BIRD ISLAND STATION REDEVELOPMENT

ENVIRONMENTAL IMPACT ASSESSMENT

BAS Environment Office

October 2017 (revision 2)

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British Antarctic Survey

NATURAL ENVIRONMENT RESEARCH COUNCIL

Cover Photo: View of Freshwater Bay and Bird Island Research Station by Adam Bradley

Contents

Non-Technical Summary

1. Introduction

This Environmental Impact Assessment (EIA) has been carried out by the British Antarctic Survey (BAS) for the redevelopment of Bird Island Research Station, Freshwater Inlet, Bird Island, South Georgia (lat. 54'00° S, long. 38'03° W). On the advice of the Government of South Georgia and the South Sandwich Islands, this bespoke EIA has been prepared and the headings and contents agreed prior to submission.

2. Description of the Proposed Activity

BAS proposes that the redevelopment of Bird Island Research Station will include:

- Replacement of the existing storage building (Beck House) with a larger more efficient building, including a dedicated biosecurity facility and waste management room
- Extension of the existing scaffold jetty into a longer and L-shaped jetty (to allow berthing of the new polar research ship cargo tender)
- Installation of a new bulk fuel tank to increase the quantity of fuel held on station and extend the period of time between ship relief visits.
- Redundant buildings and associated structures will be demolished and removed from Bird Island.

3. Alternatives

Six alternatives to the proposal were considered:

- Do the activity elsewhere
- Do nothing and continue using existing facilities at Bird Island
- Redevelop the existing buildings
- Alternative use of the proposed location
- Use of different power generation technologies

All alternatives were considered non-viable for logistical, environmental or efficiency reasons. The 'do activity elsewhere' option was rejected as this would impact previously undisturbed areas and would be impractical in terms of continued use of the existing BI facilities that remained in good condition. The 'do nothing' option was not acceptable because most buildings have already exceeded their intended lifespan and are no longer fit for purpose. Redevelopment of existing facilities is not practical as the existing buildings do not lend themselves easily to modification and this option would also require a higher level of long-term facilities maintenance. Alternative designs for the proposed location were rejected for practical, efficiency and aesthetic reasons. Other renewable energy technologies were considered but were not pursued due to identified inefficiencies and risks

to local wildlife. For example the installation of a wind turbine was rejected due to the risk of bird collisions with the turbine blades.

4. Description of the Environment

Bird Island supports large populations of birds, seals and penguins and is surrounded by productive waters with a large biomass of krill. It is important as a breeding site for several species of seabird including globally threatened species. Compared with other inhabited areas of South Georgia, Bird Island has been colonised by relatively few non-native species and is rodent-free. Freshwater Inlet, where the station is situated, is a gently sloping shingle beach, providing a natural harbour with limited shelter. Vegetation at Freshwater Inlet, is predominately tussock grass, which has been extensively damaged by fur seal activity, particularly close to streambeds that offer them access to inland areas of the island. The beach at Freshwater Inlet is an important haul-out site for fur seals and the surrounding tussocks are home to nesting and burrowing birds.

5. Impact Assessment

The demolition of redundant buildings at Bird Island and construction of new facilities will result in production of approximately 56 tonnes of waste, which will need to be removed from Bird Island for safe disposal.

No breeding birds, seals or flora will intentionally be displaced or significantly disturbed by direct construction activities. However, the potential for disturbance to coastal vegetation due and noise and vibration due to the construction activities is recognised. Removal of small areas of tussock in three locations has been identified as a possible requirement once conditions have been assessed on the ground. In these areas of tussock there is also the potential for disturbance of nesting and burrowing birds though none are currently known to nest in these locations.

The possible introduction of non-native species, including rodents, during cargo transport and offloading is identified as a potentially significant impact, should it occur.

The increased Bird Island (BI) population during the redevelopment works and the increased activity will result in increased sewage and grey water discharge into Freshwater Inlet and increased atmospheric emissions from additional generators and the operation of vehicles and plant.

The project requires an additional 35,000 L of MGO, therefore increasing the fuel held on station by 44%. The risk of spills and leaks during the transport, transfer and storage process has the potential to contaminate the water (sea and freshwater streams), the sediment and local flora and fauna.

6. Mitigating measures

The BI redevelopment will take place within the existing footprint of the current station. The proposed buildings will be prefabricated, which will considerably reduce the extent of construction activities at Bird Island.

The construction works will begin on approximately the 5th February 2018 after the peak fur seal breeding season (mid-November - early January) to avoid disturbance to breeding seals. The works will be take place at a distance from all known breeding birds in the surrounding tussocks. Monitoring of noise and vibration, which could impact upon local wildlife, will occur to ensure that activities cease if the noise threshold is exceeded.

A specific BAM Biosecurity Plan has been developed to ensure that measures are in place at all stages of the cargo packing, shipping and offload process to prevent the introduction of non-native species to Bird Island. The BAM Environmental Manager and Environmental Engineer are responsible for ensuring that all checks are carried out at all stages of the process.

Only light refined fuels, such as Marine Gas Oil, are used by BAS. Fuel spills will be avoided by adhering to safe working procedures for fuel transfer and storage. All fuel tanks will be self –bunded and everyday refuelling procedures followed by designated trained personnel who will be trained in the use of oil spill equipment, undertake oil spill exercises, have access to appropriate oil spill response equipment and will follow the BAS Oil Spill Contingency Plan in the event of any spills.

All waste, except for sewage, grey water and food scraps that will be discharged below the low water mark, will be removed from Bird Island for re-use, recycling or safe disposal.

7. Environmental monitoring and management

The BAS BI Project Manager with support from the BI Station Leader will be responsible for supervising the construction works and ensuring that the preventative and mitigating measures outlined in this EIA are implemented.

The BAM Site Waste Coordinator (appointed from within the BAM BI construction team) will manage all waste produced and ensure it is appropriately packaged, labelled and recorded for removal from Bird Island.

The BAM Environmental Engineer (appointed from within the BAM BI construction team) will be responsible for ensuring all biosecurity checks on cargo are carried out before it is offloaded or leaves Bird Island.

Any fuel spills will be reported immediately to the BI Station Leader for immediate response, recording and reporting of the spill on the BAS Accident, Incident, Near Miss and Environment (AINME) database.

The Bird Island Monitoring Plan also stipulates the requirement for the following monitoring:

- Disposal of waste water from the production of cement
- Wildlife disturbance and displacement on the beach
- Noise generation from demolition and construction
- Colonisation of tussock near areas of disturbance by burrowing birds

8. Conclusion

This EIA indicates that the proposed redevelopment of Bird Island Research Station is likely to have minimal, tolerable and non-lasting impact on the environment of South Georgia, provided that the recommended mitigation measures are carried out.

1. INTRODUCTION

This Environmental Impact Assessment (EIA) has been prepared by the British Antarctic Survey (BAS) for the redevelopment of Bird Island Research Station, Bird Island, South Georgia and South Sandwich Islands (SGSSI).

Scientific research has been undertaken on Bird Island since 1957. BAS have undertaken science at Bird Island almost every summer since 1971. The existing station location has been continuously occupied by BAS personnel since 1982.

The aim of the redevelopment is to provide new storage facilities (i.e. replacement of Beck House) that are fit for purpose and meet the needs of the station. In addition, the existing scaffold jetty will be extended to allow for the new polar research vessel's tender to moor alongside and allow for safe ship operations. An additional bulk fuel tank will also be added to extend the period of time between refuelling.

The BAS construction partner appointed to the project delivery is BAM who is partnered with design consultants Sweco UK. The technical adviser role is covered by the engineering consultancy Ramboll.

1.1. Background to Development

The RRS Sir David Attenborough (SDA) is the name given to the polar research vessel that has been commissioned by the Natural Environment Research Council (NERC) and which will be operated by BAS for research and to provide logistic support. The new ship is currently being constructed and is intended to replace the existing BAS ships (RRS Ernest Shackleton and RRS James Clark Ross) by the 2019/20 season.

1.2. Proposed Development

BAS plan to upgrade Bird Island Research Station, including the replacement of the storage buildings with a single building (new Beck House), upgrades to energy efficiency measures, an additional fuel storage tank and the extension of the existing jetty structure for use by the cargo tender of the SDA.

In order to maximise the operational efficiency of the SDA, a number of infrastructure upgrade projects are required at stations operated by BAS in the Antarctic and South Georgia. At Bird Island these works will include:

- replacing the existing storage building, Beck House;
- extending the existing scaffold jetty;
- installing an additional fuel storage tank; and

- demolition and removal of redundant buildings

The development works at Bird Island will improve storage and work area facilities at the station and further improve the operational efficiency of the new ship by shortening relief times and improving cargo logistics.

1.3. Statutory Requirements

SGSSI is a self-governing British Overseas Territory. Legislation is the responsibility of the Commissioner for SGSSI, who makes laws in the form of 'Ordinances' (primary legislation) and in the form of 'Orders and Regulations' (secondary legislation).

The Government of the United Kingdom also makes laws that are directly applied to SGSSI. These laws generally relate to matters of international relations.

Where matters are not covered by local legislation or directly applied UK legislation then the law in force in England on 22nd May 1900 is in force in SGSSI. The application of laws to SGSSI are currently under consultation and review as of January 2017.

Wildlife and Protected Areas Ordinance Permits

The Wildlife and Protected Areas (WPA) Ordinance is a Government of South Georgia and South Sandwich Islands (GSGSSI) law enacted in 2011 and provides a legal basis for the environmental policies of GSGSSI. Under the Ordinance it is an offence to wilfully or carelessly introduce non-native species, to handle or harm any flora or fauna or conduct activities that are likely to result in damage to habitats. Permits issued under the WPA are required for any activity undertaken within the Territory that may cause damage to the biodiversity of the Territory.

Environmental Impact Assessment (EIA)

The GSGSSI regulates all activities undertaken in the Territory (other than tourism) through issuing Regulated Activity Permits (RAP). The RAP application incorporates a form of EIA of the activity and it also identifies the need for any additional permits to be issued under the WPA Ordinance.

There are three levels of RAP application. Which level is completed depends upon the complexity of the project and its likely impact on the environment:

- Category 1 and Category 2 projects are considered to have a low impact on species and habitats and are logistically simple to support. RAP Category 1 and 2 projects are required to complete a standard application form that is assessed by the GSGSSI Environment Officer. The majority of science, logistics and media projects undertaken in SGSSI fall under the definition of a Category 1 or 2 project.
- Category 3 projects fall outside the scope Category 1 or Category 2, may be logistically more complex to support and may be considered to have a more

significant and long-lasting impact on the environment. GSGSSI does not define a formal RAP process for Category 3 activities as each activity is assessed on a case by case basis.

The Bird Island redevelopment falls under the definition of a Category 3 RAP project because the works are not permissible under Category 1 or 2. As such, the project requires a bespoke EIA in consultation with the GSGSSI. This document constitutes the formal EIA, produced by BAS, and has involved early consultation with GSGSSI to agree the format and contents prior to submission. The final approval of the EIA remains the responsibility of GSGSSI and will involve a consultation and review period with opportunity for input and comment by relevant GSGSSI stakeholders.

1.4. Purpose and Scope of Document

The purpose of this EIA is to provide sufficient information on the Bird Island redevelopment project for a prior assessment and an informed judgement by the GSGSSI to be made on the possible environmental impact of these activities and whether they should proceed. The scope of this document covers the Bird Island redevelopment project and directly-associated logistics.

The document has been split into the following sections;

- Section 1 provides an introduction
- Section 2 provides the approach to environmental impact assessment;
- Section 3 describes the proposed development;
- Section 4 describes the site;
- Section 5 describes the environment;
- Section 6 outlines the alternatives to the proposed development
- Section 7 identifies the potential environmental impacts and outlines the mitigation measures that are proposed to minimise and avoid the identified impacts;
- Section 9 describes the monitoring and audit requirements;
- Section 10 outlines the gaps in knowledge and known limitations;
- Section 11 summarises the conclusions of the EIA;
- Section 12 lists the references;
- Section 13 lists the authors of the EIA;
- Section 14 details the acknowledgements; and
- Section 15 contains the Appendices.

A non-technical summary has been included at the beginning of the document to provide an overview of the EIA in a clear, concise and non-technical manner as well as outlining the conclusions achieved.

2. APPROACH TO ENVIRONMENTAL IMPACT ASSESSMENT

2.1. Introduction

This chapter describes the approach to the EIA. The EIA is a systematic process that identifies and evaluates the potential impacts of an activity on the environment and identifies mitigation measures to be implemented in order to avoid, minimise or reduce the negative impacts. The purpose of the assessment is to ensure that decision makers consider the environmental impacts when deciding whether or not the project should proceed.

GSGSSI is committed, under the National Biodiversity Action Plan (NBAP), to ensure that environmental impact assessment is undertaken where necessary and for this to involve consultation with appropriate independent experts. GSGSSI has introduced the EIA process into its Regulated Activity Permits (RAP), which is required for all science projects and other activities undertaken in SGSSI.

BAS is the party responsible for preparing this EIA for the redevelopment of Bird Island.

2.2. Methodology

In order to allow for the assessment of the environmental impacts associated with the redevelopment of Bird Island the following relevant information has been gathered:

- Detail on the design of the new buildings and structures
- The alternatives to the proposed re-development
- Construction methods including scope and duration
- Detail on the temporary living and construction work facilities
- Logistics for import and export of cargo and personnel
- Current use of the station
- Information about the local environment

Chapter 7 builds upon this information to discuss how the redevelopment works might alter the baseline environmental conditions (i.e. the potential environmental impacts), and how such impacts will be mitigated.

The environmental impacts of this activity are predicted on the basis of professional opinion and judgement, using the information described above. Direct, indirect, cumulative and unavoidable impacts are examined. An impact matrix has been prepared to assess the predicted impacts of the redevelopment works. Impacts are ranked according to their probability and significance. Where impacts are predicted, measures to mitigate or to prevent those impacts are identified and discussed. All activities will be carried out in strict compliance with the mitigating measures outlined in this EIA and will be subject to approval and issue of a Regulated Activity Permit by the GSGSSI.

2.3. Consultation

Pre-EIA submission consultation

BAS has maintained ongoing consultation with statutory organisations throughout the EIA preparation process.

The GSGSSI is the statutory stakeholder and will make the decision on the final approval of the EIA.

Representatives from GSGSSI are invited to attend and feedback on all planning, decision, and design meetings with BAS, BAM/SWECO and Ramboll. The BAS Environment Office also maintains direct consultation with the relevant officers within GSGSSI on specific matters of environmental impact, particularly biosecurity.

Post- EIA submission consultation

Once the EIA is submitted to GSGSSI there will be a further opportunity for feedback. GSGSSI will work with appropriate independent experts to review any development which has a major impact on the existing footprint of operations and/or that has a potential to have a major impact on the environment and ensure best practice is upheld. GSGSSI will make the EIA and the reviewer's comments available on its website to ensure stakeholders are aware of the process. The final approval of the EIA remains the responsibility of GSGSSI.

3. DESCRIPTION OF PROPOSED DEVELOPMENT

3.1. Purpose and Need

The purpose of this activity is to redevelop Bird Island Research Station. The infrastructure development works at BI are intended to commence in the 2017-18 season. The plans include:

- replacing the existing storage buildings, with a new single building – new Beck House;
- extending the existing scaffold jetty;
- Installing an additional fuel storage tank; and
- Demolishing redundant buildings/structures and removing waste from BI.

The RRS Sir David Attenborough (SDA), which is currently under construction, is a larger research vessel than the existing BAS fleet and it will have an impact on the requirements for marine infrastructure and storage requirements at all the BAS research stations in Antarctica and South Georgia. As such, infrastructure projects are proposed at all the BAS research stations in order to accommodate an efficient transition to the new polar vessel and the logistics associated with a single vessel operation.

The existing scaffold Jetty at Bird Island is not long enough to facilitate safe operations under different tidal conditions. During low tide there is insufficient water depth to allow the tender to berth alongside and it will be incapable of supporting the berthing of the new tender of the SDA in its current design.

The existing storage facilities at Bird Island are of insufficient size for logistical requirements, in poor condition and have access issues. The aim of the redevelopment these buildings is to provide a single storage building that is fit for purpose, adequately sized and consolidates the storage facilities currently on Bird Island. The new Beck House will be approximately 50% bigger to meet the needs of the station. This redevelopment will incorporate all the existing needs of the storage room; it will improve waste storage and waste management with designated rooms, dedicate a space for biosecurity checking of incoming goods, and increase the water storage capacity to better meet the needs of the station. In addition, the new Beck House will include some energy efficiency options to increase operational efficiencies and sustainability across the station and improve the health, safety and the quality of living for staff at the station.

The existing fuel capacity at Bird Island is 45 m^3 MGO, consisting of three 15 m^3 bunded tanks. At the current station usage rate of 3 m^3 per month, the total capacity would last for 15 months. As BAS is moving to a single vessel operation where refuelling is likely to only happen once in a season. Therefore, there is a requirement to increase the bulk MGO capability of Bird Island to allow for longer periods between refuelling.

3.2. Scope

The Bird Island redevelopment comprises the following tasks:

- Inspecting the existing jetty, making repairs and extending it by 10m to make a longer L-shaped jetty;
- Decommissioning of three existing storage buildings and replacing with a single, larger storage building in same location;
- Installation of a new 15 m^3 bulk fuel tank (no decommissioning work required); and
- Demolition of redundant structures and removal of associated waste from BI.

This EIA considers the redevelopment works of Bird Island, as described in more detail in the chapters below. It also considers the associated logistics involved in supporting the transport, storage and temporary accommodation of equipment, materials, vehicles and personnel on Bird Island.

