any other way, other than the wooden panel screwed into to door to hold the two halves together.</td></tr>
<tr><td>4.3</td><td>Are there any apparent threats to the integrity of the object / site</td><td colspan="5">These could include:
• Human or other animal activity, including uncontrolled visitation.
• Environmental conditions / sustained exposure to the elements / potential extreme weather conditions.
• Longer-term environmental change.</td></tr>
</table>

		The Carpenter and Electrical Workshop will be demolished as part of the Rothera redevelopment. The object is therefore at risk of if its significance is not understood and it is not removed from its current location.
4.4	Does the object pose a risk to safety or the environment?	No
	Section 5 – Further Information	
5.1	Any other information	As appropriate, please record any other information about the object / site that you feel would be of use and which is not already covered. These doors originally connected the S end of the Carpenter and Electrical Workshop (Phase 1) to pup pens or 'dog surgery' constructed on the end of the building. The configuration of this part of the building has been modified over time (see Rothera Building reports – AD6/2R/-/C), and it is therefore unclear if the current door is in its original position. It is know that the doors to the pup pens were cut into stable doors in the 1986/87season (see AD6/2R/1986/C1). This object is part of the set of objects currently at Rothera that relate to the previous use of dogs by BAS (e.g. dog harness and trace hooks, dog genealogies and photographs displayed on base, wooden 'vet' box etc.). However, it is the only one of these objects to include the physical marks of the dogs.
5.2	Images	Please attach images to this form. If possible include: • images in close-up taken from multiple angles • distance shots showing the objects/site in context • an indication of scale • an indication of the direction the photograph was taken i.e. looking North. Please label all images with the event / ref. number at the top of this form, and include the name of the photographer. **Note: High-res tiffs of all images are held in the BAS Archives, ref. 2017/1**

Reverse

Reverse (detail)

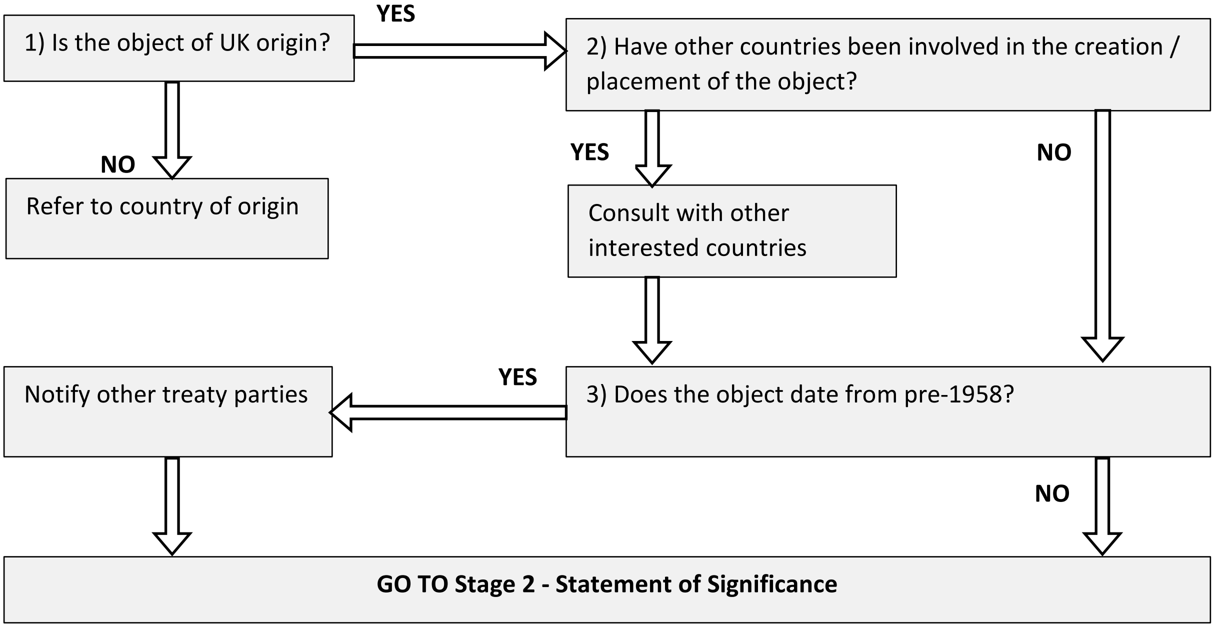
Reverse (detail)

Reverse (detail)

Front (detail)

Signed by:	Ieuan Hopkins (Archives Manager)	**Date:** Feb 2017

Part B - To be completed by BAS Environment Office



		Further details
1)	Is the object of UK Origin?: (Y/N) If No, please refer to the country of origin.	Yes – produced at Rothera
2)	Have other countries been involved in the creation / placement of the object?: (Y/N) If Yes, consult with other interested countries.	No
3)	Does the object date from pre-1958?: (Y/N) If yes, notify other Treaty Parties.	No

Signed by:	Ieuan Hopkins (on behalf of BAS EO)	**Date: Feb 2017**

Stage 2: Statement of Significance

Name of Object: Rothera Dog Pen Doors

Stage 2 should be undertaken by the BAS Archives Service / Environment Office / UKAHT, in liaison with other parties as appropriate.

The following questions relate to factors contributing to heritage value. Please provide comprehensive answers where relevant, as decisions in stage 3 of the methodology relating to the ongoing management of the objects draw directly from the information provided here.

Please note that the responses should be appropriate and proportionate to the site/object under consideration – a compass does not require the same level of response as an abandoned base.

2.1	**Context / History** *Describe the history of the object:* • *When was it first built / taken to the site?* • *What was its original purpose?* • *How has it been used since? Has its use changed over time?* The door is located at the S end of the building housing the Carpenter and Electrical Workshop, originally Phase I, the first building at Rothera, constructed in 1976. It is assumed that this door was installed soon after this, but the exact date is not known. Two doors originally connected the S end of the building to pup pens or a 'dog surgery', both of which were at the S. end of the building. These pens were used to house the mothers and their pups after giving birth, providing a more sheltered environment. The configuration of this part of the building has been modified over time (see Rothera Building reports – AD6/2R/-/C), and it is therefore unclear if the door is in its original position. It is know that the doors to the pup pens were cut into stable doors in the 1986/87season (see AD6/2R/1986/C1) – this is therefore one of those doors. It is now the door into a small storage space, and its two halves have been re-joined using small wood panel and screws on reverse of door.
2.2	**Heritage Values**
2.2.1	**Historical Significance**
i.	*Is the object associated with important events or activities relating to exploration and discovery?* This door is a tangible connection to the last UK-operated population of dogs in Antarctica, and is therefore more broadly connected to the use of dogs throughout BAS' history. Dogs were used throughout BAS' history, first arriving in the Antarctic in 1944. In 1991 the Environmental Protocol to the Antarctic Treaty legislated against the introduction of non-indigenous species to Antarctica. Under this Protocol working dogs, including those bred on the continent, had to be removed by 1 April 1994.

	By this date British Antarctic Survey (BAS) was maintaining only a small husky population at Rothera Research Station, used for recreational sledge journeys. The phasing-out of dogs began in the 1970s. The closure of Base E, Stonington Island, at the end of the 1974/75 season, was part of a planned switch to summer season field work from 1975/76 and a phasing out dogs in favour of mechanised transport. A major cull (of about 100 dogs) was undertaken at the end of the field season (Feb 1975) as teams returned to Stonington. A few teams were transferred to Base T, Adelaide Island, where dogs worked until the end of the 1976/77 season when the base closed. After that the teams were transferred to Rothera but after 1978 the number of dogs was reduced from 42 to 24. On 22 February 1994, the last fourteen dogs in Antarctica (other National Operators had removed their dogs prior to this date) were relocated to Canada. In the months before, to mark the end of almost 50 years of husky use by BAS, a final, commemorative dog sledge journey was organised. This was an ice coring and GPS traverse of Alexander Island from 25 Dec 1993 – 9 Feb 1994 and used 14 dogs in two teams - the 'Huns' and 'Admirals'. Although other objects connected to the digs are still at Rothera, this is the only object on station that bears the tangible connection with the dogs, in the form of the scratch marks they have left on it.
ii.	*Is the object associated with significant people?* No
iii.	*Does the object accurately and effectively invoke past conditions? Does it contribute to our understanding of a time, place or event? If so, how?* No – although it could be argued that the tangible nature of the connection with the dogs effectively invokes their past presence.
iv.	*Is the object evidence of the how, when, where or why of a significant past activity?* No
v.	*Does the object contribute to an understanding of the history of science, exploration or politics in Antarctica more broadly?* No
2.2.3	**Scientific Significance**
i.	*Is the object associated with important events or activities relating to scientific research?* No
ii.	*Is the object of current scientific interest or value? Is it likely to be so in the future?* No
2.2.4	**Technological Significance**
i.	*Does the object have historical importance in terms of architectural or technological interest? Will this value increase in the future as similar objects disappear?*

	No
ii.	*Is the object of unique or unusual design?* ***OR*** *Is the object a particularly good example of a technology common to the Antarctic?* No
iii.	*Does the object have aesthetic value, either through conscious design or as the outcome of the way it has evolved and/or been used over time?* No
2.2.5	**Social / Cultural Significance**
i.	*Is the object of significance to a particular group of people?* ***Note:*** *Different stakeholder groups / communities may value the same object in different ways, and to different degrees. If these differences are present, it is important to indicate them here. Stakeholder groups to consider may include:* • *former FIDS/BAS staff;* • *current personnel (station- and/or Cambridge-based);* • *historians and other heritage professionals (e.g. UKAHT)* • *the general public* • *Government* This object will be valued by the following stakeholders due to its connection with the last dog population in Antarctica, in particular its highly tangible nature in the form of physical marks and traces of dogs. **Former FIDS/BAS Staff**, who place great value on the role of dogs in Antarctic exploration and scientific endeavour. It would be particularly significant to those who worked with the dogs at Rothera. **Current station personnel**. No strong opinion as to the heritage value of the door came out of the staff discussion on heritage undertaken in Dec. 2016. However, its continued presence on station (e.g. if incorporated in some way into the redevelopment design for the new buildings) might feed into the importance of a sense of continuity and connection with the past, an aspect of heritage that was repeatedly voiced in discussions with staff at Rothera. **General public.** That this object bears the physical marks of dogs from the last population on Antarctica make it highly significant to a general audience. The immediacy of the connection with the dogs, in addition to the fact that this object is robust and fairly portable, marks it as a good object for engagement and display, to demonstrate the history and contribution of dogs to BAS and the UK's scientific endeavour in the Antarctic.
2.2.6	**Comparative Significance**
i.	*Is the object well-documented in published and/or archival sources?* No
ii.	*Is the object rare or unique? Is it likely to become more so?*

	Several artefacts are held in the BAS Archives which are physically connected with dogs i.e. dog sledging equipment (2005/19, 2005/78) – harnesses, collars, muzzle, leads, comb etc.; SPRI hold similar items in their collection, although these relate to the more general use of dogs in Antarctica, not FIDS/BAS. Other objects (for example the pup pens at Stonington) are managed by the UK Antarctic Heritage Trust. This door is therefore amongst a very small group of objects that bear the marks of the BAS dogs.
iii.	*Is the object a particularly good example of its type?* N/A
iv.	*Is the object typical of that used in the Antarctic, of which few examples remain?* *N/A*
	Has Heritage Value been Identified? (if Yes go to stage 3; if No add recommendation below) Yes
	RECOMMENDATION
	N/A

Signed by:	Ieuan Hopkins (Archives Manager)	**Date:** Sept. 2017

Stage 3 Heritage Management Flowchart Guidance Notes and Comments

Name of Object: Rothera Dog Pen Doors

Stage 3 to be undertaken by the BAS Archives Service / Environment Office / UKAHT, in liaison with other parties as appropriate.

The following questions and guidance should be read in conjunction with the Heritage Management Flowchart, below. The comments provided will document the decisions made with regard ongoing heritage management.

3.1	*Authenticity relates to the 'truthfulness' or credibility of the item, in particular in relation to the heritage values stated in Stage 2.* **Please comment:** Yes
3.2	**Please comment:** Given the age of the paintwork, the paint may contain lead. This item therefore potentially poses a low risk to the environment.
3.3	*Consider whether the heritage values reside solely in the object, or are dependent upon the object's location.* **Please comment, in relation to the heritage values stated in Stage 2:** The heritage value of this object resides in the presence of scratches from the last dog population in Antarctica – i.e. a physical link to the presence of dogs in Antarctica in general, and Rothera in particular. The heritage value is therefore largely independent of the object's location, and would not be lost if removed from Rothera.
3.4a/b	*Consider the practicalities of the specific physical removal required to retain the heritage values stated in Stage 2.* **Please comment:** Yes - this object is relatively straightforward to remove from its current location and transfer from the Antarctic. It is also robust, meaning that the heritage value would be preserved.
3.4c	*Consider (in relation to practicalities):* • *The current condition of the site / object;* • *Resource implications of preservation / conservation – is the resource and expertise available to prevent significant deterioration?* • *Resource implications of continuing maintenance / management, including the ongoing security and protection of the site/object and management of controlled visitation;* • *The impact of preservation work on wildlife.*

Specify the benefits of managing the object in situ.

Please comment: N/A – see 3.4 a/b.

3.5 *Consider:*

- *The accessibility of the site, in particular to those stakeholder groups identified in Stage 1 as valuing the heritage;*
- *The potential to increase accessibility in the future, to engage/educate new stakeholder groups.*
- *The aesthetic quality of the base and/or its setting in the landscape.*

Please comment:

If retained at Rothera, incorporated into the new building, the door would potentially feed into the sense of continuity with the past, expressed as important by the current staff.

At the time of the initial heritage assessment staff at Rothera did not express a strong opinion regarding this object, and the doors appeared to be less significant to current staff than, for example, the winterers' photographs and the continuing use of objects and equipment with a long history – the use of primus stoves, tents, sledges etc. It is possible that, unlike other experiences and activities experienced on station, the use of dogs is not something current staff share with previous personnel. However, the fact that other dog-related heritage material is displayed in a prominent position on station, and is obviously valued by staff, indicates that the lack of strong feeling might be due to the current, relatively inaccessible position of the doors i.e. a lack of awareness of them.

The doors will also be of significance to those who worked with the dogs at Rothera, and also has a broader significance as a physical link to the last working dogs in Antarctica – i.e. a significance to the general public in its connection to the history and contribution of dogs to BAS and the UK's scientific endeavour in the Antarctic. As such, the heritage value could be communicated to a broad group of interested stakeholders if removed from Rothera and returned to the UK.

The benefits of in-situ management versus removal and return to the UK are finely balanced. Following further discussion with Dave Wattam, in which a better understanding of the significance of the doors to those on station was reached, it was decided that the doors should remain at Rothera, to be placed on display in the new building.

3.6 **Please comment:**

N/A

Recommendations

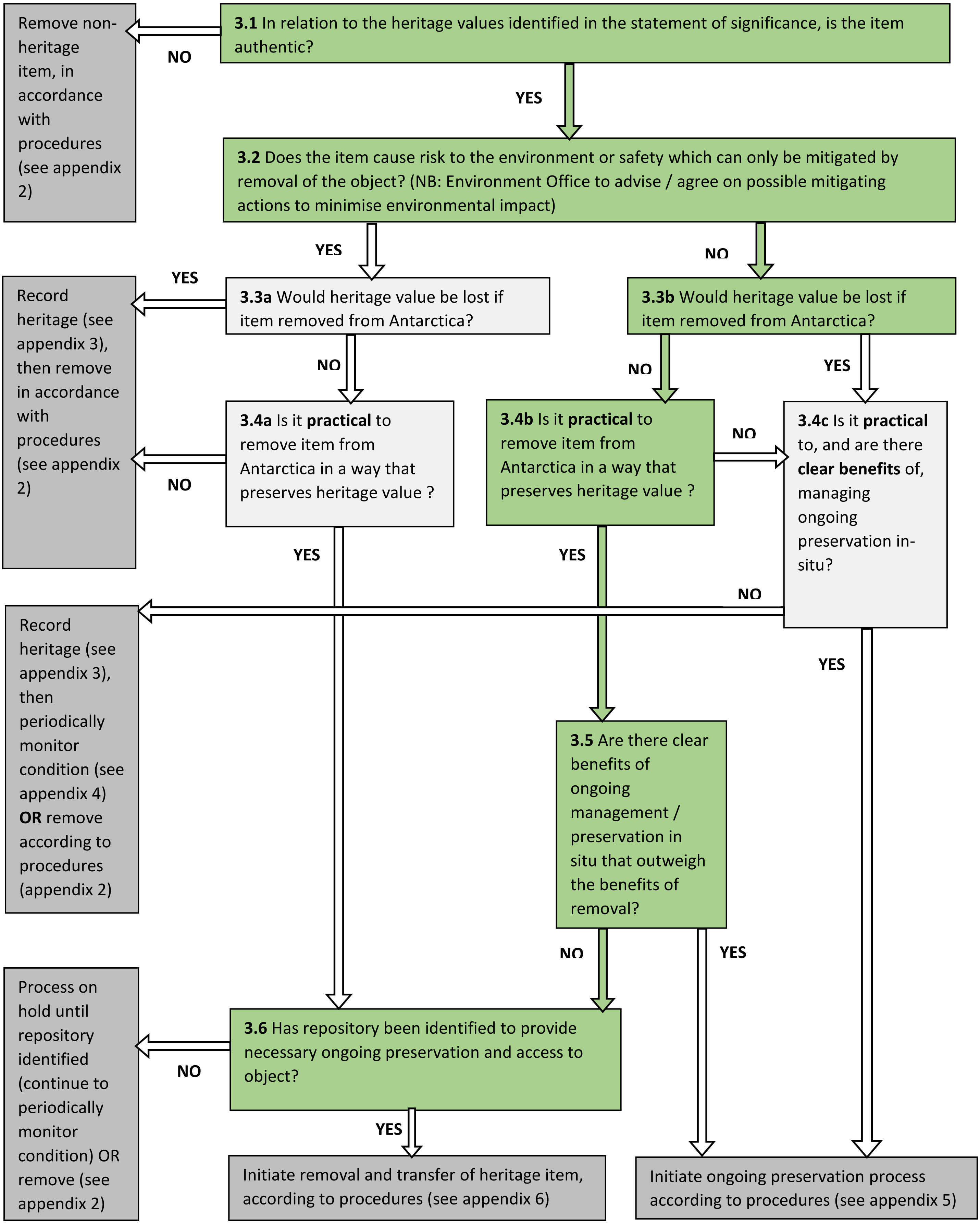
This object to be retained at Rothera, to be placed on display in the new building.
This will require:

- A specific management plan (to be produced in conjunction with a conservator) for its ongoing preservation;
- Responsibility for its continued management in accordance with the plan to be given to a specific post at Rothera.