3.2.1. Jetty

The existing scaffold jetty will be inspected and repairs made, where necessary, to enable it to be functional in all tidal conditions and improve the safety aspects of the infrastructure. The jetty will be extended a further 10 m into the sea with an L-shaped jetty. The extension will be a scaffold construction with no slipway and therefore remove the need for excavation of the seabed. The key features of the redeveloped jetty are that it will:

- Provide a longer and L-shaped jetty (to allow berthing of cargo tenders in deeper water and offer flexible mooring options based on wind directions)
- Allow mooring of the SDA cargo tender (largest vessel anticipated to moor at jetty)
- Be able to withstand potential damage of occasional bergy bits drifting into the cove
- Include a jetty supported hand operated rotating davit capable of lifting cargo from the tender onto trolleys on the jetty
- Include a relocatable handrail on the jetty which can be positioned on the opposite side of the moored vessel and the prevailing winds.

3.2.2. Beck House

The aim of the redevelopment of Beck House is to provide a new storage building that is fit for purpose, adequately sized and consolidates the existing storage facilities currently on Bird Island. The existing storage facilities at Bird Island include three separate buildings:

- Beck House (storage)
- The Dorchester (small food store and emergency accommodation)
- Timber Store

The new Beck House will be constructed in a similar location to the existing structure, between Prince House and the site Generator Shed. It will involve the decommissioning of all three existing buildings and redevelopment into a single construction that will retain the name Beck House, and will be approximately 50% larger to allow for better organisation of the space. It will involve upgrade of mechanical and electrical systems, introduce a dedicated biosecurity facility for inspecting incoming goods and provide internal storage of all waste accumulated in a season. The new Beck House will be elevated on stilts and surrounded by an external walkway at the same level as Prince House. This will allow for efficient and safe movement of personnel and trolleys between work areas and will help to keep fur seals safely away from accommodation and work buildings.

Beck House will include the following dedicated work and storage areas:

- Waste Management & Biosecurity Room
- Waste Storage area
- Science Store
- Gym
- General Assistant's Store
- Technical Store
- Workshop
- Fresh Food Storage
- Dry Food and Bond Storage
- Freezer (food) store
- Domestic Store
- Water Tank Room
- Timber Store
- Chemical Store

A few minor works will also be completed in Prince House at this time. Fridges and freezers currently stored in Prince House will be relocated to the new rooms in new Beck House freeing up space in Prince House. This will allow for the installation of a new dedicated server room. In addition, the necessary pipework will be installed in Beck House and run to the existing generator shed to allow for the future replacement of the BAS generators (in the generator shed). The intention is to replace the BAS generators in the 2018/19 or 2019/20 season (as part of future facilities work) with two new generators that will allow for the installation of a heat recovery system in Beck House at that time. The ground works and all pipework will be installed in Beck House as part of the 2018 construction work which will allow for the retrospective fitting of the new generators in future.

3.2.3. Fuel store capacity

The SDA, may only call at the station once in a season and, depending on the timing of that ship call, there may be a requirement to increase the bulk MGO capability at Bird Island to an 18 month supply. The decision was made to add another 15 m^3 bulk fuel tank and

increase the bulk fuel capacity to 60 m^3 MGO in order to provide more flexibility to the station.

No decommissioning work is required here as the proposed 15 m^3 fuel tank will be installed in the same area as the existing three fuel tanks to the north of Prince House and connected to the existing pipework distribution header.

3.3. Location

The Bird Island redevelopment works will take place within the boundaries of Freshwater Inlet beach on the site of the existing station, the surrounding beach and into the water at the existing jetty (Figure 1). The works are not anticipated to infringe upon the surrounding tussock grasses, though a request is made as part of this EIA for the removal of a few small areas of tussock as a precaution.

Figure 1. Location of existing jetty, Beck House and Fuel Storage

The new Beck House will be constructed on the site of the existing building with the same name. The site is located between Prince House and the generator shed. The building will be situated within 5 m of the high water tide line and between 1 – 3 m above high water. Several small streams pass through the surrounding tussock slopes, across the beach and into the sea and one stream in particular will run beneath and close to the new Beck House building. The drawing below indicates the new Beck House (outlined in red) superimposed over the existing named buildings (Figure 2).

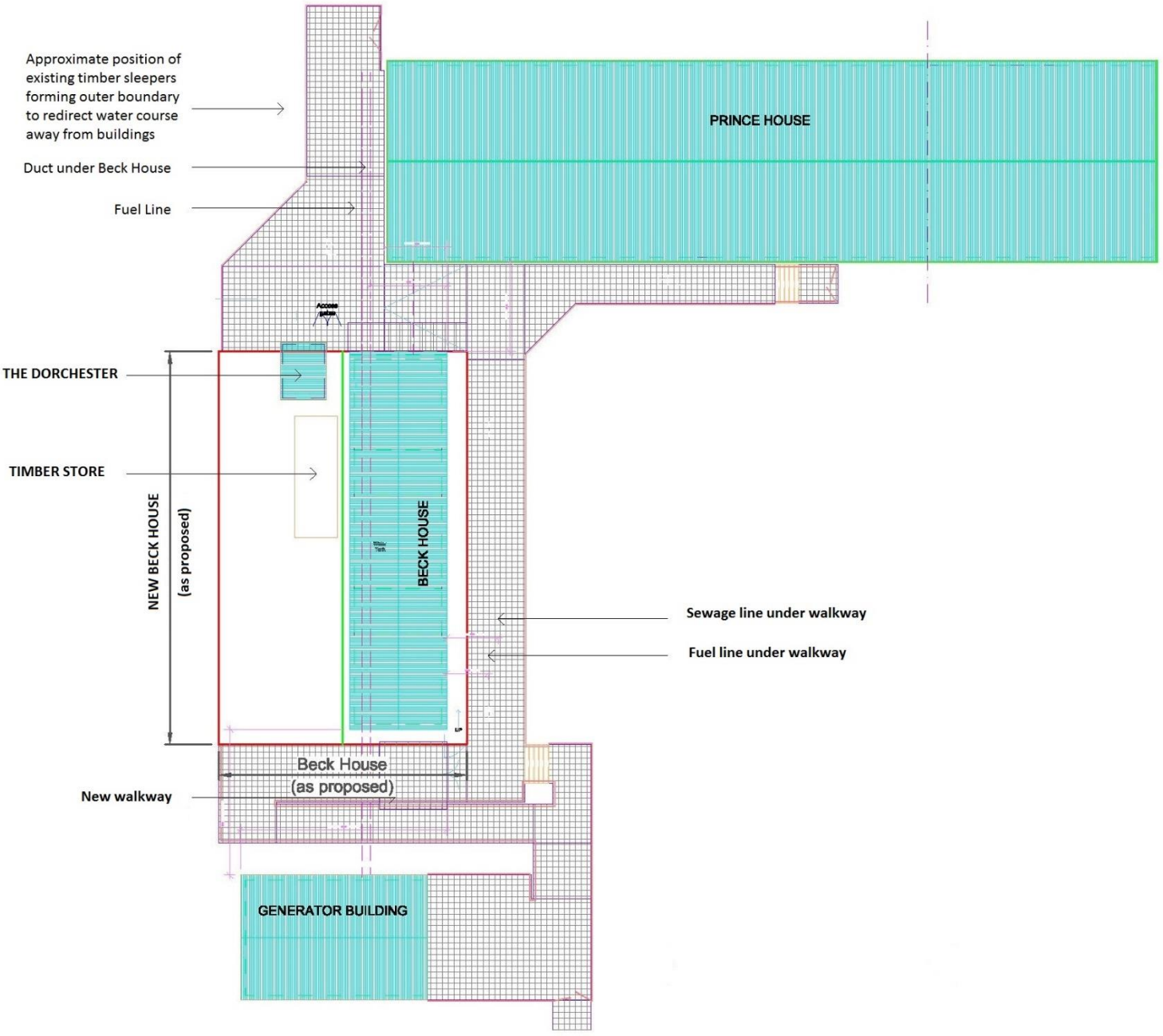

Figure 2. Bird Island existing buildings (green) and proposed buildings (red outline)

3.4. Description of the Project

The BI project will involve:

- Mobilisation of the construction team including all equipment and accommodation
- Set up of the temporary accommodation and works camp
- Preparing the area for work, including levelling ground on the beach for temporary foundations and movement of vehicles and equipment
- Demolition of existing structures (existing Beck House and other structures)
- Preparing and installing foundations
- Construction of new Beck House
- Extension of the existing jetty further out into the Freshwater Inlet
- Installation of the new bulk fuel tank

3.5. Timescale, Duration & Intensity of Activities

The construction works at Bird Island will take place over a single period starting in mid-summer. Bulk fuel, temporary fuel storage tanks, the Telehandler vehicle and 8 Tonne excavator along with gas cylinders will be delivered by the RRS James Clark Ross (JCR) in November (scheduled for 11-14th). All remaining cargo and personnel are scheduled to arrive on the 5th February 2018 aboard the RRS Ernest Shackleton (ES). Works will commence as soon as possible and are scheduled for completion by the end of May 2018. The works are anticipated to take place over a period of approximately 17 weeks. The construction programme is dependent on the availability and schedule of the ES, JCR and the commercial Falkland Islands Resupply Ship (FIRS) and therefore may be subject to change dependent on the ships itineraries.

The key fur seal breeding season at Bird Island is between mid-November and early January with majority of pupping occurring in December. As such, no construction work will take place during this time. By early January most pupping is complete and pups will have left the beaches to move into the tussock grass.

The Bird Island construction programme will begin after the key fur seal breeding season to avoid any potential disturbance to the wildlife and to ensure that the beach is as clear as possible for the safety of the construction team.

3.5.1. Overall Construction Programme

A summary of the key stages of the construction programme is listed in the table below. A more detailed construction programme can be referenced in Appendix 1 - Bird Island Construction Programme.

Table 1. Summary BI construction programme

Key construction stages	Detailed Activities	Start Date	End Date
Fuel Delivery to Bird Island	Bulk MGO fuel, bunded tanks and some vehicles to be delivered to Bird Island by the JCR which will also install a mooring.	11.11.17	14.11.17
Mobilisation and Site Establishment (ship will remain at Bird Island for duration)	All plant, temporary accommodation, construction materials, etc. unloaded to shore	05.02.18	20.02.18
	Temporary site foundations installed		
	New BI fuel tank installed (to be used by construction team during build)		
	Temporary construction facilities erected		
	Reverse Osmosis (RO) plant installed		
Demolition of Existing Beck House	Prepare site and establish access routes	20.02.18	06.03.18
	Relocate Beck House contents to temporary storage/work facilities		
	Erect scaffolding		
	Disconnect and remove all services		
	Strip roofing and all finishes		
	Deconstruct frame		
	Demolish walkway and foundations		
New Beck House Construction	Substructure construction	11.03.18	23.03.18
	Superstructure construction	24.03.18	18.04.18
	Internal fit-out	12.04.18	23.05.18
	Mechanical, electrical and plumbing (MEP) services installation	12.04.18	14.05.18
New Walkway Installation	Excavate, prepare and install foundation work	18.04.18	24.04.18
	Build support frame and install walkway		
Jetty Inspection and Extension	Maintain existing scaffold	01.03.18	31.03.18
	Extend scaffold jetty		
Other Tasks	Prince House Server room refurbishment	31.03.18	12.04.18
Handover of Buildings/Task Completion		30.05.18	30.05.18

3.6. Construction Details

3.6.1. Design details of Beck House

BAS requires all new buildings to be sustainable and energy efficient, easily maintainable and cost effective throughout their life.

This requirement is incorporated in the design of Beck House and is being assessed through the Building Research Establishment Environmental Assessment Method.

3.6.1.1. Building Research Establishment Environmental Assessment Method (BREEAM)

BREEAM is a method for assessing, rating and certifying the sustainability of buildings and it requires setting targets for the procurement, design, construction and operation of a building that is then assessed in order to award the building with either a Pass, Good, Very Good, Excellent, or Outstanding rating.

A BREEAM score of Excellent is being targeted for the new Beck House building**.** An initial pre-assessment was conducted and a targeted score of 71.87% was achieved (Table 2). The minimum score for BREEAM Excellent is 70% which BAS is on target to achieve[1].

Table 2. BREEAM Building Performance by Environmental Section and Pre-Assessment Scoring

Environmental Section	No. Credits Available	No. Credits Achieved	% Credits Achieved	Section Weighting %	Section Score
Management	21	17	80.95%	11.00%	8.90%
Health and Wellbeing	17	11	64.71%	15.00%	9.75%
Energy	22	10	45.45%	19.00%	8.64%
Water	9	6	66.67%	22.00%	14.67%
Materials	8	6	75.00%	14.00%	10.50%
Waste	6	6	100.00%	5.00%	5.00%
Land Use and Ecology	6	6	100.00%	7.00%	7.00%
Pollution	12	11	91.67%	7.00%	6.42%
Innovation	10	1	10.00%	10.00%	1.00%
BREEAM Pre-Assessment Total Score					**71.87%**

[1] BRE Global Ltd (March 2017). BREEAM International New Construction 2016, Tailored Criteria appendix for British Antarctic Survey

A post construction assessment (PCA) will be carried out once all the practical building works have been completed. The PCA will then confirm the final 'as built' performance of the building and rating and confirm whether it is accordance with the assessment target.

This EIA provides information and evidence for a few key environmental sections: Waste, Land Use and Ecology, and Pollution that will contribute towards the BREEAM score of Excellent.

BAM has produced a Site Waste Management Plan (SWMP) in Appendix 3 that identifies the key demolition waste types, estimated quantities and the preferred methods of disposal. The BAS Waste Management Policy to minimise, reduce and remove all wastes will be followed with an emphasis on recycling and diverting waste from landfill. During the construction period a dedicated waste management tent will be set up and a site waste coordinator will be appointed. When the new Beck House is operational it will have a permanent dedicated room for waste management and a separate waste storage area.

The EIA demonstrates that the location for the redevelopment was chosen within the footprint of the existing buildings as the most suitable for reducing the impact on the ecological values of other undisturbed areas. Pollution is also considered and emissions are reduced where possible with plant and generators only used where necessary, engines turned off when not in use and regularly maintained to ensure efficient operation. Light pollution will be minimised as artificial outside lights will only be permitted in the hours of darkness in the month of May (when hours of daylight are reduced and most vulnerable birds have fledged) and only upon consultation with the BAS Environment Office. All windows will have blackout blinds in place and will be used at night-time. Noise from plant will be reduced with the use of the acoustic screens and monitored to ensure the noise threshold is not exceeded.

3.6.1.2. Preferred Design Option

The new Beck House will be constructed in a similar location to the existing buildings it is replacing (old Beck House, The Dorchester and Timber Store) and will lie between the existing Prince House and the site Generator Shed. The building will be surrounded on three sides by an external level walkway that connects it to Prince House and provides access to the beach via a ramp that will be used for cargo movement during ship relief.

The new Beck House will be made up of pre-fabricated modular elements that will offer a number of benefits to the project:

- Simplify transportation and construction on site
- Ensure construction quality and improve air tightness
- Present benefits in BREEAM and sustainability assessments
- Minimise health and safety risks associated with traditional building techniques
- Reduce or remove the involvement of wet trades on site

The proposed site layout is shown below:

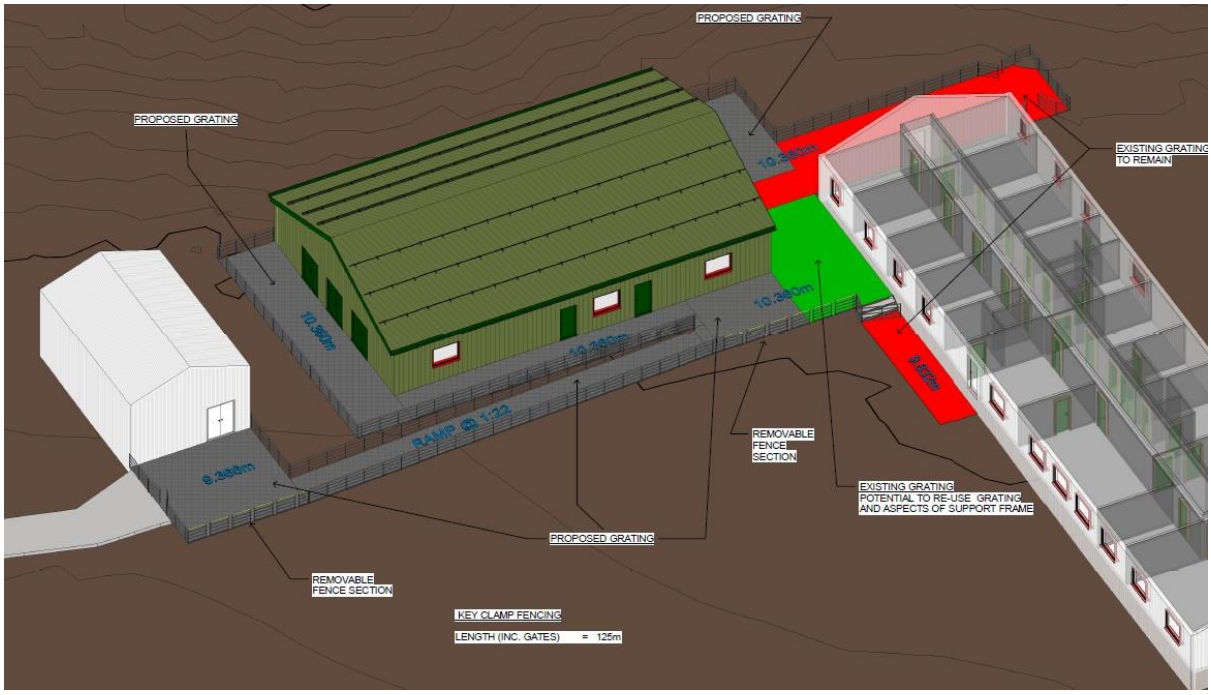

Figure 3. The proposed new Beck House (green building), shown in its position between Prince House and the generator shed, with surrounding walkways.

Beck House sub-structure

The building substructure will be formed of 55 ground bearing precast concrete foundations that will support galvanised steel stub columns and a galvanised steel beam grillage. Precast concrete rings will be filled with cementitious or epoxy grout that will provide scour protection to the sub-structure columns and additional foundation ballast. The use of precast foundations eliminates the need to mix concrete on site and the need to import aggregates.

Beck House super-structure

The steel beam grillage will support prefabricated insulated timber floor cassettes faced with a waterproof base sheet. External walls will also be of a pre-fabricated insulated timber cassette construction, with external breather board and internal vapour barrier. Internal partitions will be of a prefabricated stud wall construction, insulated accordingly to provide the required thermal properties to maintain internal room temperatures. Internal partitions will be designed such that they provide bracing and structural stability to the structure. All floor and wall cassettes will be formed with a polyurethane closed cell foam core insulation. It is anticipated that cassettes will be shipped with windows/doors, face fixed trunking for services and external cladding pre-installed, where possible. Pre-finishing of panels will minimise construction time on site. The roof will be structured by timber trusses at regular intervals, supported by wall cassettes. The trusses will be over clad with plywood sarking, batons and colour coated trapezoidal profiled steel panels. The walls will also be clad in the same steel panels to match those currently used on Prince House and the Generator Shed.

Walkway

An external raised walkway around the south, north and east sides of the building will be provided, with both ramped and stepped access to the south side to connect to the existing walkway from the jetty.

The walkway will be level with Prince House to allow for easy daily movement between the buildings. The external walkway will be formed of a galvanised steel grating supported on a galvanised steel grillage, similar to the building sub-structure. The walkway will have a galvanised steel balustrade with infill mesh panels to prevent seal access. In addition, the area between the walkway and ground level will be closed off with grating to prevent seal movement under the building.

Internal building layout

Extensive liaison with the station users and the GSGSSI has taken place regarding the layout of Beck House and the size of each of the rooms. The agreed layout includes the following rooms:

- Workshop, 5.1 m x 3.5 m, ~17.8 m^2
- Technical Store, 5.1 m x 2.4 m, ~12.1 m^2
- Gym, 3.9 m x 2.4 m, ~9.4 m^2
- General Assistant Store, 3.9 m x 2.5 m, ~17.8 m^2
- Science Store, 5.1 m x 3.5 m, ~17.8 m^2
- Waste Management & Biosecurity, 5.1 m x 6.0 m, ~30.6 m^2
- Waste Storage, 4.9 m x 5.8 m, ~28.7 m^2
- Dry Food & Bond Store, 5.1 m x 2.4 m, ~12.3 m^2
- Fresh Food Store, 5.1 m x 2.4 m, ~12.3 m^2
- Freezer Room, 5.1 m x 2.4 m, ~12.3 m^2
- Chemical Store, 2.5 m x 1.4 m, ~3.6 m^2
- Domestic Store, 2.5 m x 1.6 m, ~4.0 m^2
- Water Tank Room, 2.5 m x 2.7 m, ~7.0 m^2
- Timber Store, 5.8 m x 2.3 m, ~13.1 m^2

All rooms are accessed from a central corridor, 1.8 m in width and 4.2 m in height, apart from the Timber Store, Waste Storage room and Gym, which have external access only. External doors to the Waste Management & Biosecurity Room and Workshop are also provided.

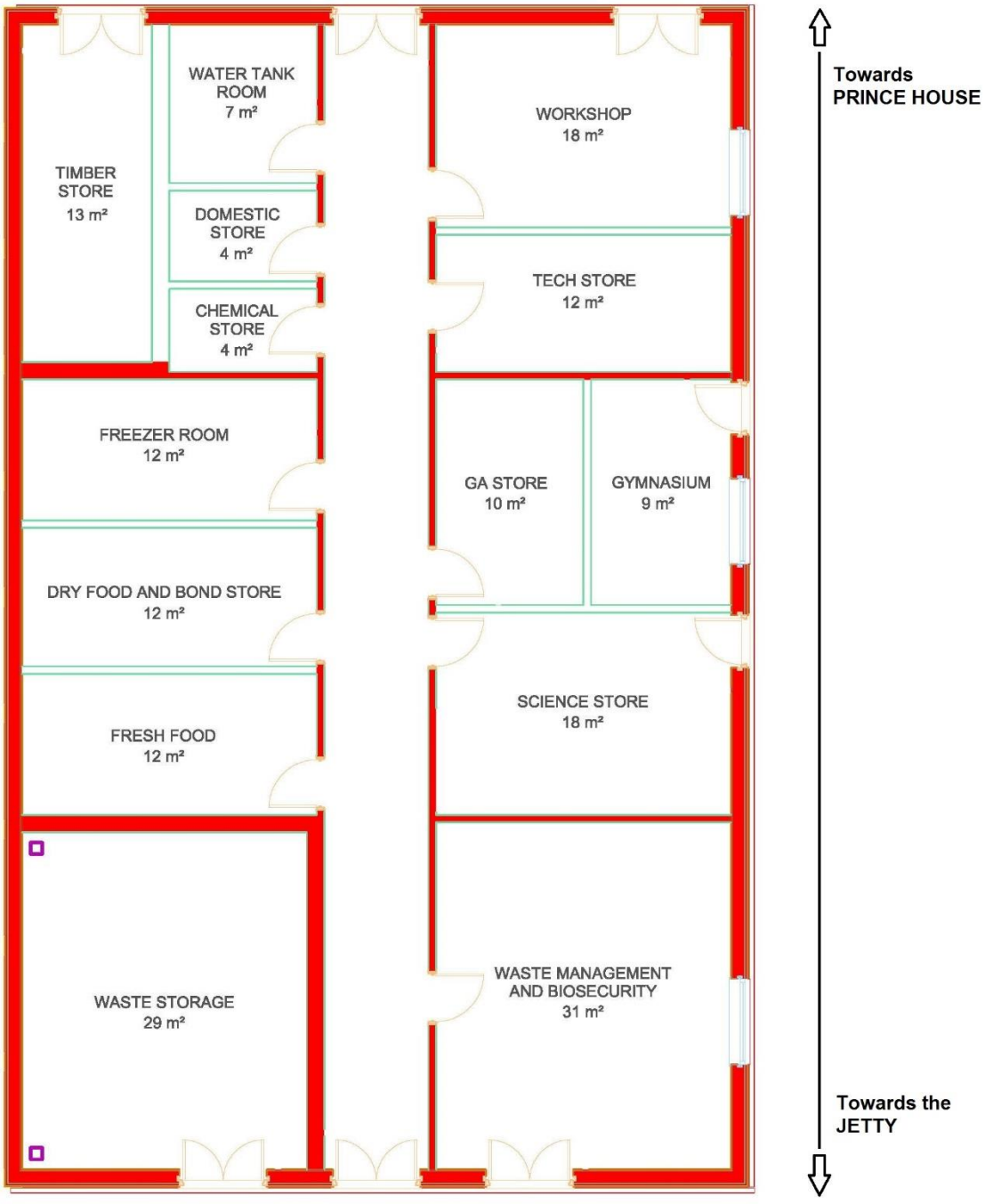

Figure 4. Beck House floor layout

External Finishes

Trapezoidal steel panels have been chosen as their performance at Bird Island is well known, they aesthetically match the existing buildings on the island and they are easy to repair, maintain and replace by the technical staff on station.

Internal Finishes

The interior of the building is designed for ease of maintenance and practicality and makes best use of natural light to improve energy efficiency. The insulated timber floor cassettes

will be finished in a vinyl floor covering with coved skirtings to allow easy cleaning. All the walls will be finished in Fermacell, which is a gypsum based product made from recycled gypsum and cellulose fibres extracted from waste paper. It is a very hard product and provides a stronger and more sustainable finish than plasterboard.

Some rooms will be over clad with a satin finished Whiterock plastic panel system for extra durability and to allow easy cleaning. These rooms are:

- Waste Management and Biosecurity Room
- Waste Storage Room
- Fresh Food Room

Mechanical and Electrical Works

The new Beck House will include the following mechanical and electrical services:

- Ventilation utilising localised mechanical extract and natural ventilation where applicable.
- Rain water harvesting with storage and large particle filtration.
- Internal water distribution
- Internal drainage to existing external system
- Energy metering system, which allows users to determine the total energy use of the building and the energy being used by certain equipment.
- Sub-mains distribution
- Mini Circuit Breaker (MCB) Distribution Board
- Containment Systems
- Lighting and lighting controls
- Emergency lighting
- Fire detection and alarm system
- Heating via a generator heat recovery system (to be retrofitted in 2018/19 or 2019/20)

3.6.1.3. Alternative Designs Considered

Beck House Primary Superstructure

Three main options for the primary structure of the replacement Beck House building were considered initially:

- Modular steel units

The modular option consists of ready-made and fitted out sections that can be fitted together on site. This option would considerably reduce construction time on site but would be logistically challenging due to the size and weight of the units. In addition, the modular option does not provide future flexibility as the room sizes must be pre-determined and cannot be altered after construction.

- Lightweight steel truss and Steel portal frame

Both the lightweight steel truss and the steel portal frame options can be transported more easily than the modular design. However, both options have greater embodied energy and carbon than the preferred timber alternative. The use of steel as the superstructure for the building results in cold bridging (gaps in insulation) unless the frame is sufficiently insulated internally, therefore increasing the overall size of the structure. The preferred steel and timber cassette option is also simpler to handle and erect on site and easier to accommodate unforeseen design changes.

Beck House Building Design

An alternative layout that was considered featured a smaller main building adjacent to a series of external store areas with a covered corridor between. The covered walkway had the potential to fill with snow and therefore during the development of the design the external store areas and the corridor were brought into the main building.

3.6.2. Construction methodologies

The construction methodology is described in more detail below and has been split into sections for ease of reading. These are:

Terrestrial Activities

- Mobilisation
- Construction and establishment of the site camp
- Installation of new fuel tank
- Demolition
- Beck House construction

Marine Activities

- Jetty

3.6.2.1. Terrestrial Activities

Mobilisation

The JCR will deliver to Bird Island on first call in November, all fuel, bulk fuel containers and vehicles (the Telehandler and 8 Tonne excavator) necessary to assist with mobilisation. When the ES arrives at Bird Island in February, the priority will be to get all cargo ashore safely and to establish the site camp. The ship's tender vessel will transfer cargo from ship to shore. The intention is that the tender will utilise the existing stone jetty for landing cargo ashore (which was constructed to the east of the scaffold jetty to support previous construction work). The first tender trip will carry the Backhoe loader and personnel to operate it and unload it directly onto the beach. The plant will then be used to smooth down the stone jetty to ensure a level surface is ready to receive the rest of the equipment and cargo. If necessary, some local beach material (no more than $6m^3$) will be used to build up any low areas on the stone jetty. The Telehandler, along with excavator mats, will be set up on the stone jetty in order to begin the safe unloading of the remainder of the cargo. All cargo will be unloaded and stored either on the beach to the east of the stone jetty, which is above the high water mark (see bulk storage area in Figure 5), or it will be moved immediately to the appropriate location in the temporary site camp. The bulk storage area is anticipated to be approximately 30 m x 20m large and will contain all building materials in crates, flat packed new Beck House building elements in crates and all the palletised and packaged waste for removal later in the season.

Temporary Construction – Site Camp Establishment

The proposed location of the sleeping units' installation is to the rear of Prince House (see Figure 5) but other areas of the beach will also be used for shared work facilities and storage. The ground behind Prince House is a little uneven and can be quite wet so the BAM team propose to smooth down the area and make it level and even using the Backhoe loader or the 8T excavator. The site camp facilities will be raised above the ground by installing them on temporary timber sleeper (treated with Protim) foundations. A total of 160 timber sleepers will be imported to Bird Island to make up the foundations of the new fuel tank (36 sleepers) and all the temporary buildings of the site camp (up to 124 sleepers). It is not known how many of the sleepers will be used for foundations of the temporary camp but it is anticipated that many will be required to level and raise the accommodation and storage units above the surface of the beach. The following accommodation and storage units are proposed as part of the site camp:

- 4 No. 4.268 m x 2.864 m Bunk-a-bin sleeping units. These are two person sleeping units including a shower and toilet.
- 4 No. 6.1 m x 4.9 m Weatherhaven storage tents, used for the following purpose:
    - 1 No. for water tanks and laundry
    - 1 No. workshop (shared with BAS Bird Island personnel)
    - 1 No. for freezers and storage of frozen food (shared with BAS)
    - 1 No. for waste management and general storage (shared with BAS)

- 1 No. 4.3 m x 2.7 m Weatherhaven tent will be used as the designated kit drying room
- 1 No. 9.7 m x 4.9 m Weatherhaven tent will be used as the communal BAM mess tent.
- 7 No. 10 foot ISO containers, used for the following purpose:
    - 1 No. for storage of reverse osmosis equipment
    - 2 No. for plant/equipment spares
    - 1 No. for dry food storage
    - 1 No. for tool storage
    - 1 No. for fixings, nuts, bolts etc.
    - 1 No. for bond
- 30 No. 1 m x 1 m storage boxes – storage of equipment removed from old Beck House. These small storage boxes will be delivered to Bird Island before the construction period and the BAS team on site will empty the existing Beck House into the storage containers in preparation for the demolition of the old building.

A total of 2 No. 75 kVA generators (1 for normal use and one as a back-up) will be used by the construction site to power the bunk-a-bins and tents. The generators will run on Marine Gas Oil (this is the fuel that is already used at Bird Island). A qualified electrician will install the electrical installations to provide power for lighting to all the accommodation units, storage tents and containers. Heating will also be provided to the accommodation units, the boot room and the mess tent. Once power has been established the various appliances, such as deep freezers, washing machines, driers, etc., will also be installed.

In order to supply water to the BAM personnel on station during the construction, a reverse osmosis plant will be installed consisting of a series of filters, a UV steriliser and a water tank. Water will be collected from the sea by a pipe and pump for desalination. It is anticipated to produce 1.5m^3 of water a day and it will be installed in one of the 10' ISO containers. It will be necessary to set this up as quickly as possible upon arrival, it will be situated behind Prince House with the water intake pipe laid to collect water from the sea and will be powered by the existing site camp generators. The potable water tank will be placed in the container with the water treatment plant. The accommodation units will then be plumbed in. A waste water pipe will then be installed from the site camp and plumbed into the research station's waste water system via an existing Y junction in the line. A pump will be required to move the waste water to the connection with the existing system.

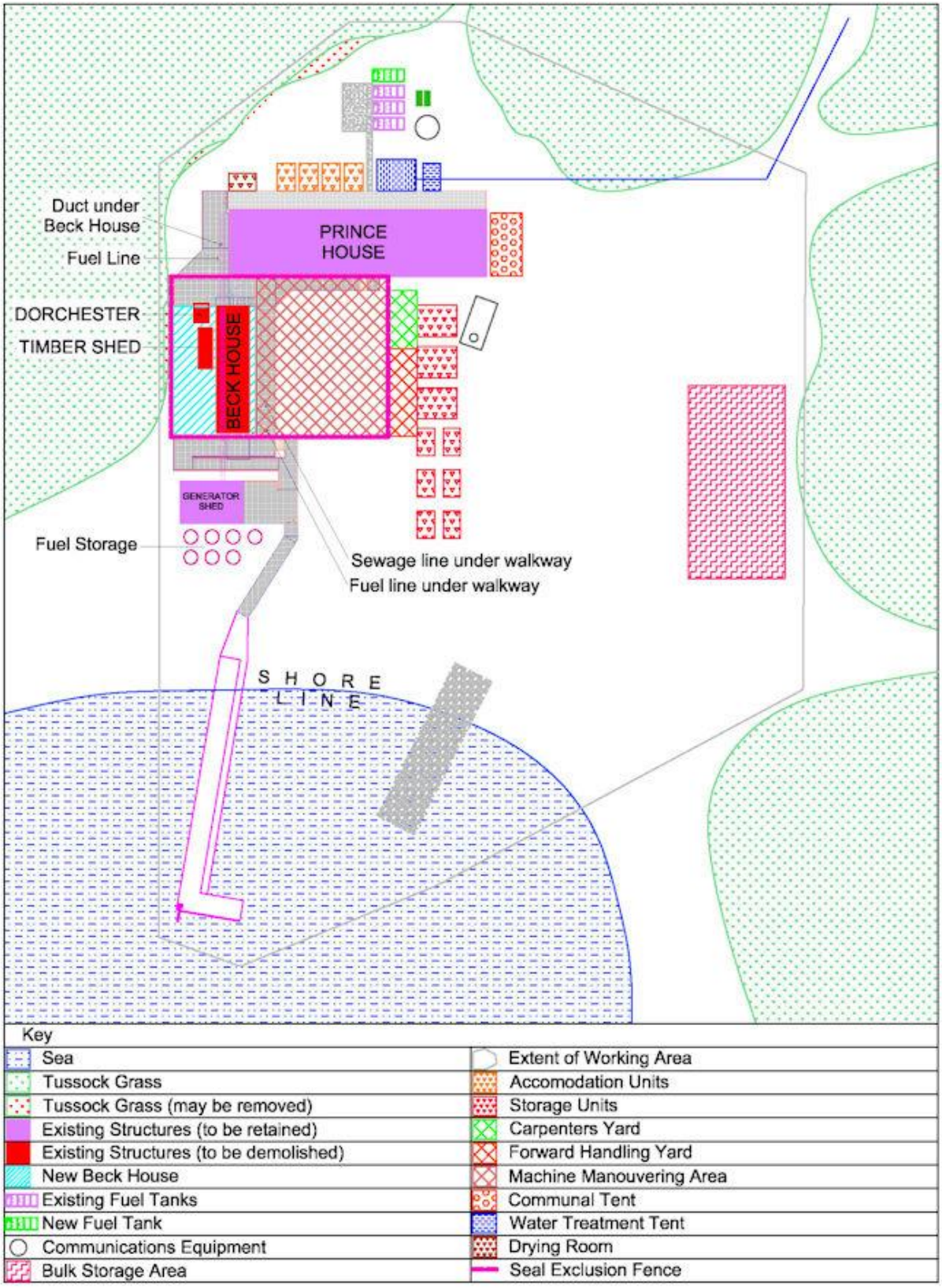

Figure 5. Bird Island Construction Impact Area

New Fuel Tank

The new 15,000 litre fuel tank (which is manufactured to the same design as the existing BAS tanks by Terrance Barker Tanks) will be delivered and installed as an extension of the existing three fuel tanks. The foundations will consist of 36 timber sleepers which will be installed and bolted together on top of a geotextile layer to form a platform upon which the fuel tank will sit. Once the tank is in its final position it will be connected to the existing tanks using a 50 mm braded steel flexible pipe for the fuel delivery and a 25 mm braided steel flexible pipe for the return. All tests and commissioning will be completed and signed off prior to use.