In the future, if this object is no longer required at Rothera, it is to be returned safely to the UK where an appropriate repository (which may or may not be BAS) will be found for its long-term management and use as engagement.

Signed by:	Ieuan Hopkins (Archives Manager)	**Date:** Sept. 2017
Signed by:	Camilla Nichol Chief Executive, UK Antarctic Heritage Trust	**Date: 07/01/2019**
Signed by:	Rachel Clarke, Head of Environment Office	**Date: Jan 19**

Stage 3: Heritage Management Flowchart



Heritage Selection Process Cover sheet

Name of Object: Rothera Dog Span Diagram

Overview

This process aims to provide a systematic and consistent methodology for the identification of those objects[1] with heritage value.

Heritage is here defined as all inherited resources which people value for reasons beyond mere utility.[2] This definition includes the widest range of physical 'things'. It also encompasses the range of emotional and intellectual values attached to them.

This methodology is scalable. It can be used to assess the heritage value of single, hand-held objects through to complete heritage sites and structures (a compass found on an abandoned base, through to the abandoned base itself and the area surrounding it).

Methodology

The methodology is in 3 stages:

Stage 1: The initial identification and recording of the object.
Stage 2: A statement of the significance of the object, arrived at by considering factors contributing to heritage value, the potential for different stakeholder groups to attach different heritage values to the same object, and the relationship of the object under consideration to comparable objects.
Stage 3: A series of pragmatic decisions, based upon the information in Stages 1 and 2.

There are 5 possible outcomes to this process:

- The object is designated as non-heritage and removed according to standard environmental procedures;
- The object is appropriately recorded as a heritage object prior to removal/destruction;
- The removal and transfer of the heritage object to an appropriate repository for ongoing management;
- The initiation of ongoing management in situ of the heritage object;
- The appropriate recording of the heritage object and initiation of periodic monitoring in situ pending the opportunity or decision to undertake one of the above.

Progress

	Completed by	Date completed
Stage 1	I Hopkins	Feb 2017
Stage 2	I Hopkins	Sept 2017
Stage 3	I Hopkins	Sept 2017

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[1] Within this document, 'object' is taken to mean either an artefact, building or site.
[2] 'Conservation Principles, Policy and Guidance'. Historic England, 2008

Stage 1 – Initial Identification Form

Name of Object: Rothera Dog Span diagram

The Initial Documentation Form should be completed as fully as possible – this will form the basis for subsequent decisions relating to the significance and ongoing management of the object.

Once Part A has been completed , the Initial Documentation Form should be sent to the BAS Environment Office, whose responsibility it will be to complete the subsequent steps in Part 1 and to liaise, as appropriate, with one or more of the following:

- BAS Archives Service;
- United Kingdom Antarctic Heritage Trust;
- The equivalent for other national operators;
- Antarctic Treaty parties.

Further information regarding the object may be sought from the individual named on the Initial Documentation Form.

Part A - Please complete this form as fully as possible – each object / site requires a separate form, as appropriate.

	Section 1	
1.1	Item / site (brief description	Rothera dog span diagram, showing dog's position on span, dates of the last seal killed, dates when last in heat and bitch pen occupants.
1.2	Date found	Assessed as part of the Rothera heritage review, Dec 2016, by Ieuan Hopkins, BAS Archives Manager.
1.3	Found by (name of person)	See above
1.4	Local event / ref. number (if multiple objects / sites are being recorded)	n/a
1.5	How was the object / site found?	n/a
	Section 2 - Location	
2.1	Where was the object / site found – GPS reference (if known)	Object is located at Rothera Station, Old Bransfield House, mounted on wall in corridor adjacent to the surgery.
2.2	Map	If possible, indicate position found on a map and attach to this form. n/a
2.3	Where was the object / site found – further details	Include: • A description of the location • Situation of the object / site (e.g. is the object windblown debris, has it been placed in position deliberately etc.) • Identification aids to help relocate the object/site No further information (see 2.1)
2.4	Is the object / site associated with others nearby? If so, provide brief details and include relevant event / ref. numbers for the respective Initial documentation forms.	n/a
	Section 3 - Description	

<table>
<tr><td>3.1</td><td>Full description of object</td><td colspan="5">Paper, with diagram in pen and coloured wash, showing the position of the dog span. Minimal topographic features and direction are shown. In the top right corner three spaces have been marked to show the occupants of the three bitch pens. A table, ink on paper stuck to the base paper, is in the bottom left corner, with spaces to record details about the seals shot and fed to the dogs, and details about bitches on heat. At top middle in ‘Rothera Dogs’.

Placed over the paper is a perspex sheet on which chinagraph(?) pencil has been used to provide a semi-permanent surface on which to record the names of the dogs on the span and other details – when in use these details would have been rubbed off and updated as necessary.

The names of dogs, written in chinagraph (?) are still visible on the Perspex showing their positions on the span. The names still visible are (from l to r): Max, Morgan, Urza, Pujok, Pris, Roy, Elwood, Jake, Rachel(?) and Rex(?) - the last two are barely visible. Some details in both the ‘seal’ and ‘heat’ are also present, although badly blurred.

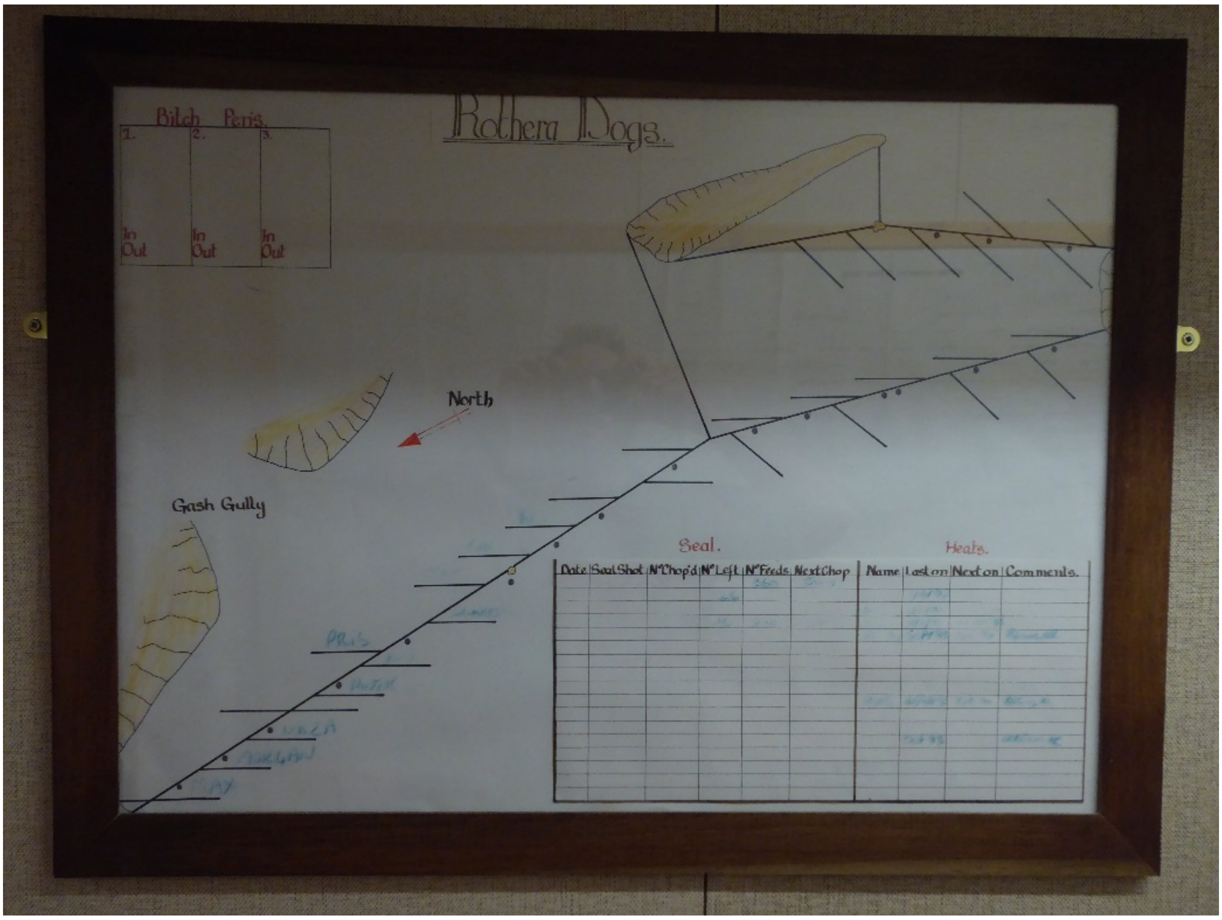
The whole is surrounded by a wooden frame, and is screwed to the wall using brass mirror plates.</td></tr>
<tr><td>3.2</td><td>Size of the object / site (e.g. cm, m^2 as appropriate)</td><td colspan="5">82cm x 62.3cm x 0.8cm (max dimensions including frame).</td></tr>
<tr><td>3.3</td><td>Age of the object / site (if known)</td><td colspan="5">The names of dogs written in chinagraph(?) markings are those of the last dogs at Rothera (see sec.5.1). It is assumed that the names were therefore written in early 1994, just prior to their departure.

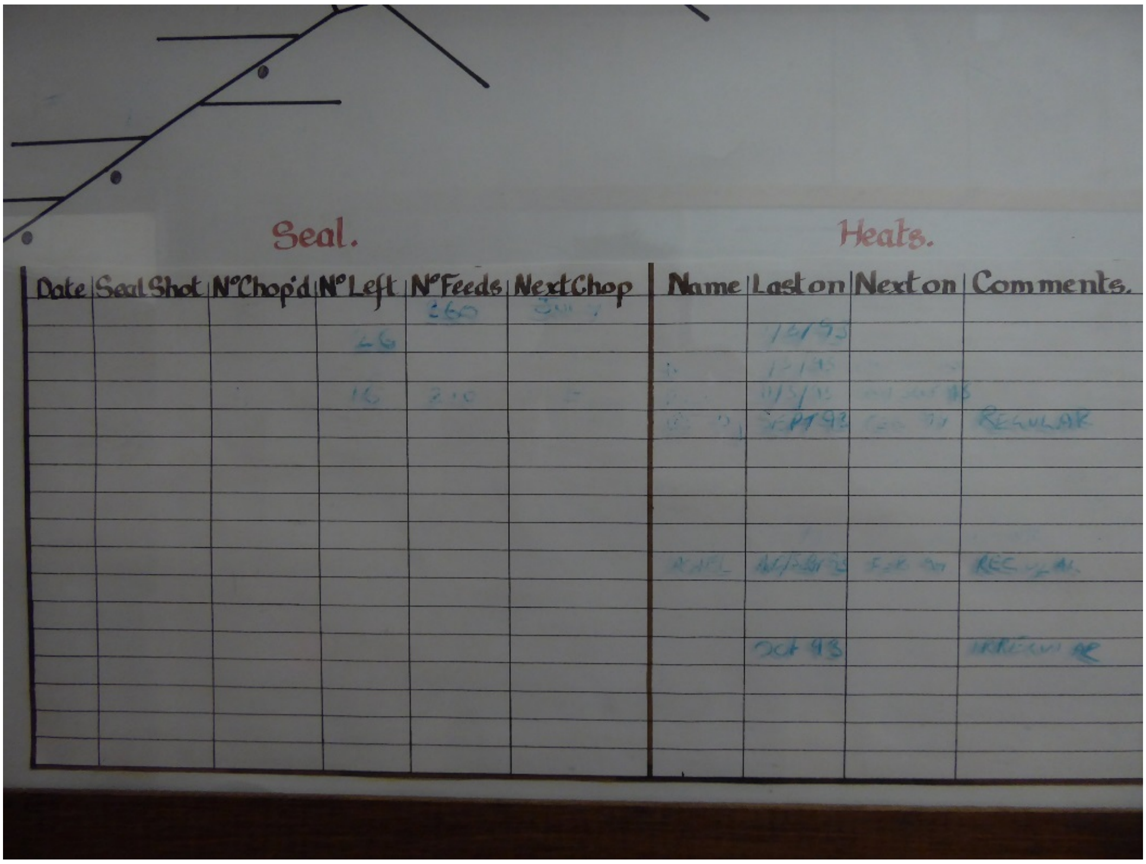
It’s unclear how long the diagram had been in use prior to this.</td></tr>
<tr><td>3.4</td><td>Origin</td><td colspan="5">Please indicate if the object / site appears to be of UK origin, or if other countries been involved in the creation / placement of the object.

Assumed to have been made at Rothera, for use on station.</td></tr>
<tr><td></td><td colspan="6">Section 4 - Condition</td></tr>
<tr><td>4.1</td><td>Condition – select one of the following</td><td>As new</td><td>[✓ Some wear]</td><td>Moderate deterioration</td><td>Significant deterioration</td><td>Extreme deterioration</td></tr>
<tr><td>4.2</td><td>Condition – further explanatory notes as appropriate</td><td colspan="5">For example:
• How much of the original object remains?
• Is the object intact?
• Does the object show alterations or repairs?
• Is it suitable for continued use?