Existing Beck House Demolition

The main working area around Beck House will be fenced off for the duration of the demolition and construction of the new Beck House in order to create a safe area in which works can be carried out without any interaction with fur seals on the beach. All vehicles will be left within this fenced zone at the end of the working day. All existing services to Beck House will be terminated and made safe before any demolition works begin. The services include: electrical services, fire suppression, water delivery pipe, fire alarm cable and heating pipe. Beck House will then be emptied and its contents relocated to the storage containers and tents as part of the construction site camp. All necessary station equipment such as the waste compactor, washing machines, freezers, etc., that will be required by station personnel during the construction period will be set up and re-connected in the temporary tents or containers as described previously. The equipment will be shared by BAS and BAM staff.

The existing Beck House is a steel framed, steel clad timber building, which can be systematically dismantled. Once the fixings are removed, the telescopic handler will remove and lift the steel cladding and timber elements of the building away from the frame. Once the exterior cladding has been stripped from the building, the roof trusses and steel frame will then be dismantled. Scaffolding will be erected to allow the construction team to access all high level connections and fixings, but all lifting of material will be carried out by the telescopic handler.

With the exterior cladding and internal frame removed, the ground will then be surveyed to establish and highlight the position of the over ground services. Timber sleepers will be positioned along the ground services to ensure they are protected whilst further ground works continue.

The concrete pad foundations will be excavated and removed by the Backhoe loader or 8T excavator. Where necessary, the concrete will be broken up utilising the breaker attachment.

The de-constructed building elements will be stacked and bound in flat manageable packages and then stored on the beach in the bulk storage area in readiness for de-mobilisation at a later date. Any other existing, redundant concrete within the footprint area will also be broken up and stored in bulk waste bags (FIBCs) in the bulk storage area.

New Beck House Construction

Once the old Beck House has been demolished and ground cleared, the footprint of the new Beck House will be marked out and levels established. The ground will then be levelled, using the Backhoe loader or 8T excavator, in order to establish firm ground conditions for the installation of the new concrete pad foundations. This is likely to be achieved by excavating a series of shallow trenches and compacting the ground with the whacker plate.

The ground in this location can sometimes be waterlogged as water from the freshwater streams runs onto the beach. There is an existing attempt at water diversion with an installed row of timber sleepers. This will be replaced with a precast concrete channel prior to the foundations being installed.

The pre-cast concrete pad foundations will then be placed and levelled in their final position using either the Backhoe loader or telescopic handler, where appropriate. Installation will begin at the northern end of the new building and continue working south. Once all the pads are installed, the steel frame of the floor will be bolted to the foundations. These vertical steel supports to the frame of the building require protection from scouring by water. This will be achieved by placing a precast concrete ring around the supports and filling this with either a cementitious grout or epoxy grout.

The design of the new building is modular meaning that much of the construction will have been achieved off site in advance. The floor, walls and ceilings are in pre-made cassette format and will simply be lifted and bolted into position on site. As the cassettes are installed, the joint sealing will be carried out in a sequential installation process. The doors and windows within the cassettes will also be checked for function as the installation process advances. Large items of plant such as the water tank and the waste compactor will be installed in the building as construction progresses and prior to internal walls and ceilings are installed. All high level access will be gained with the scaffolding and lifting of materials will be done by the telescopic handler.

Once the shell of the building has been erected, the timber roof trusses will be lifted and bolted into position and the roof can then be constructed. Following completion of the building envelope the steel cladding will be installed.

As mentioned previously as much construction as possible will be carried out off site. It will, however, be necessary to install the mechanical and electrical (M&E) elements and finishes to the new building on site at Bird Island. This will be carried out as and when safe access can be gained. Whilst the finishes are being carried out the walkways will be constructed. These are formed of a steel frame on precast concrete bases with open steel grid panels forming the floor.

Once construction is complete, testing and commissioning will be carried and the building will then be handed over for inspection by the BAS BI Project Manager. Any defects observed will be rectified by the construction partner and any necessary training on the new systems carried out.

Where practical, as and when rooms are completed and handed over, the equipment in the temporary storage facilities will be re-homed in the new Beck House and commissioned. Upon completion, Operation & Maintenance manuals, including 'As Built' drawings, will be issued.

BAM will plan the work in such a way that at the end of each shift the permanent works are left in a safe state, taking into account the unpredictable weather conditions. All permanent work materials, waste materials, plant and equipment will be strapped down or stored away.

Possible tussock disturbance

There is no plan to intentionally remove or damage areas of tussock grass during the redevelopment works. However, a few locations that are close to where works are being carried out have been identified as at risk and it may be necessary to remove small areas of tussock grass and soil. Three at risk areas have been identified and highlighted on the site map (see Figure 5). Two small areas (of 28m^2 and 6m^2, respectively) have been identified behind Prince House, close to where the new Bulk fuel tank will be installed, and near the construction team drying room. The tussock in these areas may need to be removed to enable plant to access the northwest corner of Prince House to establish the site camp. The third area, located to the west of the existing Beck House, is 24 m^2 and may require removal of some tussock in order to allow potential access of plant and vehicles for construction of the new Beck House. Whilst these areas have been highlighted for possible removal, BAM will endeavour to arrange the camp and construction so that removal is not required. Site measurements indicate that no tussock grass will require removal in order to construct Beck House, but these three areas have been highlighted as a precaution.

3.6.2.2. Marine Activities

Construction of New Jetty

The design proposal for the jetty has not been finalised at the time of writing. The current proposal is to survey and repair the existing scaffold jetty and use new materials to extend the existing jetty by a further 10 m to accommodate the deeper draft of the new tender vessel. The existing jetty is of simple scaffold construction where the vertical members of the scaffold construction have been driven into the beach/seabed using a post rammer. This same simple construction method will be replicated for the extension.

The construction team will begin surveying and repairing the existing jetty from the beach and work out into the bay to construct the extension.

All operatives will be issued with and wear lifejackets whilst working over water. Where it is necessary to work in the water, for instance when installing elements of the jetty, dry suits will be worn and the work will be supervised by a member of the team on the jetty who will also act as look out for marine mammals to ensure the health and safety of the operatives

and to ensure no animal is endangered. In addition, a safety boat will be used and will always be in the water as support during all jetty related construction work.

3.6.3. Construction materials

All permanent materials that will remain part of the Bird Island infrastructure after completion of the works will be consolidated and shipped from the UK. An anticipated 150 tonnes of material will be imported and will be temporarily stored in the designated Bird Island bulk storage area. Permanent materials will be packed for transport and storage in wooden crates, which will be made to size for the ship's tender. Where possible, building materials in crates will be stacked to reduce the bulk storage area.

Importing building materials into Bird Island poses a risk of accidentally introducing non-native species, which could have a serious impact on the native biodiversity. All imported materials will therefore undergo biosecurity screening as stipulated in the specific Biosecurity Plan for the construction (see Appendix 4 – BAM Biosecurity Plan).

The marine gas bulk fuel tank will be constructed in the UK and shipped to Bird Island. It is made from steel and weighs 4000 kg. The key construction materials for Beck House and the jetty are outlined below.

Table 3. Construction materials and quantities

Beck House Construction Materials		
Element	**Material**	**Weight**
Floor	Timber frame and plywood cover	8.2 tonnes
External Walls	Timber frame and plywood cover	6.1 tonnes
Internal Walls	Timber frame and plywood cover	8.5 tonnes
Roof trusses	Timber	11.6 tonnes
Cladding	Trapezoidal profiled steel sheets	9.2 tonnes
External walls, floor and roof	Styrofoam insulation	4.0 tonnes
Internal finishes	Plasterboard	4.8 tonnes
Columns above foundation blocks	Steel	4.8 tonnes
Floor beams	Steel	21.3 tonnes
Beam / Column end plates	Steel	1.3 tonnes
Foundation Blocks	Pre-cast concrete	44.0 tonnes
75kVA Generators x 2		1.5 tonnes
Mechanical and Electrical Equipment		5.0 tonnes
Jetty Repair and Extension Materials		
Element	**Material**	**Weight**
Scaffold tubes	Steel	2.4 tonnes
Scaffold beams	Steel	1.4 tonnes
Scaffold boards	Steel	2.3 tonnes
Scaffold fittings	Steel	0.6 tonnes

3.6.4. Equipment and Vehicles

Table 4. Construction Equipment and its fuel use and noise output

Plant Item	Uses	Fuel economy	Hours of duty	Noise output
Merlo Roto 45.19 MCSS 360 degree Telehandler	Loading/offloading materials from tender vessel Handling/lifting of all construction materials	17 ltrs/hr	5 hrs/day for 90 days	71 dB(A) at 10 m
Backhoe Loader 100 hp Terex 860SX	Levelling ground for site installation Excavation for foundation installation General small lifts and material handling of scaffold, pallets etc.	14.5 ltrs/hr	5 hrs/day for 90 days	92 dB(A) at 10 m when breaking, 67 dB(A) when moving, 68 dB(A) when levelling ground and 69 dB(A) when excavating
8 Tonne excavator	Levelling ground for site installation Excavation for foundation installation	6 ltrs/hr	5 hrs/day for 30 days	69 dB(A) at 10m
Breaker and buckets for Backhoe Loader and 8 Tonne excavator	Allows for breaking of existing concrete foundations	N/A	As above	As above
2 x No. 75 kVA Super Silent generators (1 main generator, 1 reserve) and 1000L bunded tank	Power supply to construction site and construction accommodation	15 ltrs/hr for each generator	1@24 hrs/day 1@4 hrs/day	65 dB(A) at 10 m
125 cfm Compressor	Powering small breaker and impact wrench	3 ltrs/hr		86 dB(A) at 10 m
Wacker plate compactor	Compacting granular material	N/A		80 dB(A) at 10 m
300 Amp welding set	For welding steel	2 ltrs/hr		57 dB (A)
12” Petrol disc cutter	General cutting			87 dB(A) at 10 m when cutting concrete
Oxy-Propane burning gear	Dismantling existing steelwork			65 dB(A) at 10 m when cutting steel
Small workboat with 10 hp motor	Safety boat during scaffold jetty construction	3 ltrs/hr	4 hrs/day for 10 days	50 dB(A)

Watermaker Reverse Osmosis (RO) Plant	Powered by site camp generators and stored within an insulated 10ft container	See generators	5 hrs/day for duration of season	60 db(A)
50 m of Temporary Roadway (Eve trackway or similar)	20 x modular aluminium panels (3 x 2.5 m) will be used to form 50 m of roadway linking the main construction site with the storage area			
Crane Mats	6 x 1 m x 200 mm timber mats, used for spreading the load of cranes and excavators. Each matt weights approximately 1440 kg			
400 m Picket fencing	Chestnut paling fence will be used to create an exclosure around the working area in order to deter seals from approaching. A total of 400 m will be used in order to allow for replacement of damaged fence.			
160 m^2 system scaffold (Kwikstage/Cuplock)	This quantity will create a 2.4 m lift of scaffold around the perimeter of the new Beck House			
4 No. 4.268 m x 2.864 m Bunk-a-bin accommodation units	Each unit sleeps two people and provides shower and toilet facilities			
4 No. 6.1 m x 4.9 m Weatherhaven storage tents	Storage for laundry facilities, frozen food storage, waste management and workshop			
1 No. 4.3 m x 2.7 m Weatherhaven drying tent	Used for drying all kit			
1 No. 9.7 m x 4.9 m Weatherhaven mess tent	Used as communal mess tent for BAM staff			
7 No. 10’ ISO containers	RO plant and general storage			
30 No. 1 m x 1 m storage boxes	Used to decant Beck House contents for duration of construction work			
90 litre steel or polypropylene bunded portable fuel caddy				

3.7. Description of Support Activities for Construction & Operation

3.7.1. Transportation for import and export of materials, equipment and personnel

A number of options have been identified for the transportation of plant and materials to Bird Island.

Option 1

Chartered vessel arrives at Bird Island after seal breeding season (Nov-Jan). Single mobilisation from UK.

Option 2

BAS provides vessel or vessels from UK to Bird Island.

Option 3a

Commercial ship is chartered to the Falkland Islands or Punta Arenas and from there BAS provides vessel to Bird Island.

Option 3b

Using commercial shipping to Falklands / Punta Arenas then BAM chartered vessel to Bird Island

At the time of writing a combination of Option 2 and Option 3a is the preferred option, which is being investigated further.

Prior to any plant or materials being loaded onto any of the vessels they will be inspected as per the guidelines in the BI BAM Biosecurity Plan (see Appendix 4 – BAM Biosecurity Plan).

The BAS vessel RRS James Clark Ross (JCR) will transport the following equipment from the UK direct to BI (arriving in early November): bulk fuel (15,000 m^3), 5 x bunded tanks to store the fuel on site, all petrol and gas cylinders and the telehandler and 8T excavator, both of which are essential pieces of equipment to assist with offload of cargo. The JCR will also install a mooring in Freshwater Inlet which will be used by the ES tender vessels to overnight (if necessary) during the cargo unloading in February and for future BAS operations. The mooring is made of 9 railway wheels (sourced from the Falkland Islands) which make 3 separate weights (3 wheels welded together) and will be installed at this approximate location: 54°00.5589’ South, 38°03.1732’ West. All cargo and equipment being transported by JCR to BI will be biosecurity checked.

The necessary construction equipment, plant, building materials, prefabricated Beck House building units and temporary site camp compounds will be collected from Europe, currently

anticipated to be Southampton port, by the commercial Falkland Islands Resupply Ship (FIRS) for transport to the Falkland Islands where all cargo will be offloaded to await collection by the BAS ship RRS Ernest Shackleton (ES).

The BI construction personnel are expected to fly to the Falkland Islands where they will join the ES for transport to Bird Island along with all the cargo from the commercial ship. Prior to loading all cargo/plant onto the BAS vessel a further biosecurity inspection will be carried out. All personnel will also be briefed on their personal biosecurity responsibilities.

The ES tender/landing craft will deliver all plant, materials and prefabricated units from the vessel directly onto the beach at Bird Island.

BAM personnel, plant, waste and equipment are expected to be removed from Bird Island at the end of the project at the end of May aboard the RRS ES. All dates are, however, subject to change dependent on the ships itineraries and the weather conditions.

3.7.2. Storage Requirements

During the construction period, much of the Beck House equipment will be in temporary storage whilst the new building is being constructed. Any equipment that needs to be accessed by Bird Island Station personnel (e.g. washing machines, waste compactor and packing equipment, etc.) will be stored in a shared facilities area as shown in Figure 5 and within Weatherhaven tents and ISO containers. Any other materials that are not required, or only need to be accessed infrequently, will be stored in smaller cargo boxes.

3.7.3. Energy requirements

All electrical energy will be produced from generators running on MGO. It is anticipated that a total of 35,000 litres of MGO are required for the completion of the works. This quantity is based on 25,000 litres to run the generator to supply the construction site camp and 10,000 litres to supply fuel for the construction plant.

3.7.4. Fuel Handling and Spill response

The following fuel will be imported to Bird Island for the redevelopment works;

- 35,000 litres MGO for plant and generators
- 200 litres petrol for the disc cutter and the outboard motor for the boat

Refuelling from the JCR

A total of 35,000 litres of MGO (for plant and generators) will be supplied and delivered by BAS aboard the RRS James Clark Ross (JCR) during the first call to Bird Island early in

the season, currently scheduled for the middle of November. This is necessary in order to ensure that all the required fuel for the construction period is on the island and available for use when the construction team arrive.

The JCR will deliver a total of seven empty 5000 litre capacity bunded tanks, which will be positioned on the beach adjacent to the generator shed and secured in position by strapping down with cargo straps and driving anchors into the ground. The small bunded tanks will then be filled with MGO from the JCR.

BAS will be responsible for refuelling from the JCR and all activities will follow the Ships Refuelling Procedure. An empty 10 m^3 rubber fuel bladder is deployed from the JCR into the ships tender using cargo nets and the ships crane. The ship's tender is launched into the water and pulled up to the side of the ship. The fuel bladder is then connected to the ship's fuel tanks via a 3" connection hose and pumped full. In the event of a fuel spill the Ships Oil Spill contingency Plan will be followed.

Transfer of fuel from the JCR to temporary bunded tanks

The ships tender will transport the full fuel bladder to the station and comes alongside at the jetty. On station, delivery hoses are laid out on the jetty and are used to connect one of the bunded tanks to the bladder in the tender via a pump. Once all connections are made and checked, spill response kit is made easily accessible, drip trays and absorbents are placed at all connections where a spill could occur, then the valves are opened and the pump started to transfer the fuel from the bladder to the bunded tank. This procedure is repeated until all the bunded tanks are filled. In the event of an oil spill during this procedure the Bird Island Oil Spill Contingency Plan (OSCP) will be followed.

A total of 8 No. 25 litre plastic jerry cans of petrol will also be delivered to power the safety boat and disc cutter. The petrol will initially be stored in the BAS hazardous waste storage area and later moved to one of the BAM 10' ISO containers.

Transfer of fuel from temporary bunded tanks to 15m^3 bulk fuel tank

When the BAM construction team and all cargo and plant arrive at Bird Island later in the season, the first programmed works are to install the new 15,000 litre permanent fuel tank. Once installed, some of the MGO that is anticipated to be delivered earlier in the season will be transferred from the smaller temporary bunded 5000 litre tanks to the permanent 15,000 litre bulk fuel tank for use by the construction team. The BI refuelling procedures and stations OSCP will be followed.

Daily refuelling of BAM plant and generators

The new 15,000 litre bulk fuel tank will then be exclusively used for refuelling the plant and supplying generators. The 15,000 bulk fuel tank will continue to be refilled from the smaller bunded tanks as necessary throughout the season.

Refuelling of plant will be achieved with the use of a 190 litre steel or polypropylene bunded portable fuel caddy. The fuel caddy will be filled directly from the MGO bulk fuel tank and then transported using the telehandler to the plant and refuelling will take place using the in-built hand pump and fuel delivery hose.

The site camp generators are run from a small, bunded 1000 litre tank and are permanently located adjacent to the 15,000 bulk fuel tank. The generator tank will be refuelled directly from the bulk fuel tank using a fuel hose.

Refuelling will only be carried out by BAM designated and trained personnel in accordance with the BAM refuelling procedure as shown in Appendix 2 – BAM refuelling Procedures.

All BAM operatives will be briefed on the BAM Emergency Oil Spill Plan and the procedure to follow in the event of a spill before they depart for Bird Island. Oil spill drills will also be carried out before departure.

3.7.4.1. BAM Emergency Oil Spill Plan

The purpose of this contingency plan is to describe the procedures that will be used by BAM when working for BAS at Bird Island Research Station.

BAM will be directly responsible for dealing with small volumes of spilt fuel and oil that do not pose a risk to the health and safety of staff and/or wildlife.

For larger spills or small spills that pose a risk to the health and safety of staff and/or wildlife, the Bird Island Station Leader must be informed immediately. The response procedure will then be determined and coordinated by the Bird Island Station Leader. In such circumstance, the Bird Island Oil Spill Contingency Plan will supersede any instruction provided below.

Table 5. BAM Emergency Oil Spill Plan

Fuel and chemical spills within BAS are classified as follows	
Tier 1	Small spills on land which can be dealt with immediately by one person or a dedicated station response team
Tier 2	Medium spills that require the full resources of the station and assistance from BAS Cambridge
Tier 3	Large spills which exceed the resources of the station and BAS Cambridge and require outside assistance
In the event of a fuel, oil or chemical spill the following procedure should be followed	
1	Stop work immediately
2	If spillage is flammable, extinguish all possible ignition sources.
3	Identify the source of the pollution and prevent further leakage by: • Plugging leaking drums • Righting upturned drums • Switching off machinery with leaking hydraulic hoses
4	Quickly assess the spill. Determine; • The risk of fire or harm to human health • Time and location of spill • Type of spilt material and quantity • The level of spill. All spills on water will be tier 2 or 3

For Tier 1 Spills	For Tier 2 or 3 Spills
Put on suitable Personal Protective Equipment (PPE), including fuel resistant gloves	Immediately inform the Station Leader, who will then take responsibility for co-ordinating the spill response
Prevent further spread of spills using absorbent socks	Put on suitable PPE, including waterproof gloves
Steps to be taken to prevent oil from entering the sea, watercourses or drainage systems	Follow the Station Leader's instructions
Inform the Station Leader	
Recover spilt material using absorbent pads	
Dispose of waste fuel, contaminated spill kit materials and PPE in 205 litre drums. The Station Leader will identify the correct drums for disposal.	
For All Spills	
All personnel who may have come into contact with the spill are to receive a medical check up	
BAM personnel and their subcontractors are to assist the Station Leader in preparing a detailed spill report that will be submitted to BAS AINME database	

BAM Emergency Spill Equipment

Emergency spill kits will be kept at five locations on site. These are:

- Stores
- Bulk 15,000L MGO Tank
- With telehandler (behind or under the driver's seat)
- With Backhoe loader (behind or under the driver's seat)
- With 8 Tonne excavator (behind or under the driver's seat)

Each spill kit will contain the following:

- 30 oil absorbent pads,
- 3 x 1.2 m oil absorbent socks,
- 3 oil absorbent pillows,
- 1 pair of goggles,
- 1 pair of gloves,
- 5 bags and ties

Additionally, Plant nappies for use on each refuelling occasion, 10 No. 130 mm x 3 m oil booms and 100 spare oil absorbent pads will also be contained within the site camp stores.

3.7.5. Waste Management (refer to SWMP)

Before unused materials are defined as waste they will be offered to the Station Leader and the Facilities Manager for re-use within the Research Station. Waste materials will be

packed and labelled in accordance with the BAS Waste Management Handbook[2]. A list of the predicted waste types, quantities and disposal options can be found in the BAM Site Waste Management Plan (SWMP). See Appendix 3 – BAM Site Waste Management Plan. Waste will be packed for shipping by BAM and removed from Bird Island by BAS. BAS will also be responsible for subsequent waste disposal according to the waste hierarchy.

The reduction and, where possible, elimination of the use of hazardous materials has been carefully considered during the design and planning of the works. For example, the use of pre-cast concrete as the Beck House foundations eliminates the need for importing aggregates to Bird Island and mixing up to 44 tonnes of tonnes of concrete on site.

3.7.6. Construction Personnel

Bird Island Research Station is located on a small beach with little space available for the construction site camp and construction works area. The construction personnel will be living in close proximity to each other and the station personnel and they will only receive a limited number of relief shipping visits. It should be expected that the remoteness and the living conditions could be mentally and physically demanding to the construction personnel. The selection of the construction personnel is, therefore, critical to ensure that they have the right mix of skills, work ethic and ability to work for long periods of time in this remote environment. A maximum of 10 multi-skilled construction personnel will be carefully selected to work at Bird Island. The personnel will represent the following trades and skills:

- Construction Manager – Lloyd Wickens
- First Aid, Setting Out, Welder, Burner, Steel Erector, Plumber, Dry Liner, Plaster, Ground Worker, Painter, Flooring Installer, Cladder
- Works Manager – TBC:
- Plant Operator, Steel Erector, Ground Worker, Welder, Burner, Plumber, Dry Liner, Painter, Lino Installer, Cladder
- Carpenter / Ground Worker / Steel erector / Builder / Cladder
- Carpenter / Ground Worker / Steel Erector / Builder / Cladder
- Ground Worker / Cladder / Steel Erector / Skid Steer Operator / Painter
- Ground Worker / Builder
- Plant Operator / Plant Fitter
- Generator / Plumber / Heating, Ventilation and Air Conditioning (HVAC) Installer
- Builder / HVAC Installer / Plumber / Fire Systems Installer
- Electrician / Generator Fitter / Communications Lead

BAM Bird Island personnel will also be allocated waste and biosecurity responsibilities and the following additional roles will be given to members of the site team:

- BAM Site Waste Coordinator
- BAM Environmental Engineer
- BAM Biosecurity Inspectors

[2] https://www.bas.ac.uk/wp-content/uploads/2017/10/Waste-Management-Handbook-Ed.10-2017-FINAL.pdf

In addition to the BAM construction personnel, BAS will also have the following staff on site for the duration of the construction:

- BAS BI Project Manager – Joe Corner (to supervise all BAM works)
- BAS Medical Unit (BASMU) Paramedic – TBC
- BAS Catering Manager – TBC (responsible for preparing all meals for both BI and BAM staff

The Bird Island population will double with the introduction of the construction team personnel and additional BAS staff. The Research Station is not capable of accommodating an additional ten construction personnel and, therefore, a temporary site camp will be constructed to provide additional sleeping quarters, a shared mess area, bathroom and toilet facilities and general storage areas. The site camp facilities will be kept to a minimum in size in order to reduce the temporary impact on the beach and surrounding environment. Details of the site camp establishment are provided in Section 3.6.2.1.

It is anticipated that the existing BAS Prince House accommodation building will support the additional BAS staff and a maximum of four BAM staff. The remaining six BAM staff will share the four temporary bunk-a-bin sleeping units. All meals will be prepared by the BAS Catering Manager in the Prince House kitchen and it is anticipated that all meals will be served to BAM staff in the temporary communal mess tent. The mess tent will be used throughout the construction period for BAM meals and tea breaks, staff training and briefings and for evening relaxation and entertainment. A BASMU paramedic will also be on site to offer any necessary medical support.

3.7.6.1. Training

The following pre-deployment training was delivered by BAS to the BAM BI construction team. All BAM BI staff have received the same level of training as BAS staff travelling to Antarctica or South Georgia under BAS logistics through the BAS annual pre-deployment course. In addition, to the general induction, select BAM BI staff also attended the BAS oil spill response course which is a mixture of lectures, desktop exercises and practical exercises.

The BAS Environment office delivered a specific environmental induction to all BAM BI staff with a focus on the BI EIA. All staff signed a declaration to confirm they had attended.

Table 6. BAM Environmental Training

Training delivered by BAS	Training contents	Attendees	Delivery Date
BAS Pre-deployment Training Course	Three day general Induction for all BAS staff working in Antarctica or South Georgia: • Life on station • Science on station • Intro to GSGSSI • Intro FCO Polar Regions	All BAM BI construction staff (x 10)	10/09/17 - 12/09/17

	• BAS future science • Health & Safety • Environmental Issues		
BAS Oil Spill Training	Half day BAS and Oil Spill Response Ltd training delivered to all BAS winterers and all those with fuel handling responsibilities: • Environmental and H&S impacts and responses • Oil spill contingency planning Station refuelling procedures • Desk top exercises • Familiarisation with spill response equipment	2 x BAM BI staff (Construction Manager and Works Manager) 1 x BAM Environmental Manager (based in the UK)	13/09/17
BAS BI Environmental Induction	GSGSSI legislation, BI EIA, Biosecurity, waste management, wildlife awareness, fuel management, BAM responsibilities	All BAM BI construction staff (x10)	14/09/17

3.8. Future Activities

3.8.1.1. Plans for decommissioning

As the new Beck House is to be constructed from prefabricated units, decommissioning at a future date can be achieved simply by reversing the construction process.

The scaffold jetty will be constructed from scaffold tube and, as with Beck House, any future decommissioning can be carried out by reversing the construction process.

It is anticipated that the same plant used in the construction would be required for the decommissioning. The works would require approximately 8 weeks with a work team of 8 personnel.

3.8.1.2. Predicted Lifespan of Project

The design for Beck House is based on a 60 year design life with 25 years before major maintenance is required. Some specific building materials, such as the colour coated trapezoidal profiled steel panels used as cladding on the walls and roofs, may not be able to be guaranteed for a 25 year period and these materials will be monitored as part of the usual BAS Estates works and replaced as and when necessary.

The jetty is made from scaffold tube and fittings. This will be designed according to the standards for temporary works with scaffolding and, therefore, no design life can be given. The 'UKCS Offshore, Specific Scaffolding Guidance' provides the following guidance on the life expectancy of scaffolding in the marine environment:

Table 7. Scaffold life expectancy

Area/Location	Initial Period	Extended Period
Under Deck	6 to 12 months	Subject to a formal annual inspection by the Facilities Engineer and further regular inspections throughout the year by the onsite technician particularly after periods of bad weather, excessive ice build-up or unusually high tides.
Top Side	1 to 2 years	
Internal	2 to 3 years	

The new diesel tank is the same specification as the existing tanks that BAS already have installed at BI. The specification for the tank does not include an explicit design life. However based on BAS experience they are expected to have an approximate life span of 10 – 15 years.

3.9. Biosecurity Measures

The redevelopment project at Bird Island will involve the movement of personnel and transfer of cargo, equipment and plant between locations of distinct biological diversity. This increased activity at Bird Island has the potential to increase the risk of non-native species introductions into the local environment.

GSGSSI Wildlife and Protected Areas Ordinance (2011) legislates to minimise the risk of non-native species introductions to the islands, and BAS and BAM are obliged to conform to this legislation. It is essential that all necessary precautions are taken to prevent the introduction of non-native species to Bird Island from other locations. A specific Bird Island BAM Biosecurity Plan has been prepared detailing the guidance and measures that will be taken along the material supply chain as well as for personnel working on Bird Island. See Appendix 4 – BAM Biosecurity Plan.

4. DESCRIPTION OF SITE

4.1. Location

Bird Island lies off the northwest tip of South Georgia in the Southern Atlantic Ocean (Figure 6). It is separated from the South Georgia mainland by a 500 m channel named Bird Sound. It is approximately 1000 km south east of the Falkland Islands and is accessible only by boat or ship-supported helicopter.

The Bird Island BAS Research Station is situated on Freshwater Inlet, Jordan Cove, on the southern side of Bird Island (54°00' South, 38°03' West). There is no other infrastructure on the island except for a few associated field huts used throughout the year by BAS researchers. Freshwater Inlet where the station is situated and Main Bay, both within Jordan Cove, provide a natural harbour with limited shelter. Vegetation around Freshwater Inlet, and more generally in areas on Bird Island below 150 metres, is predominately tussock grass, which has been extensively damaged by fur seal activity, particularly close to streambeds that offer them access to inland areas. Higher ground is flat boggy meadowland dotted with small tarns. Steep higher ground is generally comprised of rock and loose scree covered with mosses and lichens.

In 2012, GSGSSI created one of the worlds largest, sustainably managed Marine Protected Area (MPA) that encompasses the entire SGSSI Maritime Zone north of 60 °S and includes waters around Bird Island. The MPA occupies in excess of 1.3 million km^2 of the Southern Ocean and it puts in place measures to provide refuges for fish, protect the benthos and avoid competition between fisheries and land-based foragers.

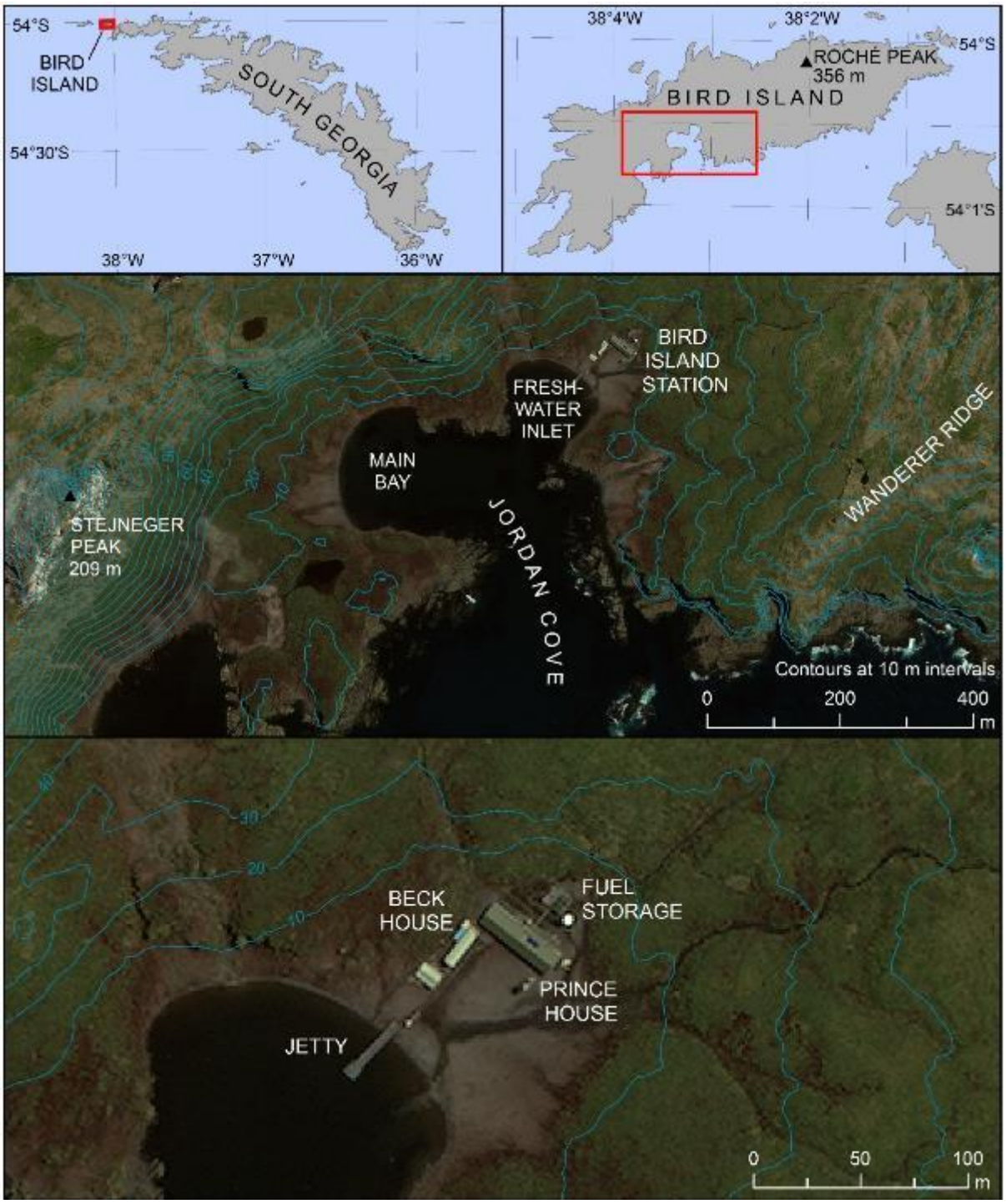

Figure 6. Maps of Bird Island, South Georgia, including the area around the current research station.