The wooden frame and underlying paper are in excellent condition, although some areas of the ink and coloured wash are faded. The chinagraph writing on the surface of the Perspex is more faded and blurred, and appears to have been rubbed off in part (assumed accidentally).</td></tr>
<tr><td>4.3</td><td>Are there any apparent threats to the</td><td colspan="5">These could include:
• Human or other animal activity, including uncontrolled visitation.
• Environmental conditions / sustained exposure to the elements / potential extreme weather conditions.</td></tr>
</table>

	integrity of the object / site	- Longer-term environmental change. Old Bransfield House is being demolished as part of the Rothera redevelopment. The object is therefore at risk from disposal if its significance is not understood and it is not removed from its current location. The chinagraph writing is at great risk. It is already fading and worn, and is in an exposed position in the corridor (at torso height) leaving it vulnerable to being accidentally rubbed off by passing traffic (or over-assiduous cleaning).
4.4	Does the object pose a risk to safety or the environment?	No
	Section 5 – Further Information	
5.1	Any other information	As appropriate, please record any other information about the object / site that you feel would be of use and which is not already covered. The names recorded on the span diagram are those of some of the last dogs at Rothera, and hence the last dogs in the Antarctic. The last dog teams were comprised of the following 18 dogs: **Huns**: Roy, Pris, Morgan, Urza, Pujok, Nuk, Max, Mouse **Admirals**: Jimmy, Rex, Fido, Blackie, Rover, Rachel, Wendy, Biff, Tom, Elwood, Jake Of these, 13 were taken off the continent from Rothera on the 22 February 1994: Wendy, Tom, Biff, ***Jake***, ***Elwood***, ***Urza***, ***Morgan***, Jimmy, ***Rex***, ***Max***, ***Roy***, ***Pris*** and ***Rachel*** (those named on the span diagram are in ***bold***). Of those named on the span diagram, Jake and Elwood were amongst the last 5 pups to be born on a BAS base. The 5 dogs not flown transported were destroyed or had died previously. Nine of the ten names visible on the span diagram are of dogs that were flown off the continent. The tenth, Pujok, was destroyed at the end of the Summer season (Feb. 94). The dogs not mentioned on the span diagram and/or were not amongst those transported died between during the preceeding winter and start of the summer season (1993) - indicating that the names were written onto the span diagram early in 1994.
5.2	Images	Please attach images to this form. If possible include: - images in close-up taken from multiple angles - distance shots showing the objects/site in context - an indication of scale - an indication of the direction the photograph was taken i.e. looking North. Please label all images with the event / ref. number at the top of this form, and include the name of the photographer. **Note: High-res tiffs of all images are held in the BAS Archives, ref. 2017/1**



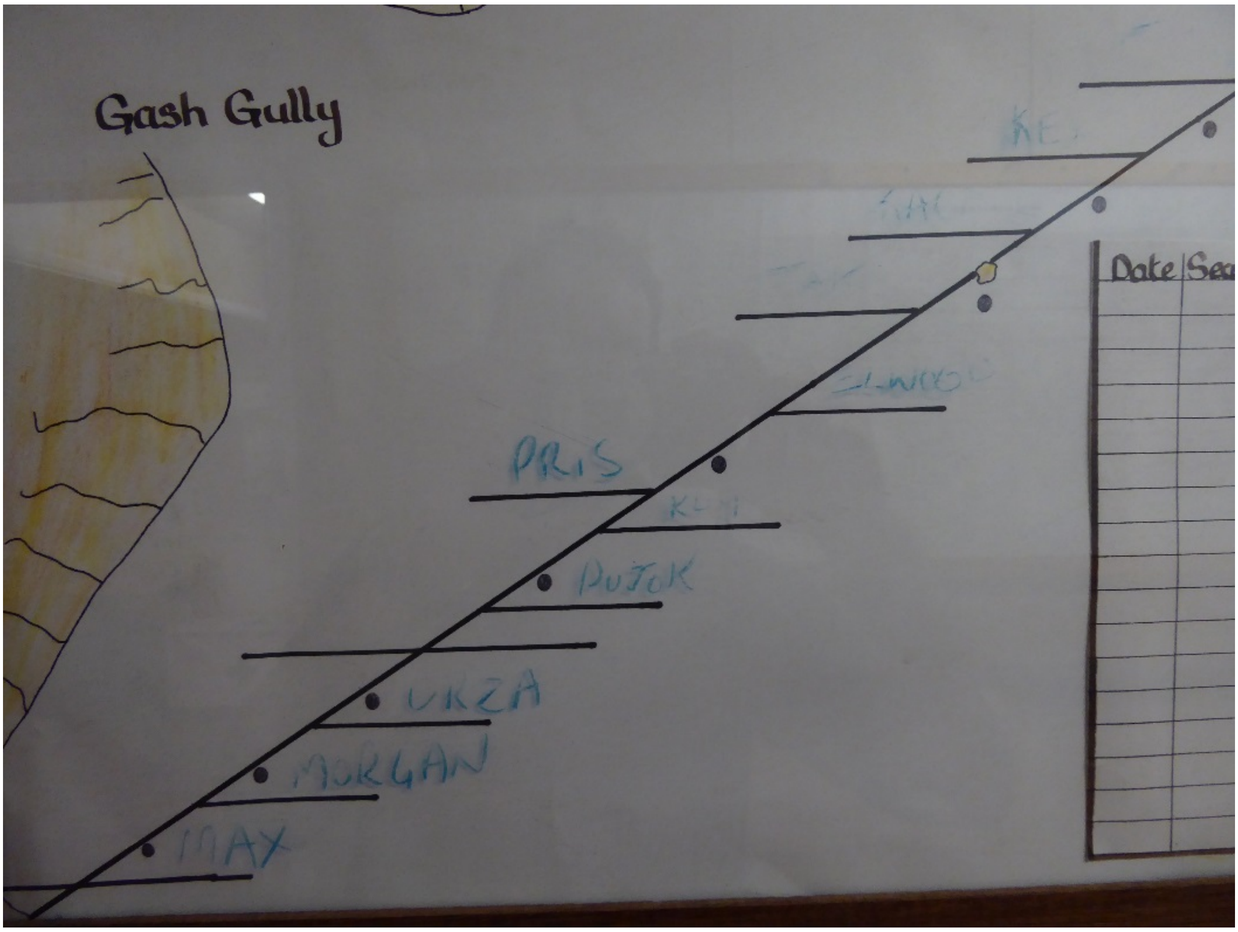


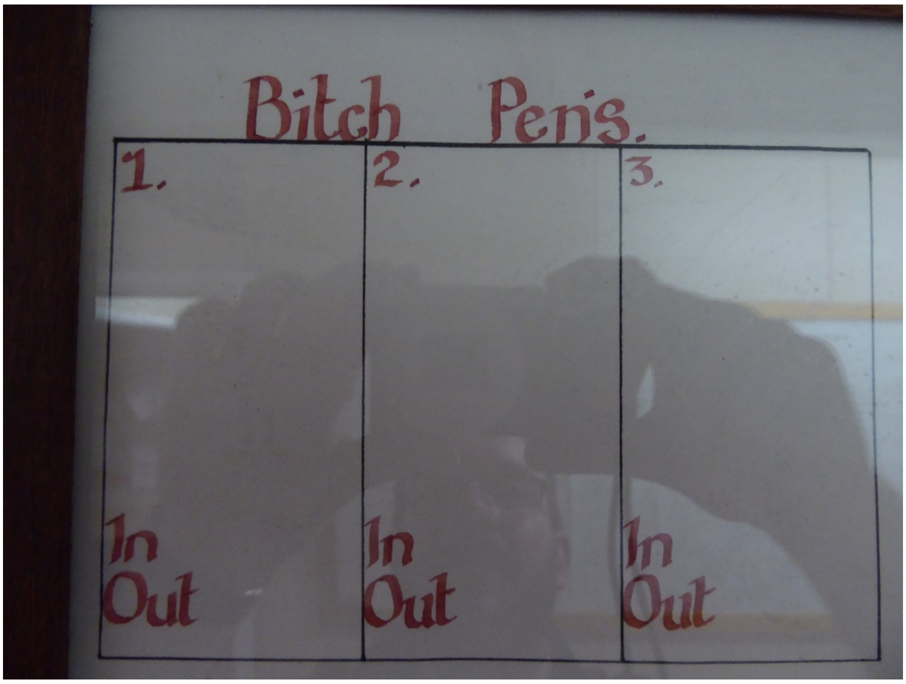
Seal.

Date	Seal Shot	N°Chop'd	N°Left	N°Feeds	Next Chop
				260	July
			26		
			16	210	

Heats.

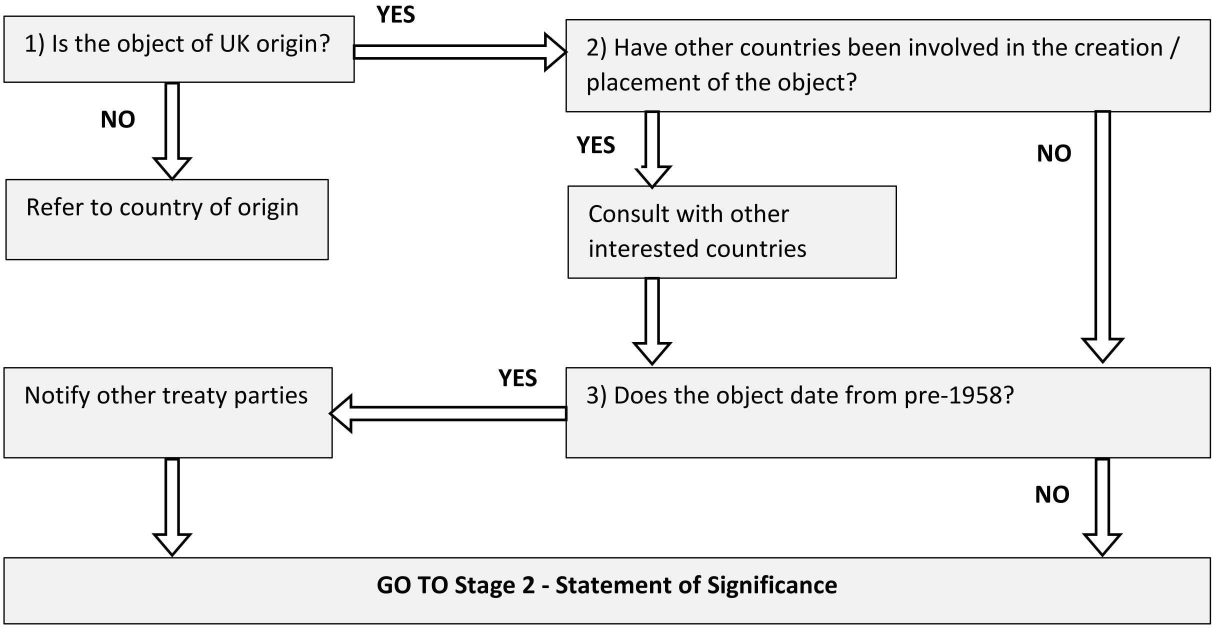
Name	Last on	Next on	Comments.
	7/4/93		
	7/2/93		
	11/5/93	[illegible] Sept 93	
[illegible]	SEPT 93	[illegible] 93	REGULAR
KARL	AUG/SEPT 93	FEB 94	REGULAR
	OCT 93		IRREGULAR


Gash Gully
KE.
ELWOOD
PRIS
DUJOK
URZA
MORGAN
MAX
Date
Sea


Bitch Pens.
1.
2.
3.
In
Out
In
Out
In
Out

Signed by:	Ieuan Hopkins (Archives Manager)	**Date:** Feb 2017

Part B - To be completed by BAS Environment Office



		Further details
1)	Is the object of UK Origin?: (Y/N) If No, please refer to the country of origin.	Yes – produced at Rothera
2)	Have other countries been involved in the creation / placement of the object?: (Y/N) If Yes, consult with other interested countries.	No
3)	Does the object date from pre-1958?: (Y/N) If yes, notify other Treaty Parties.	No

Signed by:	Ieuan Hopkins (on behalf of BAS EO)	**Date: 08/09/2017**

Stage 2: Statement of Significance

Name of Object: Rothera Dog Span Diagram

Stage 2 should be undertaken by the BAS Archives Service / Environment Office / UKAHT, in liaison with other parties as appropriate.

The following questions relate to factors contributing to heritage value. Please provide comprehensive answers where relevant, as decisions in stage 3 of the methodology relating to the ongoing management of the objects draw directly from the information provided here.

Please note that the responses should be appropriate and proportionate to the site/object under consideration – a compass does not require the same level of response as an abandoned base.

2.1	**Context / History** *Describe the history of the object:* • *When was it first built / taken to the site?* • *What was its original purpose?* • *How has it been used since? Has its use changed over time?* The span diagram was produced at Rothera, for use at the station, prior to 1994 i.e. whilst there were still dogs on station. It was used to record details about the management of dogs – where to place individual dogs on the span, the occupants of the bitch pens, the number of seals shot and fed to the dogs, and the details of bitches on heat. This information was written in chinagraph(?) pencil on a sheet of Perspex placed over the backing sheet, allowing the details to be updated as required. It is assumed, due to its size and original purpose, that it has always been wall-mounted. The original location, if different to the current location, is unknown. After the removal of the last dogs from Rothera in 1994, the span diagram appears to have been retained as a commemorative item - the names of 10 of the last dogs at Rothera are still visible in chinagraph(?) pencil. It is assumed that these names were written on as a matter of course as part of the dog management procedures contemporary with the presence of the dogs on station, and were not rubbed off or changed once the dogs had left – the names on the diagram are of dogs that were removed in Feb. 1994, and do not include those that had died during the 1993 summer season. Its use as a commemorative item is suggested by the presence on the opposite side of the corridor by the framed dog genealogy charts (see separate heritage selection documentation) and a framed display of photographs of the last dogs at Rothera.
2.2	**Heritage Values**
2.2.1	**Historical Significance**
i.	*Is the object associated with important events or activities relating to exploration and discovery?* This object is associated with the last dogs at Rothera (and by default on the Antarctic Continent).

Dogs were used throughout BAS' history, first arriving in the Antarctic in 1944. In 1991 the Environmental Protocol to the Antarctic Treaty legislated against the introduction of non-indigenous species to Antarctica. Under this Protocol working dogs, including those bred on the continent, had to be removed by 1 April 1994.

By this date British Antarctic Survey (BAS) was maintaining only a small husky population at Rothera Research Station, for recreational sledge journeys. Phasing-out of the use of dogs had started in the 1970s. The closure of Base E, Stonington Island, at the end of the 1974/75 season, was part of a planned switch to summer season field work from 1975/76 and a phasing out dogs in favour of mechanised transport. A major cull (of about 100 dogs) was undertaken at the end of the field season (Feb 1975) as teams returned to Stonington. A few teams were transferred to Base T, Adelaide Island, where dogs worked until the end of the 1976/77 season, when the base closed. After that the teams were transferred to Rothera, Base R, but after 1978 the number of dogs was reduced from 42 to 24.

On 22 February 1994, the last dogs in Antarctica (other National Operators had removed their dogs prior to this date) were relocated to Canada. In the months before, to mark the end of almost 50 years of husky use by BAS, a final, commemorative dog sledge journey was organised. This was an ice coring and GPS traverse of Alexander Island from 25 Dec 1993 – 9 Feb 1994 and used 14 dogs in two teams - the 'Huns' and 'Admirals'.

The names recorded on the span diagram are those of some of the last dogs at Rothera, and hence the last dogs in the Antarctic. The last dog teams were comprised of the following 18 dogs:

Huns: Roy, Pris, Morgan, Urza, Pujok, Nuk, Max, Mouse
Admirals: Jimmy, Rex, Fido, Blackie, Rover, Rachel, Wendy, Biff, Tom, Elwood, Jake

Of these, 13 were taken off the continent in February 1994: Wendy, Tom, Biff, ***Jake***, ***Elwood***, ***Urza***, ***Morgan***, Jimmy, ***Rex***, ***Max***, ***Roy***, ***Pris*** and ***Rachel.*** Nine of the ten names visible on the span diagram are of dogs that were flown off the continent (those in bold). The tenth, Pujok, was destroyed at the end of the Summer season (Feb. 94).

Of those named on the span diagram, Jake and Elwood were amongst the last 5 pups to be born on a BAS base.

Several dogs from the last teams were not transported as they had died, or were destroyed, previously.

It should be noted that the historical significance of this object derives from the continued preservation of the names written in chinagraph.

ii. *Is the object associated with significant people?*

No

iii. *Does the object accurately and effectively invoke past conditions? Does it contribute to our understanding of a time, place or event? If so, how?*

No

iv. *Is the object evidence of the how, when, where or why of a significant past activity?*

No

v.	*Does the object contribute to an understanding of the history of science, exploration or politics in Antarctica more broadly?* No
2.2.3	**Scientific Significance**
i.	*Is the object associated with important events or activities relating to scientific research?* Only in as much as they are associated in general with BAS' activities.
ii.	*Is the object of current scientific interest or value? Is it likely to be so in the future?* No
2.2.4	**Technological Significance**
i.	*Does the object have historical importance in terms of architectural or technological interest? Will this value increase in the future as similar objects disappear?* No
ii.	*Is the object of unique or unusual design?* ***OR*** *Is the object a particularly good example of a technology common to the Antarctic?* N/A
iii.	*Does the object have aesthetic value, either through conscious design or as the outcome of the way it has evolved and/or been used over time?* No
2.2.5	**Social / Cultural Significance**
i.	*Is the object of significance to a particular group of people?* ***Note:*** *Different stakeholder groups / communities may value the same object in different ways, and to different degrees. If these differences are present, it is important to indicate them here. Stakeholder groups to consider may include:* • *former FIDS/BAS staff;* • *current personnel (station- and/or Cambridge-based);* • *historians and other heritage professionals (e.g. UKAHT)* • *the general public* • *Government* This object has little evidential significance i.e. it does not enhance an understanding of the historical, technological or scientific activities in Antarctica. But, due to its connection with the last dog population in Antarctica, in particular the (assumed) preservation of the last time dogs were spanned out in Antarctica, this object may be valued by the following stakeholders for commemorative reasons.