4.2. History of site

The island was discovered in 1775 by Captain James Cook, who named it Bird Island on account of the large numbers of breeding birds.

Evidence of the presence of sealers on Bird Island can be seen in the Sealer's Cave, beneath Cave Crag, close to Bird Island Research Station on Freshwater Beach. Sealers were present throughout South Georgia in the late 19th century. Records of whalers landing at Bird Island exist for 1909 and 1919 and the first scientists are recorded as visiting in 1933 and 1936 as part of the "Discovery Scientific Investigations".

The first long-term scientific interest in Bird Island began in December 1956 when Nigel Bonner visited on the Grytviken sealer, Lille Karl, followed by a series of extended visits to study Antarctic fur seals.

From December 1962 - 64 the United States Antarctic Research Program (USARP) in collaboration with BAS, established three huts at Bird Island to support a three-man team overwintering and conducting studies on the breeding albatrosses.

4.2.1. Past Developments

Bird Island was occupied intermittently from 1957 – 1982 and continuously from September 1982 to the present day. It was used by summer parties from 1957-64 and from 1971-82. Personnel were evacuated on 1 Apr 1982 by HMS *Endurance* following the Argentine invasion of South Georgia. It reopened on 22 Sep 1982 when hostilities ceased.

Initial buildings 1950s–1970s

Jordan Cove was used by summer parties from 1957 to 1964 and from 1971 to 1982. Accommodation was basic camping to begin with but a small hut 'Bonner's Bothy' was erected at Freshwater Inlet in 1958 and was used up until 1961/62. Later huts were constructed by USARP, the largest known as 'Lönnberg House', in 1962 and re-occupied and used by BAS until 1981.

Developing infrastructure 1980s and 1990s

A new hut was constructed by BAS in October 1981 for wintering staff and named Beck House after an American biologist who made extensive collections of birds around the Falkland Islands, Tierra del Fuego and the Galapagos Islands between 1912 and 1917. This building provided accommodation, laboratory and office space for up to eight people.

A further building containing laboratories, a workshop and storage areas was added in the 1995/96 season.

In 1996/97 an extension to Beck House was established to house upgraded accommodation (double bedrooms) and improve water collection and treatment system. The newly

extended Beck House was renamed Prince House to commemorate Peter Prince, BAS seabird biologist. The separate storage building/laboratories were then named Beck House.

Redevelopment 2005

The station complex was completely redeveloped between Jan and June 2005 by Morrison PLC, construction partners of BAS.

Prince House was demolished and replaced with a new accommodation and office building of the same name. The old generator shed (the original Lönnberg House built in 1962) was demolished to make way for the new generator shed. The storage and workshop building built in 1995/96, Beck House, was not changed in any way at this time.

Field huts

Builds have not been restricted to the Freshwater Inlet area alone as field huts and hides have existed at one time or other at the following sites: Gazella Peak, Molly Hill, Wanderer Ridge, Johnson Gentoo Colony, Top Meadows (two locations), Colony B, Special Study Beach, Colony J and Fairy Point.

4.3. Current Use of Site

Bird Island Research Station, located at the site since 1957, is an important centre for research into bird and seal biology.

The current research station, which was last redeveloped in 2005, provides accommodation for ten staff during the summer season and for four staff over the winter period. It provides a unique research facility on an island teeming with wildlife that has been studied for over 50 years.

4.3.1. Science

The BAS scientific research at Bird Island focuses on seabird and seal population dynamics, feeding ecology and reproductive performance.

Zoological Field Assistants carry out long-term monitoring programmes at Bird Island on the following species: Antarctic fur seals[3], macaroni penguins, wandering, black browed, grey headed and light mantled sooty albatross[4], northern and southern giant petrels and blue eyed shags. The work focuses on the breeding populations and aims to monitor population size, breeding success and diet composition and feeding grounds. BI zoologists and personnel also report on monthly debris surveys from Main Beach, seal entanglement

[3] https://www.bas.ac.uk/data/our-data/publication/climate-change-selects-for-heterozygosity-in-a-declining-fur-seal/
[4] https://www.bas.ac.uk/data/our-data/publication/the-conservation-status-and-priorities-for-albatrosses-and-large-petrels/
https://www.bas.ac.uk/data/our-data/publication/recent-trends-in-numbers-of-wandering-diomedea-exulans-black-browed-thalassarche/

episodes, bird debris (fish hooks, etc.) and sightings of animals contaminated with any fuels or oils.

Many of these long-term datasets are crucial to understanding the Southern Ocean ecosystem and contribute towards the sustainable management of Southern Ocean resources[5]. Much of this data from Bird Island is reported to the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) Ecosystem Monitoring Programme (CEMP). The CCAMLR aims to establish conservation policy and management to protect the current diversity of the Southern Ocean[6].

The BAS ecosystems team (supported by research conducted at Bird Island) is responsible for a large number of scientific publications[7].

4.3.2. Recreation

Although space is limited on station, there is plenty to keep people fit and active. Gym equipment (including running, rowing and cycling machines), some free weights and a punch bag are frequently used by personnel. Recreational walking is a popular way to explore the islands various beaches, creeks and ridges.

There are daily opportunities for wildlife watching and photography. There is also an extensive range of reading material and music and videos/DVDs are also available.

4.3.3. Energy Production and Use

Power at Bird Island is supplied by two 20 kW John Deere generators. Typically, only one generator is in use at a time, with the other maintained and kept on standby. Continuous (24-hour) power is currently available.

The offline/standby generator is capable of providing emergency power to the station. In the event of loss of the generator shed and/or the station there is emergency power back up in a small portable generator that can provide the necessary power to charge emergency communication equipment.

Water in Prince House is heated via an MGO fuelled boiler and by a solar water heating system installed on the roof. Solar power is also used for some of the field huts which are visited for short periods of time. The current annual energy use at Bird Island, as recorded in the 2016-2017 season, is 62,357 kWh (see Table 8).

[5] https://www.bas.ac.uk/science/science-and-society/our-research-impact/ecosystems-valuing-sustainability/
[6] https://www.bas.ac.uk/about/antarctica/the-antarctic-treaty/the-convention-on-the-conservation-of-antarctic-marine-living-resources/
[7] https://www.bas.ac.uk/science/research-topic/ecology-biodiversity/conservation-ecology/#publications

4.3.4. Station utilities

4.3.4.1. Water

Water at Bird Island is sourced from rain and snowmelt water which is collected from the roofs of Prince House and Beck House and stored initially in a temporary roof water collection tank. Additional water can be collected from the local streams, filtered and then stored in the same water tank. The collected water is either then pumped untreated into the non-potable storage tank for use in the toilet system or it can be pumped through a filtration system and UV-steriliser into a separate potable storage tank for human consumption on station. The annual water consumption at Bird Island for the year 2016-2017 is 103,030 litres (see Table 8).

4.3.4.2. Fuel

The bulk of the fuel used at Bird Island is MGO and it is currently stored in three bulk fuel tanks at the back of the beach, each of which contain 15,000 litres of MGO. Smaller MGO fuel tanks for the generator shed and boiler room are stored internally in the buildings and are refilled weekly.

A total of 15 × 205 litre drums of MGO fuel is still kept in stock at Bird Island as emergency fuel for the generator room in the event of a fuel line failure from the main bunded fuel tanks.

Up to 750 litres of engine oil and other lubricants are stored in the generator shed.

Heating in Prince House and Beck House is through a central heating system supplied by MGO fuelled boilers used to provide heating in Prince House and Beck. 24-hour electricity is also provided by generators supplied by MGO.

Fuel use in generators at Bird Island over a one year period in 2016-17 was 37,575 litres (see Table 8).

Table 8. Annual and quarterly energy, water and fuel consumption at Bird Island provided by BAS Estates for 2016-2017 season.

	Period	Fuel (litres)	Water (litres)	Energy (kwH)
12 March 2016 - 1 March 2017	Quarter 1	9,390	25,075	14,842
	Quarter 2	9,465	25,466	14,676
	Quarter 3	9,440	25,959	17,301
	Quarter 4	9,280	26,530	15,538
	Total	37,575	103,030	62,357

4.3.4.4. Compressed gases

Approximately 30 (gross weight 44 kg) gas propane cylinders are stored on station in gas cages located next to the bulk fuel tanks. Propane gas is used to supply the Prince House kitchen gas cooking range, which is used by all station personnel.

Propane gas and other compressed gases are also used for some scientific purposes and in-use cylinders are stored in the laboratories.

4.3.5. Waste Management

Waste management at Bird Island follows the BAS Waste Management Policy and the guidance provided in the BAS Waste Management Handbook.

The BAS Waste Management Policy is to:

- Minimise waste in the first instance;
- Reuse and recycle at source where possible; and
- Remove all wastes other than sewage, grey water or food waste for reuse, recycling or final disposal.

At Bird Island, waste is separated at source, compacted and packaged. Segregated wastes are stored outside during the year, in secure FIBC bags or 205 litre drums and covered by tarpaulins, awaiting collection once or twice each season by BAS vessels. All recyclables and hazardous wastes are returned to the UK for recycling or safe disposal and all general (non-hazardous) wastes that cannot be recycled are sent to landfill in the Falkland Islands. BAS currently has an 88% average recycling rate across all its stations with Bird Island achieving an 83% recycling rate during the 2015/16 season.

The only wastes produced at Bird Island that are disposed of in the local environment are waste food, sewage and grey water. Sewage and urine and grey water are macerated and discharged directly to sea. Waste food is pressure cooked before being discharged to sea. The exception is foods that decompose slowly, such as bones, fats, and orange peels, etc. These are frozen and collected along with other accumulated wastes in order to be returned to the UK for incineration.

5. DESCRIPTION OF THE ENVIRONMENT

Bird Island is a part of South Georgia and the Sound Sandwich Islands, which is a British Overseas Territory in the Southern Ocean. The Territory is considered of global significance as a pristine and rich environment with major populations of seabirds including globally threatened species, highly productive waters with a large biomass of krill and many marine mammals and predators.

Bird Island is a small island located just off the northwest tip of the main island of South Georgia. The Island is 6.5 km long and up to 1.5 km wide with an area of approximately 4 km^2. The island is orientated approximately east-west along its long axis.

The northern coast is devoid of beaches and mainly consists of high cliffs, rising to the highest point at 365 m at Roché Peak near the eastern end of the island. The southern coast, where Bird Island station is located, has numerous small beaches and raised rock platforms. Two of the beaches are almost enclosed sea areas, one at Jordan Cove (where the research station is situated within Freshwater Inlet) and one at Evermann Bay. Most of the gentler slopes, below about 100 m, are covered with tussock grass but in places relatively level swards of shorter grass and other plants occur. These are dotted with small pools and mountain lakes. These meadows are particularly well developed in the area to the northwest of Stejneger Peak, which is the highest point, at 190 m, of the ridge which divides the western half of the island. Above about 100 m the terrain changes to areas of sparsely vegetated gravels and cryptogam-dominated scree and rock faces.

Figure 7. A typical stretch of northern coastline on Bird Island, devoid of beaches and consisting of high cliffs. (Photo: Adam Bradley)

Figure 8. Southern Coast, looking over Freshwater Bay and Bird Island Research Station (photo: Adam Bradley)

5.1. Protected Areas

5.1.1. Terrestrial Protected Areas

Under the Wildlife and Protected Areas Ordinance 2011, Bird Island is protected with access only allowed in accordance with a permit issued by the GSGSSI.

5.1.2. Marine Protected Areas

In 2012, GSGSSI created one of the worlds largest, sustainably managed Marine Protected Areas (MPA) that encompasses the entire SGSSI Maritime Zone north of 60°S which encompasses the whole island of South Georgia and Bird Island. The MPA has been carefully designed to ensure the protection and conservation of the regions rich and diverse marine life, while allowing sustainable and carefully regulated fisheries. The MPA covers a total area of 1.07 million km^2, which includes the prohibition of all bottom trawling and a ban on bottom fishing at depths less than 700 m and greater than 2,250 m. No-take zones, extending 12 nautical miles from the coast, were created around South Georgia, Clerke Rocks, Shag and Black Rocks and the South Sandwich Islands, totalling 20,431 km^2. Other protection measures within the MPA include a network of benthic no-take-zones (NTZ) in previously popular toothfish fishing areas, and closure of the krill fishery in the summer

(November 1st until March 31st), – when krill-eating birds and marine mammals are breeding. All these measures provide refuges for fish, protect the benthos and spawning fish and avoid competition between fisheries and land-based foragers.

5.2. Ecology

5.2.1. Terrestrial Flora

The vegetation of Bird Island is similar to that of mainland South Georgia though fewer species are represented. It consists of vascular plants, mosses, lichens and fungi (these are recorded in Appendix 5 – Flora of Bird Island).

The dominant plant is tussock grass, *Poa flabellate* that can either be found with a deep green colour, wherever it is influenced by fur seals or seabirds - presumably due to the availability of nutrients, or as a distinctly yellowish-green. It is a robust grass that grows in clumps or tussocks, up to a metre in diameter and 1 to 1.5 metres high, the shoots radiate from a peaty stool composed of dead and dying leaf bases with mineral inclusions.

The density of the tussock vegetation is largely determined by water availability, with dense vegetation forming in wet areas, and more open tussock found on drier ground. On seaward slopes, up to about 100 m, this tussock grass forms an almost pure continuous stand, the dense shade provided by the overhanging shoots preventing the growth of any other vascular plants between the clumps. However, where natural breaks occur in the tussock cover, or where tussock grows less densely, there may be an understorey of bryophytes (e.g. mosses, liverworts) or less commonly vascular plants, notably Antarctic starwort, *Callitriche antarctica*. In nitrogen-enriched situations the foliose alga *Prasiola crispa* may occur.

Figure 9. Tussock growing on a slope to the rear of the bulk fuel tanks at Bird Island Research Station (Photo: James Robbins)

Over large areas of low altitude grassland on Bird Island (primarily on the south side of Bird Island) there has been extensive damage by fur seals, resulting in the crowns of individual tussocks being killed leaving a fringe of flattened living tillers. More recently, the most severely affected sites have been totally destroyed and seal erosion has left large areas of bare hummocky ground. Clearings in tussock grassland may be occupied by more or less extensive swards or by banks of mosses, with variable amounts of the grass *Deschampsia antarctica*, *Callitriche antarctica*, the burnets *Acaena magellanica* and *A. tenera* or the pearlwort, *Colobanthus quitensis*.

Further inland, larger areas of flat wet ground are dominated by extensive swards of Antarctic hair-grass (*Deschampsia antarctica*) and wet habitat mosses. On screes and boulder fields and on cliffs and rocks near the coast (primarily on the north coast of the island), lichen and moss communities can be found. However, these are not dominant in the areas around the research station.

Figure 10. Tussock grass colonising moss (*Chorisodontium aciphyllum*). (Photo: Chris Gilbert)

5.2.2. Terrestrial Fauna

The fauna is similar to that of mainland South Georgia, though as with the plants, fewer species appear to be present. No native or non-native terrestrial mammals, other than humans, are found on the island and neither does the island have any reptiles or amphibians.

There is no recent thorough survey of terrestrial invertebrates at Bird Island. However, insects and arachnids recorded at Bird Island are listed in Appendix 6 – Terrestrial and Freshwater invertebrates recorded from Bird Island. The most obvious macroscopic forms of fauna include enchytraeid worms, an oligocheate (*Microscolex georgianus*), numerous mites, springtails, the spider *Notiomaso australis*, four beetles (*Crymus antarcticus*, *Perimylops antarcticus*, *Hydromedion sparsutum* and *Halmaeusa atricepts)*, and several flies including a sciarid (*Lycioriella casar*), a large helcomyid kelp fly (*Paractora trichosterna*) and a brachypterous sphaerocerid (*Antrops truncipennis*) found along the shore.

The freshwater pools and streams in the vicinity of the station do not appear to support an extensive invertebrate fauna, apart from larvae of the chironomid *Parochlus steineni* in the streams and the anostracan *Branchinecta gainii*.

5.2.3. Avifauna

Bird Island supports a large and varied avifauna (see Appendix 7 – Avifauna of Bird Island). Ten species of global conservation concern breed on Bird Island and these are: black-browed albatross, wandering albatross, grey-headed albatross, light-mantled albatross, southern giant-petrel, northern giant petrel, white-chinned petrel, macaroni penguin, gentoo penguin and South Georgia pipit. The pipit is present on Bird Island all year round; however, other species start to arrive on the island in September and their chicks fledge by May/June. The only exception is wandering albatross chicks, which are present on the island through the winter and fledge in the following December.

The area around the station has a lower diversity of bird species than other areas due to the limited availability of suitable habitat and the impact of fur seals. However, the tussock grassland that lies near the existing station and adjacent to the existing Beck House is the favoured habitat for several species of birds, including burrowing petrels and pipits. A colony of black-browed albatross is found on cliffs c. 200 m to the west of the station.