	Former FIDS/BAS Staff, who place great value on the role of dogs in Antarctic exploration and scientific endeavour. It would be particularly significant, as a memento, to those who worked with the dogs at Rothera. **Current station personnel**. No strong opinion as to the heritage value of this item came out of the staff discussion on heritage undertaken in Dec. 2016. However, its continued presence on station (e.g. if incorporated in some way into the redevelopment design for the new buildings) would feed into the importance of a sense of continuity and connection with the past, an aspect of heritage that was repeatedly voiced in discussions with staff at Rothera. The fact that the diagram has continued to have been displayed for so long, and in conjunction with other associated dog material (a display of dog photos and genealogies, for example) indicates that some significance is accorded this object. **General public.** That this object is strongly associated with the last dogs on Antarctica should be considered as enhancing its interest to a general audience, although arguably to a lesser degree than the dog pen doors (see relevant heritage documentation), which have an immediate and tangible connection to the dogs due to the presence of their physical marks. As stated in 2.2.1, It should be noted that the historical significance of this object to all of these groups derives in the main from the continued preservation of the names written in chinagraph.
2.2.6	**Comparative Significance**
i.	*Is the object well-documented in published and/or archival sources?* The specific object is not. However, the last journey and removal of dogs from Rothera is documented in detail in the BAS Archives, in administrative papers, photographic, film and oral history recordings, as is the use of spans in general.
ii.	*Is the object rare or unique? Is it likely to become more so?* The span diagram is unique, and is linked to a unique historical event.
iii.	*Is the object a particularly good example of its type?* N/A
iv.	*Is the object typical of that used in the Antarctic, of which few examples remain?* N/A
	Has Heritage Value been Identified? (if Yes go to stage 3; if No add recommendation below) Yes
	RECOMMENDATION
	N/A

Signed by:	Ieuan Hopkins (Archives Manager)	**Date:** Sept. 2017

Stage 3 Heritage Management Flowchart Guidance Notes and Comments

Name of Object: Rothera Dog Span Diagram

Stage 3 to be undertaken by the BAS Archives Service / Environment Office / UKAHT, in liaison with other parties as appropriate.

The following questions and guidance should be read in conjunction with the Heritage Management Flowchart, below. The comments provided will document the decisions made with regard ongoing heritage management.

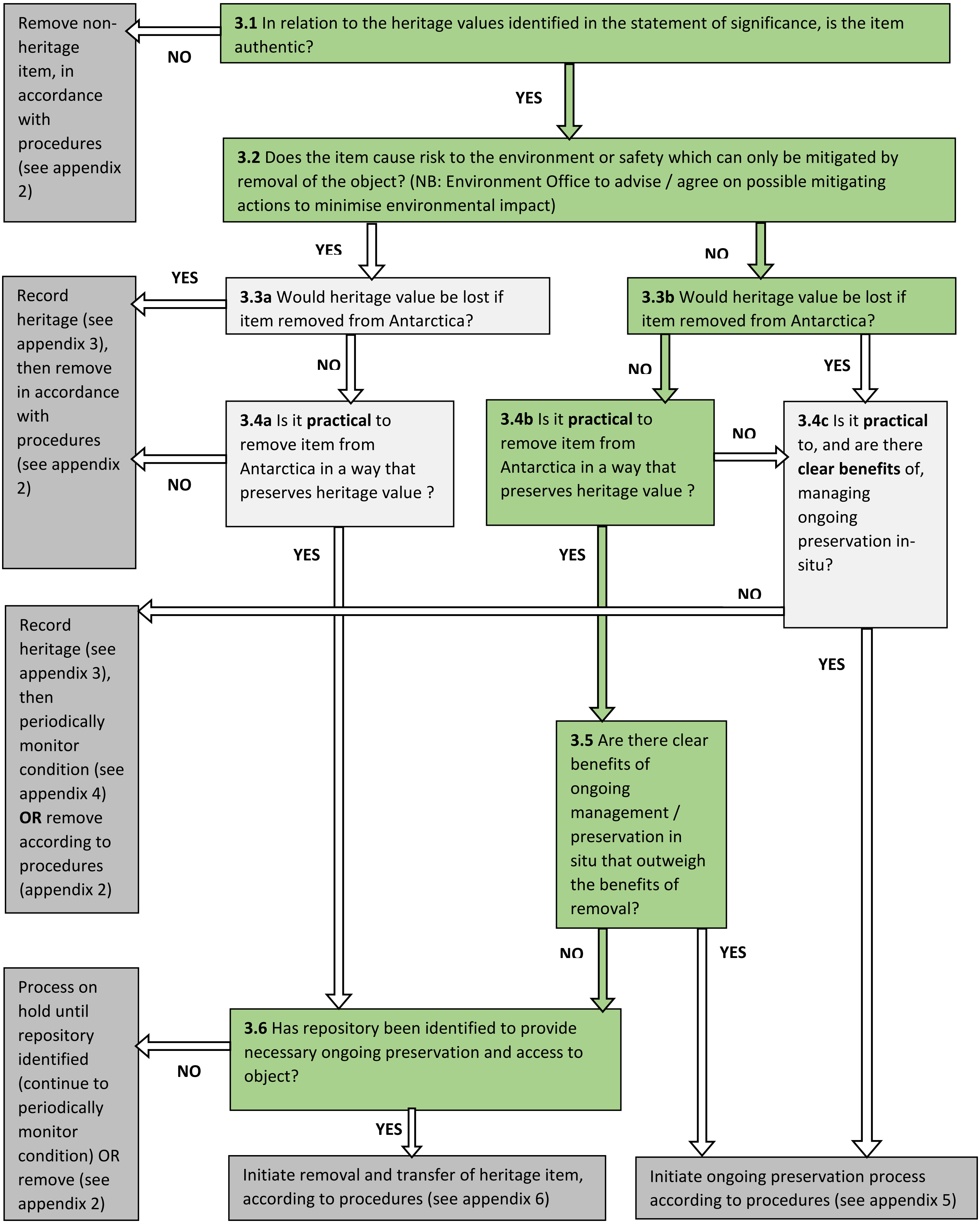
3.1	*Authenticity relates to the 'truthfulness' or credibility of the item, in particular in relation to the heritage values stated in Stage 2.* **Please comment:** The authenticity of the object in general is clear. What is less clear is the authenticity of the dog names in chinagraph – it as assumed that these were written on at the time of the dogs' removal from Rothera and that they are a record of the last use of this chart, although this is not possible to confirm.
3.2	**Please comment:** This item poses no risk to the environment.
3.3	*Consider whether the heritage values reside solely in the object, or are dependent upon the object's location.* **Please comment, in relation to the heritage values stated in Stage 2:** The commemorative (heritage) value of this object, in terms of its broader significance as representative of the last dogs on the continent and a marking of a point in history is not dependant on its location, and would not be lost if removed from Rothera.
3.4a/b	*Consider the practicalities of the specific physical removal required to retain the heritage values stated in Stage 2.* **Please comment:** Given its size and shape, this object would be relatively straightforward to remove from its current location and transfer from the Antarctic. However, care would have to be taken to preserve the (assumed authentic) chinagraph writing during transit – this is both the most fragile and most important aspect of this item. Methods for preserving this writing in the long term would need to be considered.
3.4c	*Consider:* • *The current condition of the site / object;* • *Resource implications of preservation / conservation – is the resource and expertise available to prevent significant deterioration?* • *Resource implications of continuing maintenance / management, including the ongoing security and protection of the site/object and management of controlled visitation;* • *The impact of preservation work on wildlife.*

	Please comment: n/a (see 3.4a/b)
3.5	*Consider:* • *The accessibility of the site, in particular to those stakeholder groups identified in Stage 1 as valuing the heritage;* • *The potential to increase accessibility in the future, to engage/educate new stakeholder groups.* • *The aesthetic quality of the base and/or its setting in the landscape.* **Please comment:** The benefits of in-situ management do not clearly outweigh the preferred option of removal and return to the UK for the following reasons: If retained at Rothera, incorporated into the new building, this object would potentially feed into the sense of continuity with the past, expressed as important by the current staff. However, the lack of strong opinion regarding this on the part of current staff is a result of none of them having worked with dogs – unlike other experiences and activities experienced on station, the use of dogs is not something they share with previous personnel. As such, the door appears to be less significant to current staff than, for example, the winterers' photographs and the continuing use of objects and equipment with a long history – the use of primus stoves, similar tents, sledges etc. It is of most significance to those who worked with the dogs at Rothera, and also has a broader significance as a physical link to the last working dogs in Antarctica – i.e. a significance to the general public in its connection to the history and contribution of dogs to BAS and the UKs scientific endeavour in the Antarctic. As such, the heritage value could be best communicated to the broadest group of interested stakeholders if removed from Rothera and returned to the UK. It should also be noted that the practicalities of ongoing preservation of the chinagraph writing identified in 3.4a/b would be more difficult to achieve if the object were retained at Rothera.
3.6	**Please comment:**
	A repository has not yet been identified.
	Recommendations
	This object to be protected and removed from Rothera to the UK (BAS Archives Service) in such a way that the chinagraph writing is preserved. Rothera SL to be informed of the importance of the chinagraph writing and need to protect it whilst object in-situ. (Verbally done Jan 2019 – IH to follow-up). An appropriate repository (which may or may not be BAS) to be found for its long-term management and use to engage a broad stakeholder group.

Signed by:	Ieuan Hopkins (Archives Manager)	**Date:** Sept. 2017

Signed by:	Camilla Nichol Chief Executive, UK Antarctic Heritage Trust	**Date: 07/01/2019**
Signed by:	Rachel Clarke, Head of Environment Office Rachel Clarke	**Date: Jan 19**

Stage 3: Heritage Management Flowchart



3.1 In relation to the heritage values identified in the statement of significance, is the item authentic?

Remove non-heritage item, in accordance with procedures (see appendix 2)

3.2 Does the item cause risk to the environment or safety which can only be mitigated by removal of the object? (NB: Environment Office to advise / agree on possible mitigating actions to minimise environmental impact)

3.3a Would heritage value be lost if item removed from Antarctica?

3.3b Would heritage value be lost if item removed from Antarctica?

Record heritage (see appendix 3), then remove in accordance with procedures (see appendix 2)

3.4a Is it **practical** to remove item from Antarctica in a way that preserves heritage value ?

3.4b Is it **practical** to remove item from Antarctica in a way that preserves heritage value ?

3.4c Is it **practical** to, and are there **clear benefits** of, managing ongoing preservation in-situ?

Record heritage (see appendix 3), then periodically monitor condition (see appendix 4) **OR** remove according to procedures (appendix 2)

3.5 Are there clear benefits of ongoing management / preservation in situ that outweigh the benefits of removal?

Process on hold until repository identified (continue to periodically monitor condition) OR remove (see appendix 2)

3.6 Has repository been identified to provide necessary ongoing preservation and access to object?

Initiate removal and transfer of heritage item, according to procedures (see appendix 6)

Initiate ongoing preservation process according to procedures (see appendix 5)

Heritage Selection Process Cover sheet

Name of Object: Rothera Trace and Harness Hooks

Overview

This process aims to provide a systematic and consistent methodology for the identification of those objects[1] with heritage value.

Heritage is here defined as all inherited resources which people value for reasons beyond mere utility.[2] This definition includes the widest range of physical 'things'. It also encompasses the range of emotional and intellectual values attached to them.

This methodology is scalable. It can be used to assess the heritage value of single, hand-held objects through to complete heritage sites and structures (a compass found on an abandoned base, through to the abandoned base itself and the area surrounding it).

Methodology

The methodology is in 3 stages:

Stage 1: The initial identification and recording of the object.
Stage 2: A statement of the significance of the object, arrived at by considering factors contributing to heritage value, the potential for different stakeholder groups to attach different heritage values to the same object, and the relationship of the object under consideration to comparable objects.
Stage 3: A series of pragmatic decisions, based upon the information in Stages 1 and 2.

There are 5 possible outcomes to this process:

- The object is designated as non-heritage and removed according to standard environmental procedures;
- The object is appropriately recorded as a heritage object prior to removal/destruction;
- The removal and transfer of the heritage object to an appropriate repository for ongoing management;
- The initiation of ongoing management in situ of the heritage object;
- The appropriate recording of the heritage object and initiation of periodic monitoring in situ pending the opportunity or decision to undertake one of the above.

Progress

	Completed by	Date completed
Stage 1	I Hopkins	Feb 2017
Stage 2	I Hopkins	Sept 2017
Stage 3	I Hopkins	Oct 2018

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[1] Within this document, 'object' is taken to mean either an artefact, building or site.
[2] 'Conservation Principles, Policy and Guidance'. Historic England, 2008

Stage 1 – Initial Identification Form

Name of Object: Rothera Dog Trace and Harness Hooks

The Initial Documentation Form should be completed as fully as possible – this will form the basis for subsequent decisions relating to the significance and ongoing management of the object.

Once Part A has been completed , the Initial Documentation Form should be sent to the BAS Environment Office, whose responsibility it will be to complete the subsequent steps in Part 1 and to liaise, as appropriate, with one or more of the following:

- BAS Archives Service;
- United Kingdom Antarctic Heritage Trust;
- The equivalent for other national operators;
- Antarctic Treaty parties.

Further information regarding the object may be sought from the individual named on the Initial Documentation Form.

Part A - Please complete this form as fully as possible – each object / site requires a separate form, as appropriate.

	Section 1	
1.1	Item / site (brief description	Wooden hooks for dog traces
1.2	Date found	Assessed as part of the Rothera heritage review, Dec 2016, by Ieuan Hopkins, BAS Archives Manager - the object has been at Rothera since it was made.
1.3	Found by (name of person)	See above
1.4	Local event / ref. number (if multiple objects / sites are being recorded)	n/a
1.5	How was the object / site found?	n/a
	Section 2 - Location	
2.1	Where was the object / site found – GPS reference (if known)	Trace hooks: Rothera Station – Fuchs House kit room opposite GAs' office, mounted on central wall. Harness hooks: Rothera Station – Fuchs House kit room adjacent to (N of) GAs' office, mounted on central wall.
2.2	Map	If possible, indicate position found on a map and attach to this form. n/a
2.3	Where was the object / site found – further details	Include: • A description of the location • Situation of the object / site (e.g. is the object windblown debris, has it been placed in position deliberately etc.) • Identification aids to help relocate the object/site No further information (see 2.1)
2.4	Is the object / site associated with others nearby? If so, provide brief details and include relevant event / ref. numbers for the respective Initial documentation forms.	Associated with other examples of dog-related objects, e.g. wall-mounted Vet box in GAs' workshop.
	Section 3 - Description	

3.1	Full description of object	Include: • The type of object • Materials used (if the presence of hazardous materials is suspected, please also complete section 4.4) • Markings (symbols or writing on the object), in particular manufacturer or makers marks • Is the object comprised of a number of parts? **Trace Hooks** 5 wooden hooks, slightly tapered, mounted onto a wooden backboard (plywood), the whole varnished, held on the wall by brass screws in 6 places. The word 'TRACES' in black paint at the top centre of the backboard, with the following text above each hook (l to r): '3 DOG', '5 DOG', 'ADMIRALS', 'PICTS', 'HUNS'. **Harness Hooks** 5 wooden hooks, slightly tapered, mounted onto a wooden backboard (plywood), the whole varnished, held on the wall by brass screws in 6 places. The word 'Harnessess' in black paint at the top centre of the backboard, with the following text above each hook (l to r): 'HUNS', 'PICTS', 'ADMIRALS', 'PUPS', 'SPARE'.
3.2	Size of the object / site (e.g. cm, m^2 as appropriate)	**Trace Hooks and Harness Hooks** Backboard: 101 x 19 x 1.7cm Wooden pegs protrude c.15cm, with a 2cm diameter at the narrowest end.
3.3	Age of the object / site (if known)	The names of the teams suggest that these were made between the 82/83 and 89/90 seasons as these were the only seasons where the Admirals, Huns and Picts were all run at Rothera.
3.4	Origin	Please indicate if the object / site appears to be of UK origin, or if other countries been involved in the creation / placement of the object. This object was produced at Rothera, assumed to have been made by one of the base personnel.
	Section 4 - Condition	
4.1	Condition – select one of the following	As new **Some wear** Moderate deterioration Significant deterioration Extreme deterioration
4.2	Condition – further explanatory notes as appropriate	For example: • How much of the original object remains? • Is the object intact? • Does the object show alterations or repairs? • Is it suitable for continued use? **Trace Hooks and Harness Hooks** The condition is good – the wood is sound, and the painted lettering clear. Some wear is apparent on the hooks, as would be expected through normal use. There are slight, small chips to the corners.
4.3	Are there any apparent threats to the	These could include: • Human or other animal activity, including uncontrolled visitation.

	integrity of the object / site	• Environmental conditions / sustained exposure to the elements / potential extreme weather conditions. • Longer-term environmental change. Fuchs House is being demolished as part of the Rothera redevelopment. The object is therefore at risk from disposal if its significance is not understood and it is not removed from Fuchs House. There are some risks attached to the object's continuing use – currently the hooks are being used to hang ropes, coats and other pieces of equipment, which could result in wear and tear. However, even though continually used, the condition is currently good.
4.4	Does the object pose a risk to safety or the environment?	No
	Section 5 – Further Information	
5.1	Any other information	As appropriate, please record any other information about the object / site that you feel would be of use and which is not already covered. This pair of objects are amongst a few remaining objects at Rothera with direct association with the last dog teams at Rothera (and therefore the last dogs in Antarctica), and were contemporary to and used with the dog teams, retained subsequently on station due to their utility value and, judging by other objects on station such as the dog genealogies and photographs on display, their value in connecting the present life on station with the past.
5.2	Images	Please attach images to this form. If possible include: • images in close-up taken from multiple angles • distance shots showing the objects/site in context • an indication of scale • an indication of the direction the photograph was taken i.e. looking North. Please label all images with the event / ref. number at the top of this form, and include the name of the photographer. **Note: High-res tiffs of all images are held in the BAS Archives, ref. 2017/1**

TRACE HOOKS


5 DOG
TRACES
ADMIRALS


3 DOG
DOG
TRACES


HUNS
TRACES
ADMIRALS

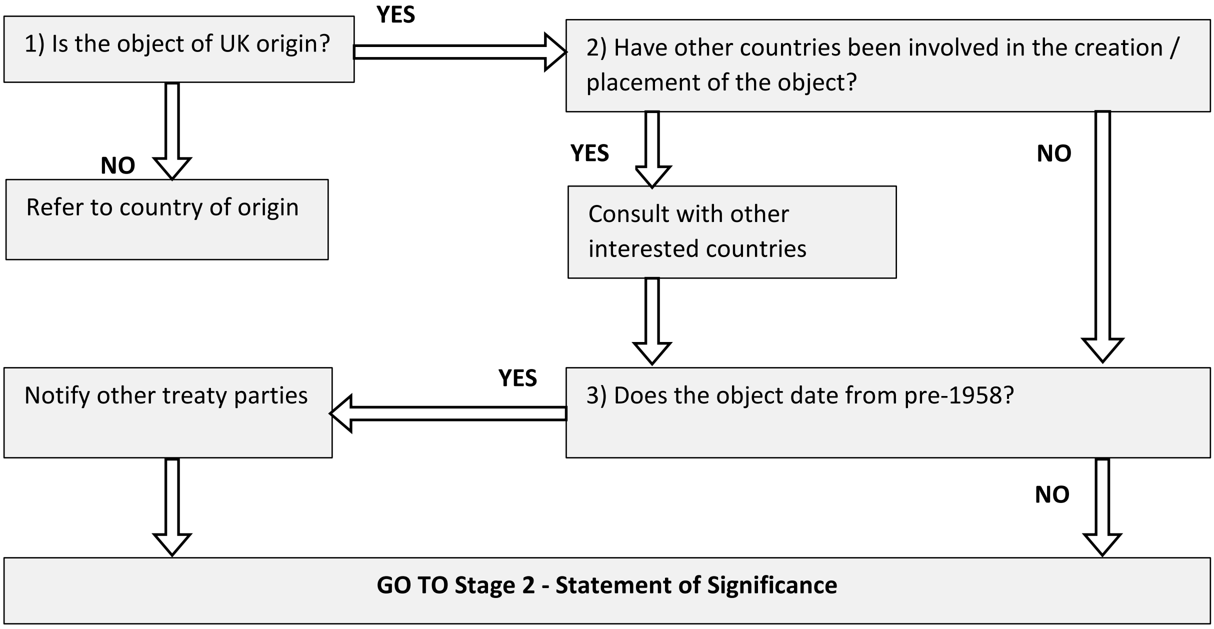
HARNESS HOOKS


HUNS
HARNESSES
96


SPARE
HARNESSES

Signed by:	Ieuan Hopkins (Archives Manager)	**Date:** Feb 2017

Part B - To be completed by BAS Environment Office



		Further details
1)	Is the object of UK Origin?: (Y/N) If No, please refer to the country of origin.	Yes
2)	Have other countries been involved in the creation / placement of the object?: (Y/N) If Yes, consult with other interested countries.	No
3)	Does the object date from pre-1958?: (Y/N) If yes, notify other Treaty Parties.	No

Signed by:	Ieuan Hopkins (on behalf of BAS EO)	**Date: 08/09/2017**

Stage 2: Statement of Significance

Name of Object: Rothera Dog Trace and Harness Hooks

Stage 2 should be undertaken by the BAS Archives Service / Environment Office / UKAHT, in liaison with other parties as appropriate.

The following questions relate to factors contributing to heritage value. Please provide comprehensive answers where relevant, as decisions in stage 3 of the methodology relating to the ongoing management of the objects draw directly from the information provided here.

Please note that the responses should be appropriate and proportionate to the site/object under consideration – a compass does not require the same level of response as an abandoned base.

2.1	**Context / History** *Describe the history of the object:* • *When was it first built / taken to the site?* • *What was its original purpose?* • *How has it been used since? Has its use changed over time?* The trace and harness hooks were made by a member base personnel (unknown) at Rothera in the 1980s (assumed from historic information). The hooks were originally used to store the traces and harnesses belonging to the three dog teams at Rothera (the 'Huns', 'Picts' and 'Admirals'), as well as spare sets and sets for training the pups. It was, and remains, usual for station personnel to craft items for use around the station – in addition to fulfilling a utilitarian need, this work also provides an opportunity for recreational activity and the learning of new skills. After the last dogs left Rothera in Feb. 1994 the hooks were re-purposed for the storage of general equipment.
2.2	**Heritage Values**
2.2.1	**Historical Significance**
i.	*Is the object associated with important events or activities relating to exploration and discovery?* This pair of objects are amongst a few remaining objects at Rothera associated with the last three British dog teams operating in Antarctica. Dogs were used throughout BAS' history, first arriving in the Antarctic in 1944. In 1991 the Environmental Protocol to the Antarctic Treaty legislated against the introduction of non-indigenous species to Antarctica. Under this Protocol working dogs, including those bred on the continent, had to be removed by 1 April 1994. By this date British Antarctic Survey (BAS) was maintaining only a small husky population at Rothera Research Station, for recreational sledge journeys. Phasing-out of the use of dogs had started in the 1970s. The closure of Base E, Stonington Island, at the end of the 1974/75 season, was part of a planned switch to summer season field work from 1975/76 and a phasing out of

	dogs in favour of mechanised transport. A major cull (of about 100 dogs) was undertaken at the end of the field season (Feb 1975) as teams returned to Stonington. A few teams were transferred to Base T, Adelaide Island, where dogs worked until the end of the 1976/77 season, when the base closed. After that the teams were transferred to Rothera, Base R, but after 1978 the number of dogs was reduced from 42 to 24. On 22 February 1994, the last fourteen dogs in Antarctica (other National Operators had removed their dogs prior to this date) were relocated to Canada. In the months before, to mark the end of almost 50 years of husky use by BAS, a final, commemorative dog sledge journey was organised. This was an ice coring and GPS traverse of Alexander Island from 25 Dec 1993 – 9 Feb 1994 and used 14 dogs in two teams - the 'Huns' and 'Admirals'. The names of the three teams mentioned on the hooks have a long history, being used from the 1950s or 60s onwards. The 'Admirals', in particular, is thought to be the team name with the longest use, dating from c.1952. It seems that the 'Huns' and 'Picts' were adopted as names in the early- to mid-1960s.
ii.	*Is the object associated with significant people?* *No*
iii.	*Does the object accurately and effectively invoke past conditions? Does it contribute to our understanding of a time, place or event? If so, how?* *No*
iv.	*Is the object evidence of the how, when, where or why of a significant past activity?* *No*
v.	*Does the object contribute to an understanding of the history of science, exploration or politics in Antarctica more broadly?* *Not particularly, other than obliquely referencing station life as described in 2.1.*
2.2.3	**Scientific Significance**
i.	*Is the object associated with important events or activities relating to scientific research?* Only in as much as they are associated in general with BAS' activities.
ii.	*Is the object of current scientific interest or value? Is it likely to be so in the future?* *No*
2.2.4	**Technological Significance**
i.	*Does the object have historical importance in terms of architectural or technological interest? Will this value increase in the future as similar objects disappear?* *No importance*

ii.	*Is the object of unique or unusual design?* ***OR*** *Is the object a particularly good example of a technology common to the Antarctic?* *The object is an example of the type of work made in the Antarctic as described in 2.1, but not a particularly intricate, unusual or interesting one.*
iii.	*Does the object have aesthetic value, either through conscious design or as the outcome of the way it has evolved and/or been used over time?* *No*
2.2.5	**Social / Cultural Significance**
i.	*Is the object of significance to a particular group of people?* ***Note:*** *Different stakeholder groups / communities may value the same object in different ways, and to different degrees. If these differences are present, it is important to indicate them here. Stakeholder groups to consider may include:* • *former FIDS/BAS staff;* • *current personnel (station- and/or Cambridge-based);* • *historians and other heritage professionals (e.g. UKAHT)* • *the general public* • *Government* This pair of objects are significant to the following stakeholders: **Former FIDS/BAS Staff:** Fids place great value on the role of dogs, and the emotional ties between men and dogs is strongly expressed within the archives and publications. This strength of feeling is demonstrated by, for example, the Sledge Dog Memorial (formerly at BAS, now at SPRI). As such, any object connected with the dogs will be significant to Fids who worked with them. These objects will be highly significant to those Fids who drove the teams named and the objects' destruction may be regarded negatively by this group. **Current Station Personnel:** Although these specific objects were not singled out by personnel on station at the time of assessment as being of particular significance, the objects' continued presence and use on station feeds into the importance of a sense of connection with the past, an aspect of heritage that was repeatedly voiced in discussions with staff at Rothera. The use of the same equipment across time was greatly appreciated by staff and being surrounded by these items promoted a sense of continuity with the past, which is important to retain (during discussions with personnel concerns were expressed over a disconnect with the past and the fact that, over time, this disconnect would only get worse). Station personnel felt that this connection was most effectively achieved through the continuing use of the same objects i.e. a constant and active re-inscription and reconnection with the past through continued use. These objects are therefore regarded by station personnel as being part of a valued living tradition.
2.2.6	**Comparative Significance**
i.	*Is the object well-documented in published and/or archival sources?* No
ii.	*Is the object rare or unique? Is it likely to become more so?*

	Only in as much as being hand-made
iii.	*Is the object a particularly good example of its type?* N/A
iv.	*Is the object typical of that used in the Antarctic, of which few examples remain?* N/A
	Has Heritage Value been Identified? (if Yes go to stage 3; if No add recommendation below) Yes
	RECOMMENDATION N/A

Signed by:	Ieuan Hopkins (Archives Manager)	**Date:** Sept. 2017

Stage 3 Heritage Management Flowchart Guidance Notes and Comments

Name of Object: Rothera Dog Trace and Harness Hooks

Stage 3 to be undertaken by the BAS Archives Service / Environment Office / UKAHT, in liaison with other parties as appropriate.

The following questions and guidance should be read in conjunction with the Heritage Management Flowchart, below. The comments provided will document the decisions made with regard ongoing heritage management.

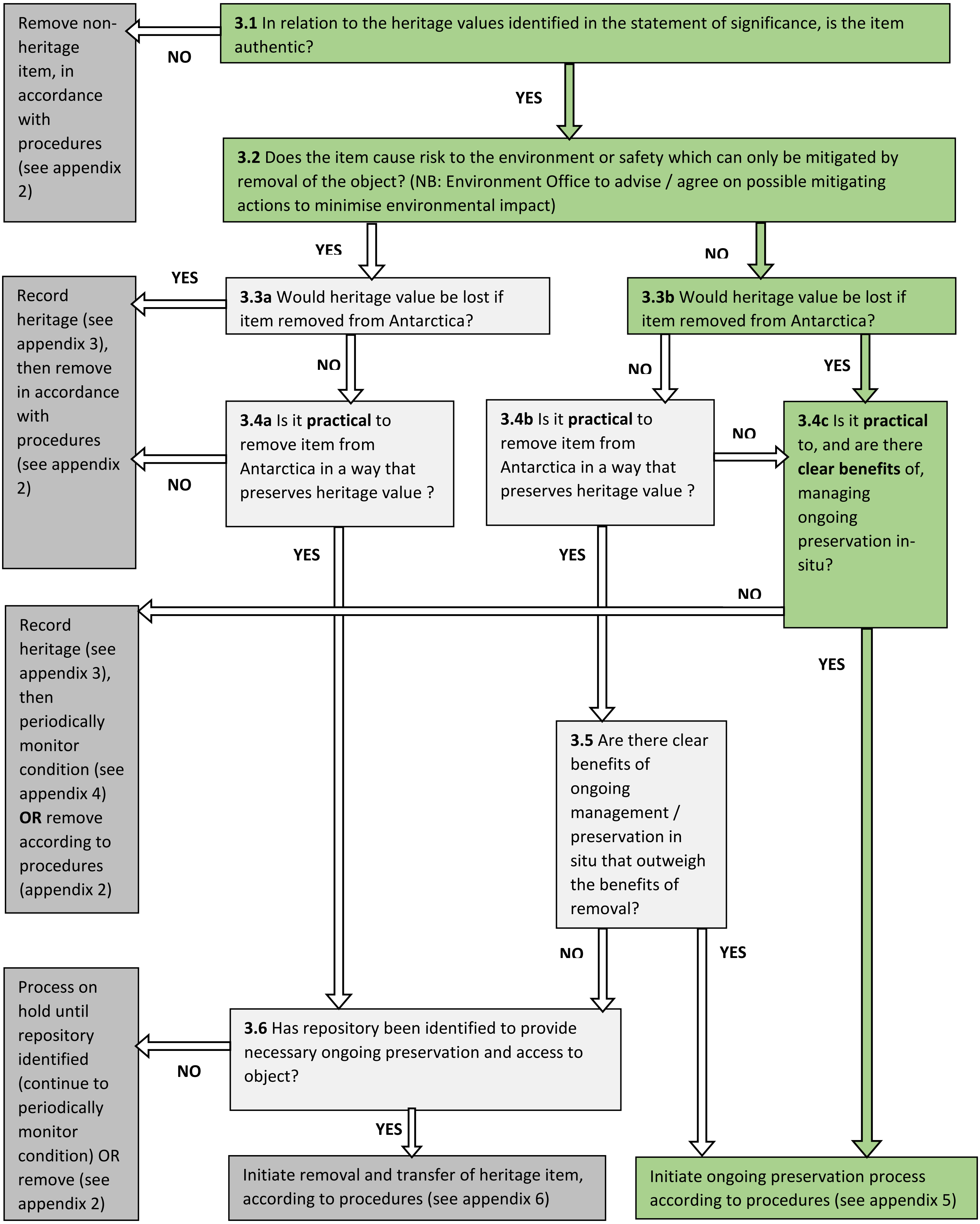
3.1	*Authenticity relates to the 'truthfulness' or credibility of the item, in particular in relation to the heritage values stated in Stage 2.* **Please comment:** These items are authentic in that they: • were made by a member of station personnel for use as hooks for the dog harnesses and traces; • were contemporary with the use of the dog teams they reference; • remain materially unchanged; • demonstrate a common aspect of station life (the making of objects); • demonstrate the practice of repurposing – a characteristic common to the material culture on station.
3.2	**Please comment:** These objects pose no risk to the environment.
3.3	*Consider whether the heritage values reside solely in the object, or are dependent upon the object's location.* **Please comment, in relation to the heritage values stated in Stage 2:** These objects have little evidential significance i.e. they do not enhance understanding of the historical, technological or scientific activities in Antarctica. Their significance is social/cultural in relation to current and previous station personnel / Fids. For former BAS staff, in particular those who worked with the dogs at Rothera, interest in this object would not be eroded if removed from Rothera, although their continued presence at Rothera would also be welcome. For current station personnel, the objects' significance is connected to: • the importance of a continuing connection with the past at Rothera – the persistence of the past (in the form of everyday, useful objects) contributing to the fabric of station life; • the pervading ethos of the importance of the re-use of objects that pervades the material culture of the station. The heritage value of these objects, as it relates to the ongoing material culture of the station, is therefore greatest if they remain in use at Rothera.
3.4a/b	*Consider the practicalities of the specific physical removal required to retain the heritage values stated in Stage 2.*

	Please comment: N/A – see 3.4c.
3.4c	*Consider (in relation to practicalities):* - *The current condition of the site / object;* - *Resource implications of preservation / conservation – is the resource and expertise available to prevent significant deterioration?* - *Resource implications of continuing maintenance / management, including the ongoing security and protection of the site/object and management of controlled visitation;* - *The impact of preservation work on wildlife.* *Specify the benefits of managing the object in situ.* **Please comment:** It is practical to, and there are clear benefits in, retaining these objects at Rothera. These objects are relatively small and easy to move / rehang, and pose no issues for retention at Rothera. They do not require specialist maintenance / management. They are currently in good condition and have been looked after and respected throughout their lifetime. There is no reason to suppose that their continued use would lead to their loss. The benefits of managing in situ relate to their significance to current station personnel noted in 3.3.
3.5	*Consider:* - *The accessibility of the site, in particular to those stakeholder groups identified in Stage 1 as valuing the heritage;* - *The potential to increase accessibility in the future, to engage/educate new stakeholder groups.* - *The aesthetic quality of the base and/or its setting in the landscape.* **Please comment:** N/A (see 3.4c)
3.6	**Please comment:** N/A
	Recommendations
	These objects to remain in use at Rothera. This will necessitate them being taken down and stored safely prior to re-development, and subsequent reinstatement in an appropriate location once development is complete. As the historical significance (as distinct from their social/cultural significance on station) is limited no specialised ongoing management/preservation is required, although their condition should be assessed periodically. Degradation through continued use is an acceptable aspect of the nature of their ongoing importance.