Figure 11. Black-browed albatross (*Thalassarche melanophris*) nesting site with Bird Island Research Station in background

In all areas of Bird Island, it is possible that South Georgia pipits may have nests hidden within the tussock. It is also possible that South Georgia pintail ducks may occur in these areas as they also nest in tussock; however, they nest in areas near freshwater ponds so are unlikely to be found at Bird Island station.

The area directly behind Beck House and the wood store consists of a stream leading down to the beach. Beyond this, there are two concrete blocks – one at ground level, and one several metres up and into the tussock. The slope is quite steep and rocky compared to similar tussock slopes nearby. No pipits were heard or seen on this slope during a survey carried out in October 2016. In addition, no white-chinned petrel burrows were observed in the ground adjacent to Beck House when surveyed in July 2017.

The area behind Prince House currently houses the satellite dome, gas and bulk fuel storage. The area between the fuel storage and the station is flat and clear. To the rear of the bulk storage there is an additional c. 6 m of clear ground before the base of the tussock. The tussock rises steadily in a gradual slope directly behind the tanks, with steeper inclines to the side. There is a stream that runs past, and a small off-shoot that pools under the tanks. At night, white-chinned petrels can be heard to the back of the station, but likely nest further up the hill. Pipits can often be heard and seen in this area, but again are likely to nest further up the slope.

Figure 12. The area behind the station where the bulk fuel storage, satellite dome and gas storage are located.

On the far-eastern side of Freshwater Inlet beach, there is a worn cut-through to a neighbouring beach. The beach gradually gives way to tussock. There is an exposed part of beach with tussock encroaching around it. This slope is a mixture of rocks and muddy tussock during the summer months. In October 2016, pipits could be heard and seen further up the slope, past the first few metres of tussock.

Figure 13. Sloping ground to the east and Freshwater Inlet beach with Prince House visible to the left

5.2.4. Marine shallow water benthic communities

The intertidal and nearshore marine ecosystem at Bird Island is unlikely to differ from that of the rest of South Georgia, though no systematic study has been published. A common feature observed just off shore of Bird Island is the presence of banks of kelp, *Macrocystis pyrifera*. These occur on stony bottoms where there is some shelter from the full force of the sea and *Himantothallus grandifolius* forms an understory beneath the kelp canopy. Other brown microalgae include *Durvillea antarctica* and *Lessonia antarctica*. Both microalgae are attached to rocks at the lower limit of tides and just below. The former is found at the base of the North Cliffs which are exposed to very violent wave action. A red alga, *Gigartina apoda*, is found intertidally as is a green *Enteromorpha*-like species.

Amphipods and isopods are abundant in the littoral and sublittoral zones. The most conspicuous mollusc is the limpet, *Nacella concinna*, often bearing spirorbid polychaetes on its shell. The byssate bivalves *Kidderia subquadratum* and *Gaimardia trapesina* occur in rock pools but the latter is more often found attached to the kelp Macrocystis. Various opisthobranch and gastropod molluscs are found intertidally.

Figure 14. The seaweed *Macrocystic pyrifera*

Permanent communities occur in the intertidal zone, especially in rock pools, and these are dominated by green algae, hydroids, littorinid and polyplacophoran molluscs, amphipod crustacea and polychaete annelids. The tidal range is normally less than two metres and so zonation patterns are not especially obvious.

The kelp forests provide habitat for an extensive range of epifauna and epiflora. The holdfasts are colonised by invertebrates, mostly polychaetes, nemerteans, molluscs, sponges and crustaceans. The mid-water, below the canopy, is much utilised by shoals of postlarvae and juvenile stages of demersal fish. The fronds are colonised by hydroids, bryozoans, spirorbinids, byssate bivalves and isopods such as *Cassidinopsis emarginatus*.

5.2.5. Marine Mammals

5.2.5.1. Fur seals

By far the most conspicuous animal at Bird Island is the Antarctic fur seal, *Arctocephalus gazelle*, which dominates all the available beaches during the breeding season and extends far inland. Some fur seals, mainly mature males, are present throughout the year, but numbers increase in the breeding season, bulls taking up their territories in the beaches in September/October and the cows arriving in early December. Pupping is highly

synchronised, with 90% of the pups being born between 1 and 24 December. Females bear pups on the beaches and remain with them for about eight days, before going to sea to feed. On return they usually suckle their pups at the back of the beaches or in the tussock grass behind the beach. Juveniles are found in the tussock throughout the breeding season. By lying on the tops of the tussock the seals eventually kill the plants, causing severe erosion. By April most pups have been weaned and the females leave the island. Groups of immature seals are abundant until June, when the majority leave.

Figure 15. Seals on the beach near Bird Island Research Station (Photo: Ian Boyd)

5.2.5.2. Other seal species

Elephant seals, *Mirounga leonine*, breed in small numbers at Bird Island, sometimes in Jordan Cove and Evermann Bay. Leopard seals, *Hydrurga leptonyx*, are regularly seen, particularly in the winter but do not breed on the island. They haul out in Jordan Cove and Johnson Cove as well as elsewhere. Weddell seals, *Leptonychotes weddellii*, have been recorded occasionally.

5.2.5.3. Whales

Southern right whales, *Eubalaena glacialis*, and minke whales, *Balaenoptera acutorostrata*, are regularly seen feeding off Bird Island, mainly between December and March, occasionally as late as early June. Humpback whales, *Megaptera novaeangliae* and pilot whales, *Globicephala melaena*, are recorded from time to time.

Figure 16. Southern right whale at Bird Island (Photo: M. Jones)

5.2.6. Recent changes in biota

Conspicuous changes have taken place at Bird Island in the last 60 years. The most important of these concern the fur seal population. Fur seals were all but exterminated from South Georgia by skin hunters in the course of the nineteenth century and first decade of the twentieth century. However, a remnant population, perhaps consisting of only a few tens of animals, remained. These may have been located at the Willis Islands, which are an inaccessible group of islands 10 km to the west of Bird Island. In the mid-1950s when the first scientific observations on Bird Island began, pup production was probably below 5,000. Breeding fur seals were confined to the beaches and by no means were all of these occupied. The only class of seals found in the tussock were juveniles, which occurred in small numbers, and lactating cows which fed their pups in the tussock immediately behind the beaches. Damage to tussock was very restricted and was confined to a few localities. The population at this time was undergoing a very rapid increase. The last recorded total for pup production at Bird Island was 36,000 in 1976-77.

The effect of this very large number of fur seals on the restricted and relatively fragile tussock grassland, as well as the even more fragile *Deschampsia antarctica* meadows and bryophyte stands has been extremely severe. In the 1950s, the raised beach on which the research station is located was covered with a continuous sward of *Deschampsia*. This has now been totally destroyed. The incidental effects of this habitat modification on birds which burrow or nest in the tussock has been severe. Breeding populations of blue petrels and Antarctic prions may have decreased because of habitat destruction by fur seals.

Figure 17. Image of the beach around Bird Island Research Station taken during the fur seal breeding season of 1999/2000. Note in the foreground the damage to the tussock grass caused by fur seals. (Photo: Pete Bucktrout)

Figure 18. Fur Seal (*Arctocephalus gazella*) exclosure one year after erection. The image shows regrowth of tussock grass *Poa flabellate* following damage and erosion caused by increase in numbers of fur seals in recent decades. (Photo: Simon Pickering)

5.2.7. Non-native species

Compared with other inhabited areas of South Georgia, Bird Island has been subject to relatively few non-native species. Neither rats nor mice have invaded the island and reindeer were never introduced. A dead female rat was found washed ashore outside the station in July 2007, but based upon stomach content analysis and extensive checks around the island, it was considered likely that the rat was washed to the island from the mainland. Rat and mice eradication operations throughout South Georgia and including the mainland adjacent to Bird Island mean the risk of rat introduction via natural vectors has been greatly reduced. Unlike many areas around the old whaling stations on the mainland, some non-native plants, such as dandelions or bittercress, have not established on Bird Island. However, in March 2016, a 30 cm patch of annual meadow-grass *Poa annua* was found and reported to the Government of South Georgia and South Sandwich Islands (GSGSSI), then removed. This is the only recorded instance of a non-native plant species on Bird Island and although, since its removal, there no known extant individuals, there may still be a seedbank.

5.3. Air Quality & Meteorological Conditions

Lying well to the south of the Polar Front, the climate of South Georgia shares characteristics of the sub-Antarctic and maritime Antarctic. Meteorological data are available for other areas of South Georgia, such as Grytviken, located about 120 km to the west of Bird Island, but weather recorded there is colder, drier and sunnier than at Bird Island. The weather at Bird Island is predominantly damp and cloudy with frequent high winds. Temperatures vary from -2 ^{o}C to 9 ^{o}C in summer, and from -10 ^{o}C to 3 ^{o}C in winter. Snow occurs in all months of the year but although late snow patches may persist until January, there is no permanent snow or ice on the island.

Given the location of Bird Island far from other areas of human habitation, the level of air pollution is almost certainly very low with the only sources likely to be from the station's generators. Therefore any pollution is likely to be very localised and rapidly dispersed. Air quality may be impacted by natural sources, in particular, the large amounts of faecal material produced on the beach near the station by the resident seal population.

Figure 19. Bird Island station during winter (Photo Stacy Adlard)

5.4. Bathymetry and marine conditions

Preliminary soundings taken from the existing jetty to 20 m beyond it show that the foreshore in the location of the existing jetty slopes from 1.9 m above Chart Datum at the landward end of the jetty (i.e. same as current jetty deck level) to c. 1.5 m below Chart Datum at 20 m beyond the end of the jetty in the middle of the inner cove. The depth at the end of the existing jetty is c. 0.3 m below Chart Datum and the average foreshore slope is approximately 1:16. The estimated seabed levels are shown in Figure 20.

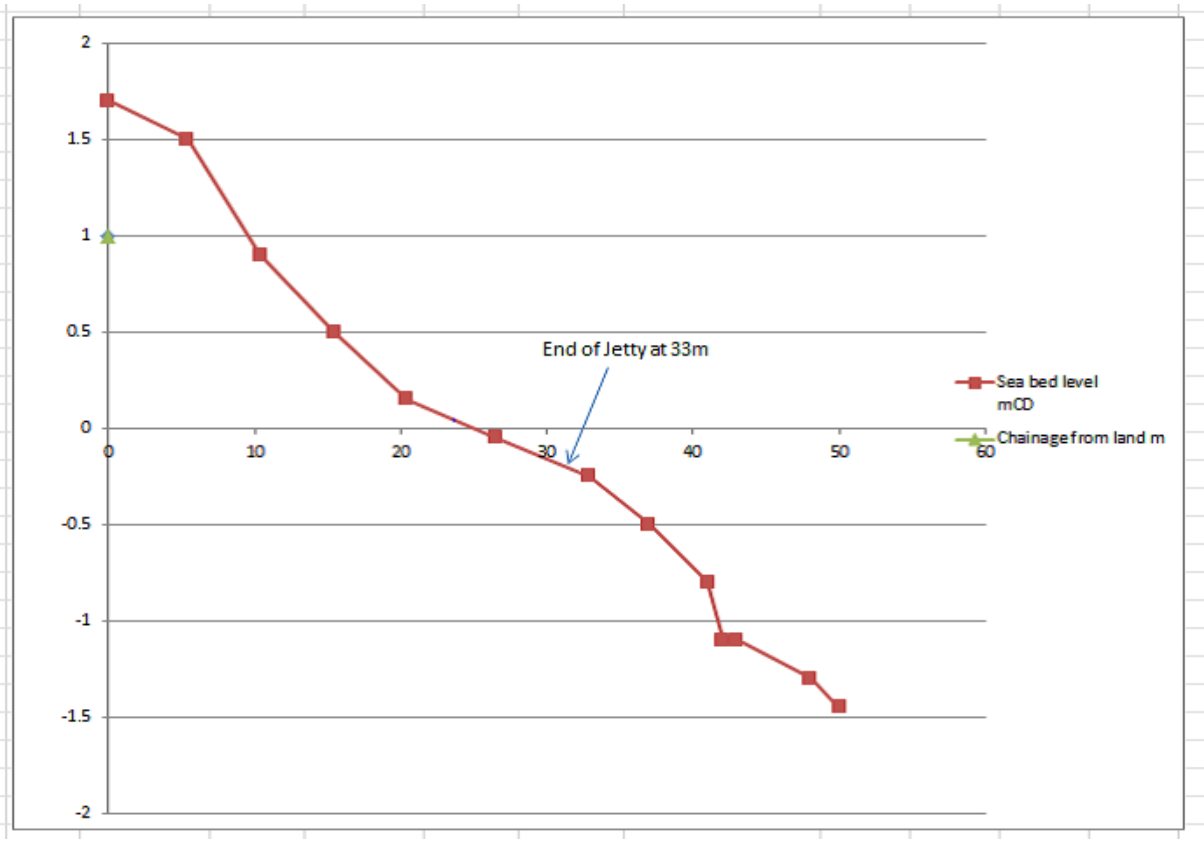

Figure 20. Beach and seabed level, measured with reference to Chart Datum, along the line of the existing jetty

Table 9. Approximate tide information for Bird Island (Elsehul)

State of the Tide	Abbrev.	Level
Mean High High Water	MHHW	+1.0 m CD
Mean High Water Neaps	MHWN	+0.7 m CD
Mean Low Water Neaps	MLWN	+0.5 m CD
Mean Low Low Water	MLLW	+0.2 m CD

Due to the position of Freshwater Inlet within Jordan Cove, the nearshore sea conditions are generally calm relative to other equivalent areas of the island. During winter months, brash ice can accumulate in Jordan Cove and sea ice has been known to form (see Figure 21).

Figure 21. Bird Island in the winter showing some brash and sea ice in Freshwater Inlet (Ewan Edwards)

5.5. Geology and Geomorphology

Geology

South Georgia is the easternmost extension of the mostly submerged North Scotia Ridge that extends from the tip of South America towards the South Sandwich Islands in the east. The North Scotia Ridge developed approximately 50 million years ago and is a chain of continental blocks that have been displaced as sea floor spreading led to the development of the Scotia plate and ultimately the opening of Drake Passage. The continental blocks of the North Scotia Ridge including, South Georgia, are likely to have their origins in the Fuegian Andes of South America.

South Georgia is not of direct volcanic origin; the majority of South Georgia's sediments are derived from the eroded rocks of a volcanic arc. Geologically, South Georgia and Bird Island are dominated by a sequence of sandstones and shales, up to 8 km thick called the Cumberland Bay Formation which were laid down in an Early Cretaceous sedimentary basin around 130 million years ago. Rare fossils indicate an Aptian age (125 – 113 Ma) but morainal deposits suggest the sequence may extend to Late Jurassic. The entire sequence is moderately deformed into large scale folds with an associated tectonic foliation. The rocks on Bird Island are steeply dipping towards the south-southwest and form part of a local syncline.

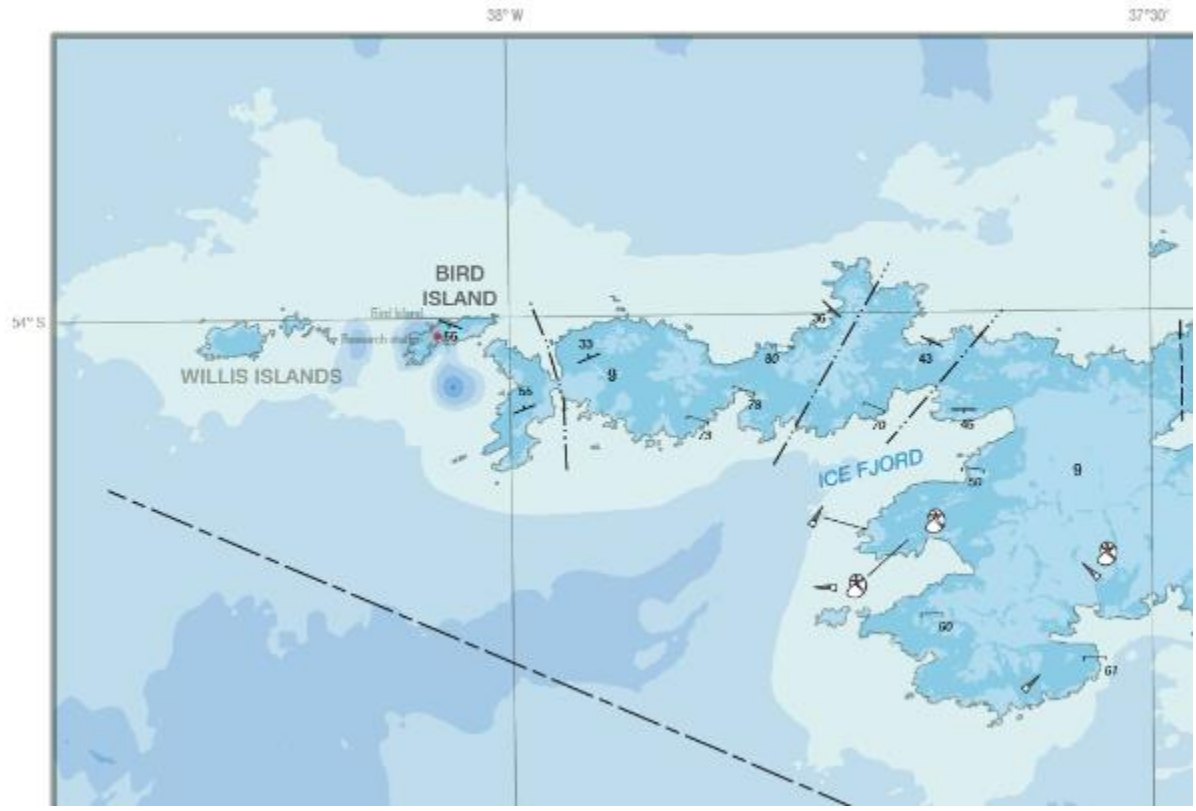

Figure 22. The geology of western South Georgia and Bird Island, composed entirely of the Cretaceous-age Cumberland Bay Formation, which is denoted in blue.