Signed by:	Ieuan Hopkins (Archives Manager)	**Date: Oct. 2018**

Signed by:	Camilla Nichol Chief Executive, UK Antarctic Heritage Trust	**Date: 07/01/2019**
Signed by:	Rachel Clarke, Head of Environment Office Rachel Clarke	**Date: Jan 19**

Stage 3: Heritage Management Flowchart



3.1 In relation to the heritage values identified in the statement of significance, is the item authentic?

Remove non-heritage item, in accordance with procedures (see appendix 2)

3.2 Does the item cause risk to the environment or safety which can only be mitigated by removal of the object? (NB: Environment Office to advise / agree on possible mitigating actions to minimise environmental impact)

3.3a Would heritage value be lost if item removed from Antarctica?

3.3b Would heritage value be lost if item removed from Antarctica?

Record heritage (see appendix 3), then remove in accordance with procedures (see appendix 2)

3.4a Is it **practical** to remove item from Antarctica in a way that preserves heritage value ?

3.4b Is it **practical** to remove item from Antarctica in a way that preserves heritage value ?

3.4c Is it **practical** to, and are there **clear benefits** of, managing ongoing preservation in-situ?

Record heritage (see appendix 3), then periodically monitor condition (see appendix 4) **OR** remove according to procedures (appendix 2)

3.5 Are there clear benefits of ongoing management / preservation in situ that outweigh the benefits of removal?

3.6 Has repository been identified to provide necessary ongoing preservation and access to object?

Process on hold until repository identified (continue to periodically monitor condition) OR remove (see appendix 2)

Initiate removal and transfer of heritage item, according to procedures (see appendix 6)

Initiate ongoing preservation process according to procedures (see appendix 5)

Appendix G: Monitoring Plan

Appendix G: Rothera Modernisation Monitoring Plan

Appendix G: Rothera Modernisation Monitoring Plan

The monitoring activities at Rothera Research Station detailed in this section are those that will require the collection of information or data to verify the effectiveness of the impact prediction and proposed monitoring described in the Rothera Modernisation IEE.

The main impacts identified in this assessment for which there are key environmental indicators include the contamination of the terrestrial environment, noise, vibration, dust and wildlife displacement.

The monitoring tasks are split into three types of activities;

1. Short term monitoring of activities which could result in an immediate impact on the environment and can be modified during the construction programme to avoid adverse effects. This will include monitoring of the following activities:
    - Neutralisation of cement contaminated water
    - Wildlife displacement
    - Noise from quarrying and construction activities
    - Vibration from quarrying and construction activities
    - Airborne dust
2. Monitoring of environmental parameters which may reflect impacts that can only be measured in the long term (i.e. over several Antarctic seasons) and subsequently are unlikely to be modified beyond the original mitigation identified in the EIA. This will include monitoring of Skua breeding success on Rothera Point

Any changes to activities proposed as a result of the monitoring data, will be made by the Construction Manager in conjunction with the BAS Environment Office. All monitoring data will be communicated to the BAS Environment Office and be available on request for auditing purposes.

3. Environmental management activities – these will be undertaken by the construction partner as indicated in the table below and the data or findings reported to the BAS Environment Office.

Environmental Management Activities

Environmental Management Activity	Location in EIA	Reporting Output
Waste Management: segregation, packaging, storage and disposal of waste as per the SWMP and BAS WMH	Appendix B	▪ Waste Transfer Notes ▪ Waste Data
Biosecurity: Implementation of the Rothera Biosecurity Plan at all stages of cargo and personnel movement	Appendix C	▪ Biosecurity Checklists ▪ Biosecurity breaches reported
Fuel Management: daily refuelling as per refuelling procedure.	BAM refuelling procedure – Section 6.1	▪ Training records of staff ▪ Fuel spills reported ▪ Fuel consumption for carbon accounting
Oil Spill response: BAM staff will respond to all Tier 1 spills and follow the direction of Rothera Station Leader for all Tier 2 and Tier 3 spills. BAM will	BAM Oil Spill Contingency – Section 6.1.4	▪ Fuel spills reported ▪ Spill kits used and disposed of appropriately

provide appropriate spill response equipment.	BAM Spill Response Equipment – Section 6.1.5	

In addition BAS will continue to monitor waste statistics, fuel use for construction activities, and fuel use for carbon accounting e.g. flights, ships etc. which will be reported annually to the FCO as the UK's competent authority.

A. Neutralisation of cement-contaminated water

1	**Monitoring type and purpose**:
	Measurement of the pH of cement contaminated water, to ensure only pH neutral water is discharged into the environment NB: Neutralised water must be discharged below the low water mark in North Cove.
2	**Description of the monitoring activity**:
	Use of cement may produce waste water that is strongly alkali. Before release into the local marine environment, the waste water should be neutralised using citric acid.
3	**Methodology used** (equipment, thresholds)
	A pH meter will be used to ensure waste water matches the pH of the sea water before it is discharged to the ground.
4	**Designated person undertaking the monitoring**
	BAM Site Environmental Engineer
5	**Period over which monitoring will occur**
	Monitoring only needs to occur during the period of cement use and when waste water is generated. Estimated volumes of wash waters would be c. 3 m^3.
6	**Frequency of monitoring**
	During period of neutralisation of cement contaminated waste water, and immediately prior to subsequent disposal.
7	**Action(s) should any thresholds be exceeded**
	Should the pH not be reduced to pH 7.0, the waste water shall not be released, but more CO_2 bubbled thought the waste water until the desired pH is achieved.
8	**Recording and management of monitoring data**
	For each water release event, the following information shall be recorded and reported to the Environment Office. • The volume of neutralised water released to the environment • The pH of the water
9	**Method of results communication to the Environment Office**
	• The monitoring data must be presented to the Environment Office every two weeks on the a *Monitoring and Reporting Schedule*, and in a final report submitted at the end of each season. • Should any waste water be released to the environment that has not been adequately neutralised (pH 7.0) then the Environment Office shall be informed immediately and an AINME report describing the circumstances submitted within 24 hours.

B. Wildlife displacement

NB: Displacement of flying birds not associated with nests are not included in this monitoring, as numbers in the vicinity of the wharf and station are typically low and these birds are will readily fly away if approached.

1	**Monitoring type and purpose:**
	Recording of wildlife displacement, i.e. herding of seals and penguins located on land to remove them from areas where work is being undertaken or vehicle access routes. • All those moving or herding wildlife must have undergone training on station by BAS management. • No bird nest sites are to be moved or physically disturbed by individuals or machinery, without prior consultation with the BAS Environment Office
2	**Description of the monitoring activity**
	Records must be kept of all wildlife displacement events involving seals and penguins. Such events may include the movement or herding of seals or penguins to allow the site to be secured (to enable, for example, building work to commence) or for vehicle movement around Rothera Point.
3	**Methodology used (equipment, thresholds)**
	Visual observations and recording of the species displaced. Thresholds: • more than five seal displacement events per day, or • more than five penguin displacement events per day
4	**Designated person undertaking the monitoring**
	BAM Site Environmental Engineer or other trained personnel
5	**Period over which monitoring will occur**
	Recording shall be undertaken during the period when BAM is present on site
6	**Frequency of monitoring**
	Displacement events must be recorded following every occurrence.
7	**Action(s) should any thresholds be exceeded**
	Should the thresholds be exceeded, then BAM shall contact the Environment Office within 24 hours to discuss the feasibility of mitigation measures.
8	**Recording and management of monitoring data**
	For each displacement event record the following information: • Number, type, and maturity of displaced seals or penguins (where known) • Reason for displacement (e.g. vehicle movements) • Location where wildlife was moved from and where it was moved to
9	**Method of results communication to the Environment Office**
	• The monitoring data must be presented to the Environment Office every two weeks on the *Monitoring and Reporting Schedule*, and in a final report submitted five months after the commencement of the construction work at Rothera Research Station. • Any wildlife injury or fatality associated with the work should be reported immediately to the Environment Office and an AINME report submitted within 24 hours.

D. Noise from quarrying and construction activities

1 **Monitoring type and purpose:**

Air overpressure and noise from quarrying and construction activities. Excessive noise may cause disturbance to local wildlife and needs to be monitored to ensure thresholds are not exceeded.

Before commencing use of particularly noisy equipment (e.g. hydraulic breaker or impact driver) consideration should be given to the impact upon wildlife. Animals on land are likely to move away from the noise source at the commencement of the activity. To allow this to occur, if wildlife are in the vicinity of the work, the noise source should be operated for 30 seconds then switched off, to allow animals the opportunity to move away. Once any disturbed animals have stopped moving, operate the equipment for another 30 seconds and then observe the response of the animals. Continue this cycle until the wildlife has moved away to a distance where the noise no longer causes further movement away. Only then should the equipment be used more continuously.

2 **Description of the monitoring activity**

Air overpressure from quarry blasting

Although it is possible to make predictions of the attenuation of air-overpressure, it is considered unrealistic to do so due to the affect that meteorological factors and surface topography have on the transmission of this energy. UK guidance contained within mineral planning guidance MPG 9:1992 and MPG 14:1995, MTAN1 (Wales) and the UK Department of the Environment, Transport and the Regions report 'The environmental effect of production blasting from surface mineral workings 1998' recommend that air overpressure should be controlled at source rather than setting a specific limit. Control measures will therefore be used as detailed in (Section 10.4.2.2)

Noise from construction activities

Monitoring will occur at sites around Rothera Point to estimate the noise generated by de-construction/construction activities, rock crushing and grading, and plant operation and movement.

3 **Methodology used (equipment, thresholds)**

Noise shall be monitored using a Norsonic Nor140 Sound Analyser.

One monitor shall be positioned at each of the following sites:

1. In the proximity of the nesting skuas midway along the roughly N-S 'ridge' of Rothera Point
2. Within the ASPA.
3. Admirals House
4. Bonner Laboratory

In the absence of established Antarctic limits, noise thresholds will be monitored in accordance with British Standard 5228 Part 1, i.e. 'noise levels… …should not exceed: 75 decibels (dBA) in urban areas near main roads in heavy industrial areas'.

The noise level will be recorded as a LAeq $_{12\text{ Hour}}$. This is the equivalent noise level over a 12 hour period.

4	**Designated person undertaking the monitoring**
	BAM Site Environmental Engineer
5	**Period over which monitoring will occur**
	During entire build period
6	**Frequency of monitoring**
	Continuous
7	**Action(s) should any thresholds be exceeded**
	Activities related to vehicle movement and de-construction/construction must cease and noise management be reassessed. If thresholds are exceeded, noisy activities should not be undertaken simultaneously, but rather rescheduled to occur sequentially and thereby reduce the noise. Acoustic screens may be used to further reduce noise levels.
8	**Recording and management of monitoring data**
	Noise data must be backed up once downloaded from measuring equipment to ensure data are not lost
9	**Method of results communication to the Environment Office**
	• A brief summary of the monitoring data showing any exceedances of the limits and the maximum recorded levels from each monitor shall be submitted to BAS daily on the *Monitoring and Reporting Schedule*, when noisy activities have occurred. A full summary of the monitoring data must be presented to the Environment Office in a report submitted at the end of each season. The raw data files must also be made available. • Should mitigation measures and practices be insufficient to keep noise levels below the threshold, contact must be made with the Environment Office at the earliest opportunity to discuss further options.

E. Vibration from quarrying and construction activities

1 **Monitoring type and purpose:**

Vibration from quarrying and construction activities. Vibration will be monitored to ensure levels do not significantly impact upon local wildlife.

Before commencing use of particularly noisy equipment (e.g. hydraulic breaker or impact driver) consideration should be given to the impact upon wildlife. Animals on land are likely to move away from the noise/vibration source at the commencement of the activity. To allow this to occur, the noise/vibration source should be operated for 30 seconds then switched off, to allow animals the opportunity to move away. Once any disturbed animals have stopped moving, operate the equipment for another 30 seconds and then observer the response of the animals. Continue this cycle until the wildlife has moved away to a distance where the noise/vibration no longer causes further movement away. Only then should the equipment be used more continuously.

2 **Description of the monitoring activity**

Vibration from quarrying activities

Vibration from construction activities
Monitoring of vibration from construction activities (vehicle movement, etc.) shall be done to ensure local receptors are not impacted above threshold levels (see below).

3 **Methodology used (equipment, thresholds)**

Vibration from quarrying

During operations, blasting vibration levels will be monitored using Instantel® Minimate Pro6™ vibration and overpressure monitors to measure levels of peak particle velocity and air-overpressure at selected site sensitive locations. This monitoring will be both to ensure compliance with site threshold limits and to further increase the number and distribution of results, to allow continuous improvement of vibration prediction models and increasing confidence in MIC predictions.

Monitoring should initially be undertaken at the closest sensitive receptors of each type. Once confidence is gained that vibration limits will not be exceeded at these receptors, monitoring should continue at varied distances to obtain data for prediction models.

Vibration form construction activities
Vibration from construction activities will be monitored using Mabey triaxial vibration monitors.
In the absence of established Antarctic limits, noise thresholds will be monitored in accordance with British Standard 5228 Part 2, i.e. 3.0 ms^{-1}

Monitors shall be positioned:
1. Bentham Container
2. Within the ASPA.
3. Admirals House
4. Bonner Laboratory (to be reviewed after 2019/20 season)

4	**Designated person undertaking the monitoring**
	BAM Site Environmental Engineer
5	**Period over which monitoring will occur**
	During entire build period
6	**Frequency of monitoring**
	Continuous
7	**Action(s) should any thresholds be exceeded**
	Activities must cease and noise/vibration management reassessed. If thresholds are exceeded, activities likely to produce substantial vibration should not be undertaken simultaneously, but rather rescheduled to occur sequentially and thereby reduce the total level. Acoustic screens may be used to further reduce noise levels.
8	**Recording and management of monitoring data**
	Noise data must be backed up once downloaded from measuring equipment to ensure data is not lost.
9	**Method of results communication to the Environment Office**
	• A brief summary of the monitoring data showing any exceedances of the limits and the maximum recorded levels from each monitor shall be submitted to BAS daily on the *Monitoring and Reporting Schedule* when vibratory activities have occurred. A full summary of the monitoring data must be presented to the Environment Office in a report submitted at the end of each season. The raw data files must also be made available. • Should mitigation measures and practices be insufficient to keep vibration levels below the threshold, contact must be made with the Environment Office at the earliest opportunity to discuss further options.

G. Airborne dust

1	**Monitoring type and purpose:**
	Dust and particulate deposition may have adverse impacts upon the melting rate of the ice ramp, the small areas of vegetation present on Rothera Point and the breathing of personnel.
2	**Description of the monitoring activity**
	Monitoring of dust will be undertaken to ensure excessive generation is avoided for the duration of the quarrying and construction process.
3	**Methodology used (equipment, thresholds)**
	Particulate monitoring will be undertaken using an Aeroqual Dust Sentry with a threshold of >250 µg particulates m^{-3} 15 min^{-1}. Monitoring equipment shall be positioned: 1. At the bottom of the ice ramp (i.e. on the opposite side of the runway relative to the station buildings). 2. Within the ASPA. 3. Beside the area of green vegetation located behind the miracle span
4	**Designated person undertaking the monitoring**
	BAM Site Environmental Engineer
5	**Period over which monitoring will occur**
	During entire build period
6	**Frequency of monitoring**
	Continuous
7	**Action(s) should any thresholds be exceeded**
	Dust suppression strategies will be investigated to reduce dust levels associated with quarrying and deconstruction/construction activities.
8	**Recording and management of monitoring data**
	Particulate data must be backed up once downloaded from measuring equipment to ensure data is not lost.
9	**Method of results communication to the Environment Office**
	• A brief summary of the monitoring data showing any exceedances of the limits and the maximum recorded levels from each monitor shall be submitted to BAS daily on the *Monitoring and Reporting Schedule* spreadsheet, when dusty activities have occurred. • A summary of the monitoring data must be presented to the Environment Office in a report at the end of each season. The raw data files must also be made available. • Should mitigation measures and practices be insufficient to keep dust levels below the threshold, contact must be made with the Environment Office at the earliest opportunity to discuss further options.

H. Skua breeding success on Rothera Point

1	**Monitoring type and purpose:**
	Skua breeding success on Rothera Point. Nesting skua populations on Rothera Point may be vulnerable to disturbance associated with the proposed works. This monitoring work will proceed to assess the impact of the quarrying and construction activities on skua breeding success.
2	**Description of the monitoring activity**
	BAS routinely undertake monitoring of skua breeding success as part of its long-term monitoring commitments.
3	**Methodology used (equipment, thresholds)**
	The breeding parameters that will be recorded include laying dates, clutch size, egg dimensions, hatching success, fledging success, chick condition and adult attendance (which provides an index of foraging effort). In addition, monitoring includes re-sighting of colour-ringed adults, which can be used to estimate adult survival, breeding frequency and divorce rates, and to determine the breeding histories of individuals and the effects of mate change. In addition, there will be monitoring of birds on Anchorage Island, which will act as controls.
4	**Designated person undertaking the monitoring**
	BAS: Bonner Lab Manager
5	**Period over which monitoring will occur**
	Each summer (November – March) for each construction season 2019-2020, 2020-2021, 2021-2022, 2022-2023.
6	**Frequency of monitoring**
	Weekly
7	**Action(s) should any thresholds be exceeded**
	Should any direct physical damage to birds or nests be noted, this will be communicated to the Environment Office immediately and an AINME report completed within 24 hours.
8	**Recording and management of monitoring data**
	Data are routinely recorded by the Bonner Lab Manager and submitted to the BAS Data Centre
9	**Method of results communication to the Environment Office**
	• A summary of the monitoring data must be presented to the Environment Office at the end of each breeding season. • Should any direct physical damage to birds or nests be noted, this will be communicated to the Environment Office immediately and an AINME report completed within 24 hours.

Appendix H: Noise Assessment

Antarctic Construction Partnership – Rothera Modernisation

Employer	NERC/British Antarctic Survey	Project Number	BAA4008
Tech Adv	Ramboll	Document Number	BAA4008-BAM-ZZ-YYY-RC-YE-0006
Contractor	BAM	Revision	P01

Rothera Modernisation - Terrestrial Noise Assessment

Reference Sheet

Document Number	Description
BAA4008-BAM-ZZ-YYY-SP-WA-0016	Rothera Modernisation Method Statement
BAA4008-BAM-ZZ-YYY-SP-WA-0014	Project Execution Plan
	Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (published by NOAA)
	A synthesis of two decades of research documenting the effects of noise on wildlife. Graeme Shannon and others
	Fieldwork at Año Nuevo. Colleen Reichmuth, Caroline Casey, and others
	Effects of Continuous Noise on Avian Hearing and Vocal Development by Peter Marler et al.
	Effects of Traffic Noise and Road Construction Noise on Birds (published by the California Department of Transport)
	University of Rhode Island – Discovery of Sound in the Sea (Website)
	Review of Effects of Construction Noise on Birds in SSSI near Springs Road Exploratory Wellsite by Simon Stephenson of RPS
	BS5228 Part 1

Revision History

Revision	Date	Revision Description

Prepared by	Checked by	Approved by
NGO	DPH	John Clancy
Author	Project	Area Environmental Advisor

Status Definition (latest revision)	Total number of pages (Excluding attachments)
	14

Uncontrolled when printed, unless stamped in RED to the contrary.

Table of contents

1 Introduction

1.1 Purpose

This assessment has been carried out to evaluate the environmental impact of noise generated from the modernisation works at Rothera research station and the associated quarrying works.
The main noise generating activities associated with the wharf construction which have been assessed for their impact are;

- Quarry operations
- Material transportation
- Backfilling operations
- Bored piling
- Demolition works
- Construction of the Science / Operations Building

1.2 Rothera Research Station

Rothera Research Station is situated on Adelaide Island on the Antarctic Peninsula within the British Antarctic Territory. Rothera is approximately 1,400 km south of the South American mainland. The station is operated by the British Antarctic Survey (BAS). The research station comprises: living accommodation, science laboratories, boatshed, fuel storage facilities, meteorological and communications equipment, equipment storage and waste treatment facilities. Access can be made by air or by sea via a temporary wharf, with the new permanent wharf becoming available at the end of the 2020 season.

The ridge, which runs north to south along Rothera Point, provides nesting and breeding sites for South Polar Skuas and Dominican Gulls. Other seabirds also visit the station including Antarctic Terns, Wilson's Storm Petrel and Blue Eyed Shags. Adélies are the most numerous penguin species around Rothera, with chinstrap and gentoos occasionally present in the summer.

Weddell seals, which are present year-round, are the most obvious mammal around the station. Pups are born on the sea ice in late September. Crabeater and elephant seals are also present, fur seals arrive in varying numbers at the end of summer, and although leopard seals are present all year round, they are seen only infrequently.

1.3 Project Background

The Rothera Modernisation project encompasses significant investment to modernise and restore the Rothera infrastructure so that it remains cost effective and safe. Many of the existing buildings have reached or are fast approaching the end of their economic life driving up maintenance costs and reducing organisational resilience.

The objective of the project is to reduce operating costs at Rothera, whilst maintaining the current level of Antarctic presence, through:

- Replacing aged buildings with modern more flexible spaces to minimise future maintenance and operating costs and significantly improve the energy efficiency.

- Consolidate and rationalise the existing estate to provide infrastructure that minimises energy

The Rothera Modernisation project will commence construction in the 2019/20 season with earthworks and enabling works for the new operations building to be founded between the vehicles garage and New Brandsfield House. There will be a wholesale replacement of the site wise utilities infrastructure for the remaining buildings and provision for future modernisation phases. The new building will replace 6 existing buildings and a dozen structures and ISO containers. These building will be demolished as part of the project.

External work is only possible during the Antarctic Summer season, between November and May.

2 Legislative Framework and Policy Context

All activities in the Antarctic are governed by the Antarctic Treaty (1959) and the Protocol on Environmental Protection to the Antarctic Treaty (1991). The Protocol consists of 5 annexes:

- Annex I: Environmental Impact Assessment;
- Annex II: Conservation of Antarctic fauna and flora;
- Annex III: Waste disposal and waste management;
- Annex IV: Prevention of marine pollution;
- Annex V: Area protection and management;
- Annex VI: Liability arising from Environmental Emergencies
- Annex II commits signatories to the comprehensive protection of the Antarctic environment and dependent and associated ecosystems.

The UK has enacted domestic legislation to enforce the provisions of the Protocol through the Antarctic Act 1994 and the Antarctic Regulations 1995/490 (as amended).
Whilst most UK environmental legislation is not applicable in the Antarctic, the requirements of UK legislation should be considered and regarded as best practice where relevant.

3 Assessment Methodology

This assessment consists of four parts

- Baseline environment
- An assessment of the sensitive receptors in the vicinity of the works and their sensitivity to noise
- simple calculations to predict the noise levels at sensitive receptors

An assessment of sensitive terrestrial environmental receptors at KEP has been undertaken by Kevin Hughes of BAS. This has provided information on species present in the area, their location and their breeding dates. Information on species sensitivity to noise has been sought from academic papers on the subject.

Calculations of noise propagation have been carried out in accordance with BS5228 Part 1, Code of Practice for Noise and Vibration Control on Construction and Open Sites. Noise levels for construction operations have been taken from Annex C. Where the exact activity and plant item are not available, the next largest piece of plant has been used in order to produce a conservative assessment.

4 Baseline Environment

As part of the noise assessment process, the existing ambient noise environment at Rothera should ideally be determined for the purpose of establishing both the level and character of noise already impacting on the site and the visiting birds prior to the commencement of construction activities. The ambient noise levels at Rothera are dominated by wind noise but also include noise from wildlife (particularly elephant seals) and vehicle and plane movements associated with base operations.

Noise monitoring was established at Rothera before the start of construction works on Rothera Wharf in December 2018. Monitors were erected at 4 locations around the station: the Bonner Laboratory, Admirals House, Rothera Ridge and in the Antarctic Special Protected Area (ASPA) 129. The monitors at Rothera Ridge and Admirals House are the closest monitors to the two receptor locations chosen for assessment in 5.1.4 of this report. The monitor at Admirals House, unfortunately was not operational before works commenced on the Wharf.

The monitor at Rothera Ridge recorded maximum sound pressure levels $L_{Aeq\ 15\ min}$ of 62.1dB$_A$ and $L_{Aeq\ 12\ hour}$ of 54.3dB$_A$. These levels were recorded prior to wharf works commencing.

It should be noted that maximum noise levels at over locations around the station could be significantly higher.

The noise off aircraft taking off is measured in Effective Perceived Noise (EPN). This is an integral of the sound power emitted during the take-off. Although data was unavailable for DHC-6 and DHC-7 aircraft used by BAS, similar aircraft have noise levels at take-off of around 90 EPNdB, (Focker F27 take off noise data from European Union Aviation Safety Agency data)

As discussed in section 6 of this assessment, the noise emitted by male elephant seals has been recorded to be as loud as 126dB, contributing significantly to the baseline noise at Rothera

5 Receptors

5.1 Ecology

5.1.1 Seals

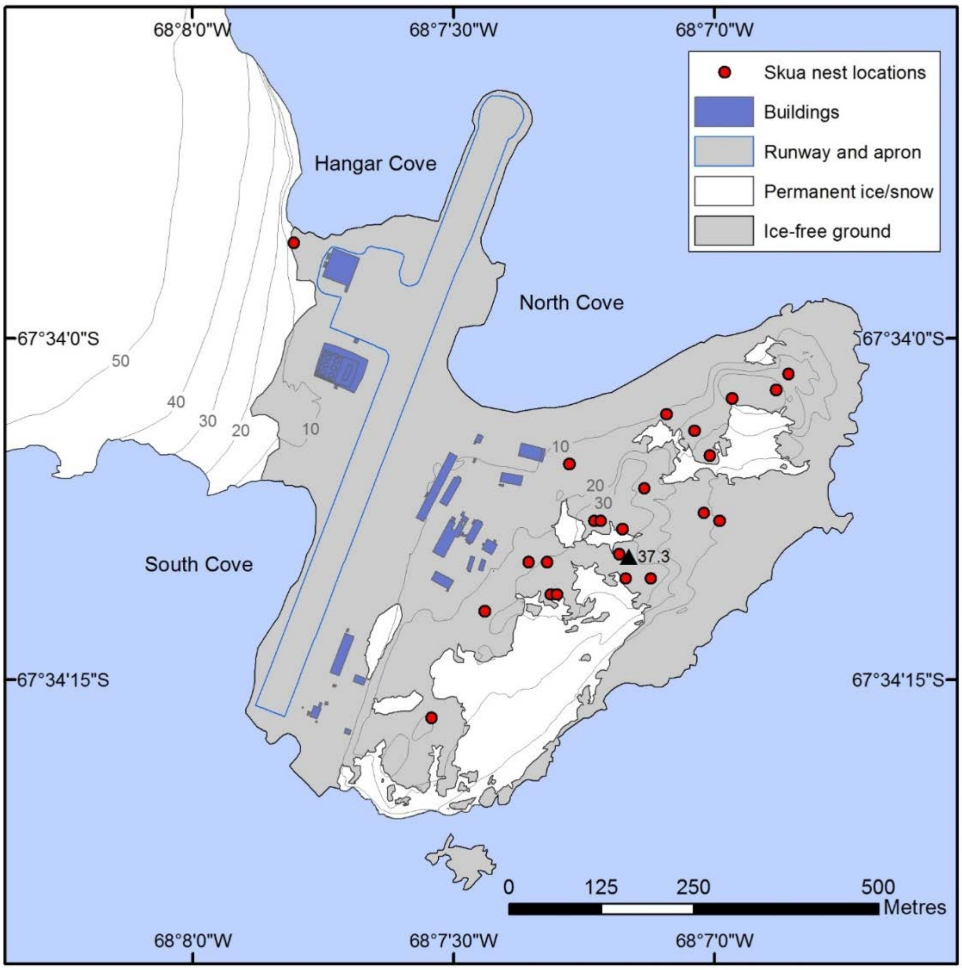
Southern Elephant Seals (Mirounga leonine) bask around the station and are therefore the closest mammalian receptors to the noise generated from the construction works.
Whilst Fur, Weddel and Crabeater Seals are present around the point, there distance from the construction works are significantly greater than the Elephant Seals, so these are not considered in this assessment.

5.1.2 Birds

South Polar Skuas and Dominican Gulls are the only birds that breed at Rothera, nesting along the rocky ridge which runs north to south along the point. The table below shows previous nesting sites for Skuas. Whilst these birds tend to nest in the same location each year, it is possible that new nest sites could be established, but these are likely to be in the same general area.

South Polar Skuas arrive at their breeding colonies in late October to mid-December. The eggs hatch in late December to late January after an incubation period of 24–34 days. Young may leave the nest soon after hatching and wander in the immediate vicinity. Typically their age at first flight is 49-59 days.

Figure 5.1.2 Breeding Sites for Skuas at Rothera



Whilst other birds such as Antarctic Terns, Wilson's Storm Petrel, Blue Eyed Shags and penguins are present at Rothera, they do not breed there and therefore can move away from sources of noise if they wish to.

5.2 Humans

The BAS Research Station at Rothera can be home to over 100 staff during the summer months. This will be boosted by up to 45 construction staff.
Accommodation is provided in Admirals House, Giants and Vikings. Admirals House is the closest accommodation block to the works and this is typically where those on night shifts are housed.

5.3 Receptor Locations to be Assessed*.*

Based on the distribution of the receptors discussed and the areas where the majority of noise will be generated from construction activities, three locations have been chosen.

- Admirals House: This is the closest living accommodation to the majority of the works and is where those on night shifts are normally housed. This location has therefore been assessed for the effects of construction noise on humans.
- Bridge over Service corridor: This bridge is frequently used as a basking location for Elephant Seals. This location has therefore been assessed for the effects of construction noise on seals. This is in approximately the same are as Admirals House and therefore distances to Admirals house have been used.

- Behind The Generator Shed: The closest recently used nesting site for South Polar Skuas is behind The Generator Shed. This location has therefore been assessed for the impact of construction noise on birds.

Noise will be modelled at these locations and compared with thresholds, which are discussed in the next section of this assessment.

6 Sensitivity of Receptors

6.1 Response to Noise

Animals can respond to noise in different ways depending upon how they perceive the noise. Noise can be perceived as a threat or in some instances, noise may provide a shelter from disturbance-sensitive predators. Extended exposure to noise sources may ultimately lead to tolerance or habituation, particularly if it provides an indirect benefit such as predator shelter. The numbers of elephant seals at Rothera, which anecdotally were at their highest levels during the 2018/19 season, demonstrate a level of tolerance to the normal noise of operations at Rothera.

Noise can cause an inability to detect acoustic cues from conspecifics, predators, prey or the environment, which can alter predator–prey interactions, reduce reproductive success and change settlement dynamics. Noise can also be a direct stressor causing pain and at elevated levels can cause temporary or permanent damage to hearing.

6.2 Seals

Much research has been carried out into the levels of noise that cause both temporary threshold shift (TTS) and permanent threshold shift (PTS) in marine mammals, although this research typically looks at underwater sources of anthropogenic noise. The National Oceanic and Atmospheric Administration (NOAA) has published Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing, which was last revised in April 2018. This document classifies marine mammals into 6 categories and provides underwater noise levels for the onset of TTS and PTS in each category. The category of interest for this assessment is Phocids (incl. Elephant Seals).

No information on the noise levels required to induce hearing loss in seals in air has been found.

The NOAA Technical Guidance gives the following levels for the onset of TTS in water

- Phocids 180 dB SEL re 1 μPa^{2}s

Sound waves with the same intensities in water and air when measured in watts per square meter have relative intensities that differ by 61.5 dB. This amount must be subtracted from sound levels in water referenced to 1 micro Pascal (μPa) to obtain the sound levels of sound waves in air referenced to 20 micro Pascals (μPa) that have the same absolute intensity in watts per square meter. The difference in reference pressures causes 26 dB of the 61.5 dB difference. The differences in densities and sound speeds account for the other 35.5 dB. (From University of Rhode Island – Discovery of Sound in the Sea Website)

Therefore, referenced to 20 micro Pascals in air the following levels for the onset of TTS can be calculated.

- Phocids 118.5 dB SEL re 20 μPa^{2}s

Sound Exposure Level (SEL) is the numerically equivalent to the total sound energy and is normalised to 1 second.

Whilst this method for developing a threshold for TTS in air cannot be proved, experiments by D. Kastak and R.J. Schusterman (1999) show that the threshold of hearing of Elephant seals in water is 19 dB lower than corresponding in-air thresholds when compared in terms of sound pressure, and 52 dB lower when compared in terms of sound intensity. The Sound exposure levels calculated for the onset of TTS are therefore probably conservative.

Further evidence of the poor hearing of elephant seals in air is also discussed in the paper. Acoustic signals produced by this animal in air are loud and repetitious and are sometimes accompanied by exaggerated visual displays (Bartholomew and Collias 1962). Additionally, it has been suggested that seismic cues, produced by displaying males slamming their forequarters on the ground, are important in intra-individual signalling (Shipley et al. 1992)

Elephant Seal calls on land need to be loud in order to overcome ambient noise, especially that of the wind and surf. The peak loudness has been recorded at 126 dB, which is among the loudest of mammal sounds on land, according to fieldwork carried out at Año Nuevo by Colleen Reichmuth, Caroline Casey, and others (No weigting was mentioned in this report)

6.3 Birds

Construction noise can have several effects on birds. Low levels of noise can produce behavioural and/or physiological response. Increasing levels of noise will mask communication signals between birds. Still higher levels of noise are likely to cause temporary or permanent damage to the hearing organs which is shown as a shift in the hearing threshold.

A 2009 report by Institute of Estuarine and Coastal Studies (IECS), University of Hull observed the effects of disturbance to waterbirds from different activities that may arise as a result of a construction project. Five levels of disturbance impact were defined for feeding and roosting, as shown in Table 6.3 below.

Table 6.3 IECS Noise Impact Criteria

Level	Impact	Effect Level	dBA	Type of Noise
1	No impact	Low	Below 50	Regular construction noise
2	Behavioural changes (alarm calls, heads up, change in feeding/roosting activity)	Moderate	Equal to or below 70	Piling noise
3	Movement within zone	Moderate to high	Above 70	Piling noise
4	Movement out of zone but remaining on site	High	Above 85	Piling noise
5	Movement off site	High	Not defined	

Marler et al (1973) subjected canaries to sound pressure levels of 95 to 100 dB for 40 days which produce a 20dB threshold shift. Although the frequency spectrum was not entirely flat, it covered the hearing range of the canary and was not heavily weighted in any one part of it. The paper, “the paper Effects of Continuous Noise on Avian Hearing and Vocal Development” looked at the development of vocalisation in canaries and did not consider the levels of onset of threshold shifts.

The California Department of Transport published guidelines in 2016 on the Effects of Traffic Noise and Road Construction Noise on Birds. This document suggests that continuous traffic and construction noise above a sound pressure level of 93 dB_A may cause TTS.

6.4 Humans

The effects of noise on humans can be considered in two ways; disturbance and health.

BS5228 looks at the disturbance caused by construction noise and outlines methods for methods for assessing the significance of the disturbance to humans. The two main methods outlined are;

- Significance based on fixed noise limits

- Significance based upon noise change

As background noise level across all areas where construction noise may cause an impact is not available, only significance based on fixed noise limits can currently be assessed.

The standard 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 75 decibels dB_A in urban areas near main roads in heavy industrial areas. Since Rothera Research Station has a landing strip and often sees movements of large plant around the station, it has been considered as an urban environment for the purposes of this assessment.

Under the Health and Safety of Work Act, producers of noise associated with work activities have a duty of care toward the public. The Control of Noise at Work regulations require employers to protect persons against risk to their health and safety arising from exposure to noise at work. These regulations only cover the protection of employees, however the action levels set in the regulations can be useful in assessing the impacts of noise on the public. Three action levels are set:

Lower exposure action value	a daily or weekly personal noise exposure of $80dB_A$
Upper exposure action level	a daily or weekly personal noise exposure of $85dB_A$
Exposure limit value	a daily or weekly personal noise exposure of $87dB_A$

If an employee is subjected to the lower exposure action level, the employee must make hearing protection available. Above the upper exposure action level, hearing protection is compulsory. The exposure limit value is an absolute limit of the level of noise an employee can be subjected to (after attenuation from hearing protection is taken into account).

7 Construction Noise Sources

7.1 Derivation of Construction Noise Outputs

This assessment has considered the predicted noise produced by the construction works on a single theoretical day where the majority of large plant on site will be in use. The plant on this theoretical day will be distributed across 5 work sites plus vehicles moving between sites. An assessment has been made of the actual working time of each piece of plant. Noise levels for each piece of plant are obtained from appendix C of BS 5228 Part 1. Where data for the exact item of plant and activity it is performing are not available, the closest similar plant item / activity has been used.

8 Adjustments to Noise Levels

8.1 Distance

Noise is air attenuates over distance from the source. The source noise level quoted in BS 5228 or derived from manufacturers data in the previous section of this assessment are taken as being 10m from the source. With each doubling of distance, 6dB of attenuation is subtracted. This is expressed by the formula:
Attenuation = 20 x log (10/distance)

8.2 Screening

Screening can produce varied levels of attenuation depending primarily on the density of the screen and its position in relation to the source and receptor. The denser the screen, the more effective, particularly for lower frequency noise. A screen is more effective if placed directly adjacent to the source or the receiver. If placed equidistant between the source and the receiver, then the screen will have the lowest efficiency. It is very difficult to predict the exact performance of an acoustic screen. For this reason, BS 5228 has used a simplified approach.

If the source can be partially sighted from the receptor, a 5dB attenuation is applied. If the source is completely obscured from vision from the receptor, then a 10dB attenuation is applied.
For the purposes of this assessment, it has been assumed that there is no attenuation from screening unless screens have specifically been erected or formed for the purpose of noise reduction.

8.3 Units of results

Construction noise is normally reported as A weighted equivalent continuous sound pressure levels (L_{eq}) and calculations using BS5228 also produce outputs in L_{Aeq}. The level of onset of TTS in seals referred to in this assessment is a sound exposure level (SEL). In order to produce outputs of construction noise as an SEL, the total energy of the construction works over the 12 hour period calculated in BS5228 will need to be expressed as a single event of 1 second. This can be calculated using the formula below.
$SEL = L_{eq} + 10\log T/T_0$ where $T_0 = 1$ second and T = 43,200 seconds (12 hours)

9 Periods of Assessment

Whilst the modernisation works are due to continue for 4 seasons, the period when the most noise is to be generated from these works are during season1. During this season, the wharf construction works will also be ongoing and must also be added to this assessment.
The period considered in this assessment is February 2020 as during this month the majority of the noisy activities will be undertaken, both by the wharf team and the modernisation team.
During this period, the following activities will be ongoing.
Modernisation:

- Excavation and Quarrying at the new Operations Building location
- Transfer of quarried / excavated material to the stockpile adjacent to the fuel farm
- Screening of materials at the stockpile
- Diversion of services / Site wide service

Wharf

- Placing steelwork
- Transferring fill from the stockpile to the wharf
- Placing fill

For consideration of noise at the Skua nest site, the service diversions have been considered, as these are nearer than the site wide services work. For admirals House and the service bridge the noise from the site wide services has been considered, again as the nearer of the 2 activities.

10 Calculations

Date:	Feb, 2020
Modernisation Activities:	Rock Removal, Rock Processing, Transporting Rock, Service Diversions
Wharf Activities:	Placing Steelwork, Transporting Fill, Placing Fill
Receptor:	Closest Recent Skua Nesting Site

Project	Plant type	Location	Data Source	LAeq at 10m dB	Distance m	Adjustments		Resultant LAeq dB	Distance ratio* max/min	Equiv. on time**	Duration of activity h	Duration of activity as %age of 12h %	Correction to LAeq, 12h h	Activity LAeq, 12h dB	Maximum L_{Aeq}	Activity SEL
						Distance dB	Screening dB									
Modernisation	49 Tonne Excavator	Quarry	Table C9-6	91	70	-17	0	74			8	67	-2	72	74	119
	35 Tonne Excavator	Quarry	Table C2-15	76	120	-22	0	54			8	67	-2	53	54	99
	C6 Drill Rig	Quarry	Table C9-3	91	70	-17	0	74			4	33	-5	69	74	116
	Screener	Mod Aggregate Stockpile	Table C9-15	96	325	-30	-5	61			6	50	-3	58	61	104
	Loading Shovel	Mod Aggregate Stockpile	Table C10-3	83	325	-30	0	53			8	67	-2	51	53	97
	25 Tonne Dumptruck	Quarry - Mod Stockpile	Table C10-19	87	70	-17	0	70	3.7	0.16	8	11	-10	60	70	107
	25 Tonne Dumptruck	Quarry - Mod Stockpile	Table C10-19	87	70	-17	0	70	3.7	0.16	8	11	-10	60	70	107
	35 Tonne Excavator	Service Diversions	Table C2-15	76	80	-18	0	58			9	75	-1	57	58	103
	Telehandler	Service Diversions	Table C2-35	71	80	-18	0	53			6	50	-3	50	53	96
Wharf	300 Tonne Crane	Wharf	Table C4-50	71	350	-31	0	40			6	50	-3	37	40	83
	300 Tonne Crane	Wharf	Table C4-50	71	350	-31	0	40			6	50	-3	37	40	83
	90 Tonne Excavator	Wharf	Table C6-4	80	350	-31	0	49			8	67	-2	47	49	94
	Loading Shovel	Wharf Aggregate Stockpile	Table C10-3	83	160	-24	0	59			8	67	-2	57	59	104
	25 Tonne Dumptruck	Quarry - Wharf Stockpile	Table C10-19	87	160	-24	0	63	1.9	0.40	8	27	-6	57	63	104
	25 Tonne Dumptruck	Quarry - Wharf Stockpile	Table C10-19	87	160	-24	0	63	1.9	0.40	8	27	-6	57	63	104

* Distance ratio = Minimum Distance to Receptor / Haul Traverse Length

** Equivelent on time derived from distance ratio and extracted from table F.2 in BS 5228 Part 1

Construction Noise Totals **75** **79** **121**

Modernisation Haul Distances

Traverse Length (m)	260
Minimum Distance (m)	70

Wharf Haul Distances

Traverse Length (m)	300
Minimum Distance (m)	160

Date:	Feb, 2020
Modernisation Activities:	Rock Removal, Rock Processing, Transporting Rock, Service Diversions
Wharf Activities:	Placing Steelwork, Transporting Fill, Placing Fill
Receptor:	Admirals House / Bridge Over Services (Elephant Seal Congregation Location)

Project	Plant type	Location	Data Source	LAeq at 10m dB	Distance m	Adjustments		Resultant LAeq dB	Distance ratio* max/min	Equiv. on time**	Duration of activity h	Duration of activity as %age of 12h %	Correction to LAeq, 12h h	Activity LAeq, 12h dB	Maximum L_{Aeq}	Activity SEL
						Distance dB	Screening dB									
Modernisation	49 Tonne Excavator	Quarry	Table C9-6	91	100	-20	0	71			8	67	-2	69	71	116
	35 Tonne Excavator	Quarry	Table C2-15	76	50	-14	0	62			8	67	-2	60	62	107
	C6 Drill Rig	Quarry	Table C9-3	91	80	-18	0	73			4	33	-5	68	73	115
	Screener	Mod Aggregate Stockpile	Table C9-15	96	160	-24	-5	67			6	50	-3	64	67	110
	Loading Shovel	Mod Aggregate Stockpile	Table C10-3	83	160	-24	0	59			8	67	-2	57	59	104
	25 Tonne Dumptruck	Quarry - Mod Stockpile	Table C10-19	87	20	-6	0	81	26.0	0.06	8	4	-14	67	81	113
	25 Tonne Dumptruck	Quarry - Mod Stockpile	Table C10-19	87	20	-6	0	81	26.0	0.06	8	4	-14	67	81	113
	35 Tonne Excavator	Service Diversions	Table C2-15	76	130	-22	0	54			9	75	-1	52	54	99
	Telehandler	Service Diversions	Table C2-35	71	130	-22	0	49			6	50	-3	46	49	92
Wharf	300 Tonne Crane	Wharf	Table C4-50	71	350	-31	0	40			6	50	-3	37	40	83
	300 Tonne Crane	Wharf	Table C4-50	71	350	-31	0	40			6	50	-3	37	40	83
	90 Tonne Excavator	Wharf	Table C6-4	80	350	-31	0	49			8	67	-2	47	49	94
	Loading Shovel	Wharf Aggregate Stockpile	Table C10-3	83	75	-18	0	65			8	67	-2	64	65	110
	25 Tonne Dumptruck	Quarry - Wharf Stockpile	Table C10-19	87	75	-18	0	69	3.7	0.20	8	13	-9	61	69	107
	25 Tonne Dumptruck	Quarry - Wharf Stockpile	Table C10-19	87	75	-18	0	69	3.7	0.20	8	13	-9	61	69	107

Construction Noise Totals **75** **85** **122**

* Distance ratio = Minimum Distance to Receptor / Haul Traverse Length

** Equivelent on time derived from distance ratio and extracted from table F.2 in BS 5228 Part 1

Modernisation Haul Distances

Traverse Length (m)	260
Minimum Distance (m)	10

Wharf Haul Distances

Traverse Length (m)	275
Minimum Distance (m)	75

10.1 *Summary of Calculations*

With Quarry 1 in operation, the predicted noise levels are as follows:

Receptor Location	SPL 12h Limit	SPL Max Limit	SEL Limit	Estimated SPL 12h	Estimated SPL Max	Estimated SEL
	(dB$_{A\ 12\ hour}$)	(dB$_{A}$)	(dB$_{A}$)	(dB$_{A\ 12\ hour}$)	(dB$_{A}$)	(dB$_{A}$)
Skua Nests	93			75	79	121
Admirals	75	80		75	85	122
Service Bridge			118.5	75	85	122

11 Results and Conclusions

11.1 *Discussion of Results*

The results of the calculations can be seen as a worst case scenario. The calculations assume that the noise sources are a the nearest probable distance to the receptors. They also include no attenuation effects of screening except for the screener in the quarry, which has had 5dB of attenuation in the calculations.

11.2 *Skua Nesting Sites*

The sound pressure levels at the closest recently used skua nesting site over the 12 hour working period are estimated to be 75 dB$_{A\ 12h}$ during the month of February. This is well below the level of 93 dB$_{A}$ and are therefore unlikely to cause physical damage to birds. The estimated maximum sound pressure levels of 79 dB$_{A}$ at this location are likely to cause disturbance to birds, but are unlikely to cause birds to leave the area.

11.3 *Admirals House*

The sound pressure levels at Admiral House over the 12 hour working day are predicted to be at the threshold of 75 dB$_{A\ 12h}$ discussed in section 5 of this assessment. Furthermore, the maximum sound pressure level is also at the 80 dB$_{A}$ lower exposure action value although this lower action level is for daily exposure so the 12 hour sound pressure levels are more suitable for comparing with this limit. Earplugs should however be made available for those who feel they require them.

11.4 *Service Bridge*

The sound exposure levels at the bridge over the services close to Admirals House are predicted to be 122 dB$_{A}$. This is above the threshold of 118.5 discussed in section 5 of this assessment. As also discussed in section 5, seals are not constricted to one area of the site and have the ability to move away from the source of disturbing noise. This threshold is based on a 12 hour working day, therefore if seals move away from the source of the noise when disturbed, they are unlikely to receive the full sound exposure level.

11.5 *Omissions*

Blasting activities have not been considered in this assessment. The effects of blasting are normally measured in air over pressure and not in sound pressure levels or sound exposure levels and cannot be added to the sound pressure levels used in this assessment. The noise from the blasting is unlikely to increase the 12 hour sound pressure levels or sound exposure levels due to its instantaneous nature. They will increase the instantaneous maximum sound pressure levels, but since an exclusion zone will be in place, this will have no effect on human receptors. The effects of this instantaneous maximum on seals and birds cannot be assessed with currently available data.

Demolition works on the Miracle Span have not been assessed. The noisiest element of the demolition works will be the use of a floor saw to cut up the concrete base into manageable pieces. The SPL of this saw at 10m is 91dB$_A$, equivalent to the C6 drill rig. These works are to be carried out when other works are not being undertaken due to the requirements for plant and personnel. Therefore, the sound pressure levels from the demolition works will replace the sound pressure levels of either the site wide services or the quarrying which will not be carried out concurrently.

11.6 Previous Assessments

Modelling of noise using the same method was carried out before commencement of the wharf construction project at Rothera. This assessment predicted that 12 hour sound pressure levels at the Bonner Laboratory would reach 83 dB$_{A\ 12h}$. These recorded maximum 12 hour sound pressure levels at the Bonner Lab during the 1st season of the wharf works rarely exceeded 75dB. Therefore, this assessment method can be regarded as extremely conservative.

11.7 Mitigation measures

The following mitigation measure may be used to reduce the impact of construction noise.

11.7.1 Positioning of Plant

Careful positioning of plant items, ensuring exhaust outlets point away from sensitive receptors, can help reduce the noise received by those receptors. Positioning plant as far as possible from site boundaries with environmentally sensitive areas will also reduce noise received by receptors.

11.7.2 Reduction in hours of operation of construction plant.

Both the equivalent sound pressure level (L$_{Aeq}$) and the sound exposure level (SEL) take into account the number of hours that a machine works. A judgement has been made when carrying out the calculations as to the probable number of hours each piece of plant will be operating. Reducing the hours the plant works for will reduce the sound pressure level and the SEL. A reduction in operating hours will however prolong the programme and is therefore not a viable option.

11.7.3 Blast Mats

Blasting mats are used when explosives are detonated in places such as quarries or construction sites. The mats are placed over the blasting area to contain the blast, suppress noise and dust as well as prevent high velocity rock fragments called fly rock from damaging structures, people or the environment in proximity to the blast site. These will be used during blasting for the modernisation works.

11.7.4 Acoustic Screening

Acoustic screening can attenuate noise by up to 20dB in an ideal situation although this ideal siting is unlikely in the construction environment and 10dB is more likely to be achieved. Screening is most effective if erected either close to the source or close to the receptor. Noise barriers are available at Rothera and could be deployed if monitoring results showed it was required.

11.7.5 Screening of Rock Processing

The formation of a stockpile of screened aggregates between the screener and the main parts of the station will act as an acoustic screen, reducing the sound pressure levels on station. A 5dB cut has been applied for this in the calculations.

11.7.6 Plant Maintenance

Well maintained plant will generates less noise. A fitter will be available on site to ensure that plant is regularly inspected and maintained.