Geomorphology

Bird Island Research Station is built upon a raised beach at the back of Freshwater Inlet. Steep ground to the rear of the station makes access to the rest of the island difficult, particularly due to the tussock mounds that are found on the nearby slopes. Cliffs colonised by black browed albatross are found c. 200 m to the west of the station and the high ground of Wanderer Ridge restricts access to the east.

Soils

Little soil exists in the immediate vicinity of Bird Island Research Station; however, areas of eroded and damaged tussock are present behind the station which may lie over accumulated peat. On much of the beach area, organic material may consist of fur seal faecal material, hairs and bones while sediments may also be added from stream run-off.

5.6. Surface Water & Flood Risk

The research station at Bird Island is constructed on a raised beach at Freshwater Inlet. The freshwater, which gives the inlet its name, is provided by several small streams that pass down through the surrounding tussock slopes, across the beach and into the sea. One

stream, in particular, is located to the northwest of the Beck House and then flows parallel with the west side of the Beck House and the existing jetty before reaching the sea. Part of this stream also may overflow down the east side of the Beck House and the jetty (see Figure 23). Another stream flows across the beach to the east of Prince House, before emptying into the sea. The stream flow rates are extremely variable, with flow rates almost halting during periods of prolonged freezing weather or increasing dramatically during periods of high or prolonged rainfall.

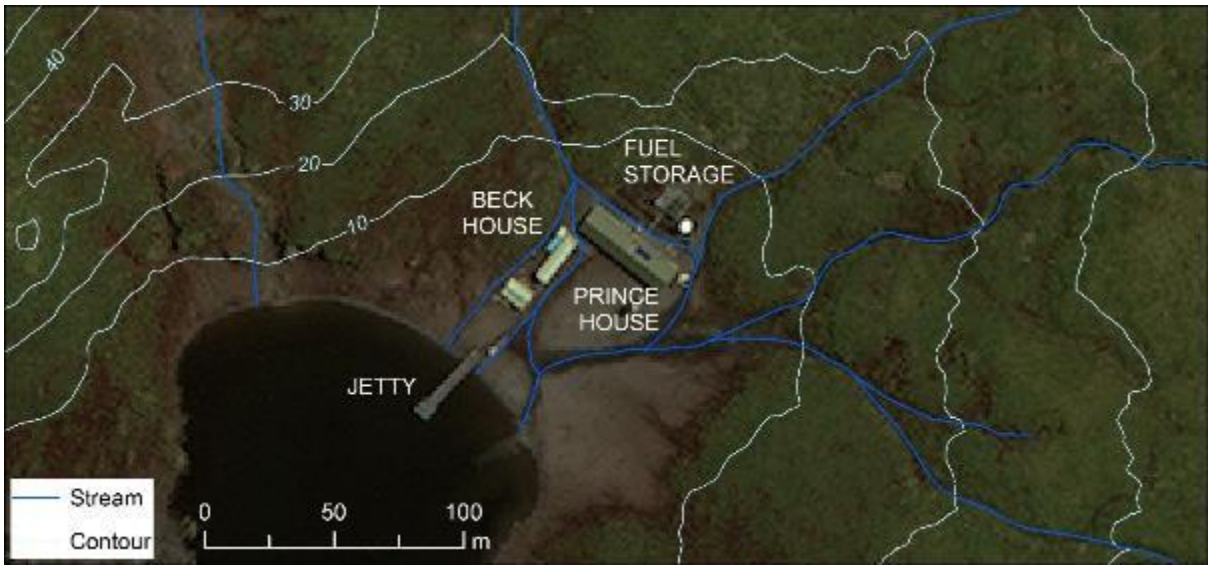

Figure 23. Surface streams flowing in the vicinity of Bird Island Research Station

Figure 24. The area behind Beck house, showing the largely frozen stream.

5.7. Glaciology & permafrost

No areas of permanent ice are present on the island. Permafrost does not exist on the island.

5.8. Noise & vibration

During much of the summer season the area around Bird Island is subject to considerable noise originating from the wildlife that occupies the beach area and surrounding tussock vegetation. Vehicles are absent from the island and the only persistent source of noise is likely to come from the generators, which are contained within the generator shed and are not overly loud.

5.9. Landscape & Visual

An extensive, if often poorly developed, series of trails exist across the island, crossing different vegetation types. However, due to the presence of extensively eroded tussock grass around the station caused by fur seals, no obvious trails are visible in the vicinity of the station.

5.10. Cultural Heritage

Bird Island, like much of South Georgia, is thought to have been used by the early sealers in the late 1800s and later by the whalers in the early 1900s. No formal research or archaeological excavations have been made at Bird Island but observations and photographs taken by staff at BI over the years indicate that some sealing sites are likely to exist on the island. The remains of a sealing site or temporary camp are thought to exist on the beach in 'Main Bay' which is opposite to 'Freshwater Inlet' and the research station as seen in Figure 25 and Figure 26. The site appears to include the remains of a stone hut and wall and some possible wooden and metal remains of artefacts.

Cave Crag, Figure 27, which is located in the hills above 'Main Bay', may have been used as a refuge by sealers, but no remnants have been found that verify this.

Figure 25. Possible location of sealing site in 'Main Bay' opposite BI station, Stacey Adlard 2010

Figure 26. Possible sealing site in 'Main Bay' indicating possible stone hut and wall and some wooden remains, Stacey Adlard 2010

Figure 27. Cave Crag, located above beach on 'Main Bay', Sally Poncet

5.11. Wilderness & Aesthetic Value

South Georgia is one of the world's most remote islands and its distance from areas of large scale human habitation (1400 km from the Falkland Islands and approximately 2000 km from South America) and associated impact have made it a haven for wildlife, including numerous species of bird. The area around Freshwater Cove is dominated by the research station, but once outside this area there are few signs of human presence, bar a small number of unobtrusive field huts and some trails. The dramatic scenery, coast landscape and rich wildlife give the area its high wilderness and aesthetic value.

5.12. Climate Change Projections

No available detailed regional modelling exists for Bird Island or South Georgia that can provide information on the anticipated and potential environmental consequences of climate change at these locations.

However, SCAR's Antarctic Climate Change and the Environment (ACCE) Review Report (2009)[8] makes some climate projections about the Antarctic and Southern Ocean climate which can provide some context for Bird Island and South Georgia.

Climate evolution in the Antarctic is studied through climate models which improve on simple projections of current trends and give a wide range of predictions for some aspects of the Antarctic climate system, such as sea ice extent, which is sensitive to changes in atmospheric and oceanic conditions. The models project significant surface warming over Antarctica to 2100 AD but there is low confidence in the regional detail. A range of global sea-level increase is also predicted, from 18 to 59 cm between 1980-1999 and 2090-2099 but this does not include a contribution from the dynamic instability of the Greenland or Antarctic ice sheets and is not indicative of regional changes. Sea level will not rise uniformly.

Predicted ongoing and global sea level rise means that a station located at Bird Island has a finite life expectancy though any direct climate change impacts are anticipated to be well beyond the current life expectancy of the proposed construction.

[8] https://www.scar.org/library/policy/antarctic-treaty/atcm-xxxii-and-cep-xii-2009/2879-atcm32-ip005/file/

6. ALTERNATIVES TO THE PROPOSED ACTIVITY

Six alternatives to the proposal were considered:

i. Do the activity elsewhere
ii. Do nothing and continue using existing facilities at Bird Island
iii. Redevelop the pre-existing buildings
iv. Alternative use of the proposed location
v. Use of different power generation technologies

6.1. Do the activity elsewhere

Consideration was given to seeking an alternative location for a new station elsewhere on South Georgia. This was rejected on the grounds that Bird Island is the best-known location for BAS's programme of globally important bird and seals research, and also because of the need to maintain long-term monitoring datasets.

Relocating the station building to other beach sites on the south coast of Bird Island was also briefly considered. However, these options were rejected on the grounds that construction would take place on a previously undisturbed site, and it would not practically allow for the continued use of some of the existing facilities (e.g. Prince House, the jetty, mast tower, communications equipment and bulk fuel storage).

6.2. Do nothing and continue using the existing facilities

The current storage building, Beck House, and its surrounding walkways were built during the 1995-96 austral summer. The Dorchester and the Timber Store were also built close to this time. Most of the infrastructure is of insufficient size for logistical requirements, in poor condition and has access issues.

The existing buildings do not provide adequate space for storage of waste materials and, therefore, waste is currently packaged up and stored outside where it may be exposed to the elements for several months until it is removed by BAS ships once or twice in a season. There is no dedicated facility for biosecurity inspection of all goods that are received on station. Currently, the existing kitchen in Prince House is used only to inspect fresh foods, but no other cargo. The surrounding walkways cause issues with access, particularly during relief when cargo has to be manhandled up steep access ramps to Beck House. In addition, the walkways surrounding Beck House and Prince House are at different levels making every day movement between the buildings difficult and inefficient.

The existing scaffold Jetty at Bird Island is not long enough to facilitate safe operations under different tidal conditions. During low tide, there is insufficient water depth to allow

the tender to berth alongside and it will be incapable of supporting the berthing of the new tender of the SDA in its current design.

As BAS is moving to a single vessel operation where refuelling is likely to only happen once in a season then there is requirement to increase the bulk MGO capability of Bird Island to allow for longer time between refuelling periods.

Continued use of the existing facilities at Bird Island is therefore not considered a practical option.

6.3. Redevelop the existing buildings

Consideration was given to extending the existing Beck House to provide additional space and dedicated waste storage areas and a biosecurity facility. This option was rejected on the grounds that the existing Beck House is 22 years old and at the end of its anticipated design life. The existing buildings do not lend themselves easily to modification and this option would also require a higher level of long-term facilities maintenance.

6.4. Alternative use of the proposed location

Constructing a two-storey building, with a smaller footprint, at the proposed location was considered and rejected on the grounds that:

- Beck House is primarily a storage building and therefore transporting cargo and equipment up two levels is not practical or an efficient use of time.
- A two-storey building would have half the roof area of a single storey building with larger roof area, and hence half the water collection capacity.
- Future maintenance time and effort would increase due to the need for scaffolding and additional plant to maintain the first-floor exterior.
- A two-storey building may have a greater visual and aesthetic impact on the landscape of Bird Island.

Constructing two single storey buildings at an elevated level separated by a walkway was also considered. The intention was to separate the waste storage area and the timber store from the remaining storage rooms. Each room in both the buildings would be accessed by external doors. This proposal was considered and rejected on the grounds that:

- An uncovered walkway between two buildings would cause snow build up issues and require unnecessary amounts of snow clearing
- A reduced roof area would minimise the water collection capacity and the lower roof pitch/building height would limit the size of water tank.

- Two separate buildings with mainly external access were considered a poor use of space and inefficient in terms of additional use of building materials and excessive power and heating.

6.5. Use of different power generation technologies

The following alternative renewable energy technologies were considered and rejected:

- **Photovoltaic (PV) panels** were considered for use at Bird Island and rejected on the basis that their performance would be unpredictable due to the weather conditions on the island, which are dominated by overcast skies most of the time.
- **Wind turbines** were considered as a sustainable power option at Bird Island and rejected on the basis that the risk of bird strikes and injuries was too high and unacceptable.
- **Micro-hydro Power** was discussed but the option not pursued on the basis that the technology has been trialled unsuccessfully at BI in the past. The local streams contain debris that caused frequent blockages to the power units.

7. IMPACT IDENTIFICATION & MITIGATION MEASURES

Environmental impacts associated with the Bird Island redevelopment work have been identified in this chapter. Mitigation measures to minimise or avoid these impacts have been suggested beneath each impact. A Monitoring Plan has been included in Appendix 8 outlining specific and targeted activities which will help to mitigate some of the impacts identified. Table 10 provides a summary of the predicted overall impacts which may result from the proposed construction works at Bird Island. Activities which are anticipated to have an impact are identified and their effects listed. A qualitative measure of the likelihood of the impact occurring and the significance (severity and importance) of the impact (if it were to occur) is then estimated based on professional judgement and using the knowledge and information detailed in this EIA. The final column proposes mitigation measures to be put in place to reduce or eliminate the impacts identified.

A briefing will be provided to all members of the construction team prior to deployment in the 2017/18 season. The briefing will involve an overview of this EIA with specific guidance on the identified impacts and compliance with the mitigation measures identified and committed to within this document.

The criteria for ranking impacts prior to mitigation are as follows:

Likelihood

Very Low	Very unlikely to occur under any circumstance
Low	Unlikely to occur under normal operations & following standard BAS procedures
Medium	Possible but unlikely if standard BAS procedures are followed
High	Probable. Likely to occur during the project
Certain	Unavoidable. Certain to occur

Significance

Very Low	Ecosystems or natural processes or scientific research not directly affected. The impacts are negligible and recovery is definite.
Low	Changes to ecosystems or natural processes or scientific research are less than minor or temporary. Impacts are reversible in the short term.
Medium	Changes to ecosystems or natural processes or scientific research are minor or temporary. Recovery is likely.
High	Changes to ecosystems or natural processes or scientific research are potentially significant or lasting. Recovery is slow and uncertain.
Very high	Major changes to ecosystem or natural processes or scientific research are significant and irreversible. Recovery is unlikely.

7.1. Potential Impacts

The following section details the main activities related to the BI redevelopment and identifies the potential impacts related to each activity and the necessary mitigation measures required to minimise or reduce the impacts.

7.1.1. Import and storage of construction materials and personnel

i. **Potential Impact:** All construction materials, equipment, vehicles, plant and accommodation units will be imported to Bird Island from the UK (direct or via the Falkland Islands) for storage and use during the re-development period. An additional 10 construction personnel and 3 BAS support staff will also be stationed at Bird Island during this time effectively doubling the population. The risk associated with this is the possible importation of non-native species (including rodents) in any of the cargo or on the personnel. This could lead to establishment of non-native species and an alteration to the native ecosystem potentially leading to: changes in ecosystem structure and function, increased competition, introduction of disease, decline in breeding bird populations and an impact on science.

   Mitigation: Specific and detailed mitigations have been developed and agreed for the BI redevelopment work and are detailed in the BI BAM Biosecurity Plan (Appendix 4 – BAM Biosecurity Plan):

   - All cargo packing areas will be clean and free of weeds, plants, invertebrate infestations and rodents.
   - Appropriate sealed packaging will be used for all materials, where possible.
   - All vehicles, plant and tools will be cleaned and inspected before shipping.
   - All containers will be cleaned prior to packing and fumigated prior to sealing.
   - All cargo will be inspected before it is loaded onto the ship and before it is offloaded to Bird Island.
   - A number of biosecurity checklists have been produced that must be completed at various stages of the cargo transport.
   - All construction personnel will receive pre-departure training and will be instructed to clean their clothing, footwear and belongings before arriving at Bird Island.
   - Any biosecurity breaches or near misses will be reported immediately.
   - In the event that a rodent is sighted the BAS Bird Island Rodent Contingency Plan will be followed.

7.1.2. Construction of site camp & additional personnel

i. **Potential Impact:** The Bird Island population will increase significantly during the redevelopment period and therefore there will also be increased sewage and grey

water production and discharge into Freshwater Inlet. This has the potential of increasing the risk of introducing non-native species and increasing nutrient addition to the environment.
Mitigation: All sewage and grey water produced by the BAM construction team will be discharged through a waste water pipe that connects to the station's existing waste water system. This outlet of the waste water pipe discharges directly into the sea and below the low water mark where the motion of the water and the waves will quickly disperse and dilute any added nutrients. There is no possibility of discharge occurring on the beach in the vicinity of terrestrial flora or wildlife.

ii. **Potential Impact:** Additional personnel on station and in the temporary site camp will result in increased domestic waste production and a risk of possible harm to human health or danger to wildlife should it be scattered by wind.
Mitigation: BAM will designate a site waste coordinator who will have overall responsibility for managing waste produced by the construction personnel and re-development works. All waste will be correctly segregated, packaged, labelled and safely and securely stored until it is ready for removal, reuse, recycling or safe disposal. All management of waste will be carried out in accordance with the BAS Waste Management Handbook and with the BAM Site Waste Management Plan (Appendix 3 – BAM Site Waste Management Plan).

iii. **Potential Impact:** Possible damage to heritage or sites with historical importance.
Mitigation: There are no known heritage sites within the Bird Island station surrounds and, therefore, impacts are considered minimal. However, items considered to be of interest or of cultural importance (upon consultation with BAS Archives and the GSGSSI where appropriate) in the existing buildings will be identified and relocated to the new Beck House or returned to Cambridge. A three stage heritage selection process has been established which will be communicated to BI station staff to aid the identification of any items considered significant. A possible sealing site is thought to have existed in Main Bay (adjacent to Freshwater Inlet) though the site has never been formally identified as a historical site. All BAM staff are to be briefed on the presence and importance of suspected sealing or heritage sites and instructed to avoid walking over, damaging, handling or removing any objects. Recreational travel on the island will be at the discretion of the Station Leader and restricted to agreed travel routes and travel areas.

7.1.3. Transfer, storage and handling of fuel

i. **Potential Impact:** This project requires the import and use of an additional 35,000 litres of MGO (the station holds its own annual fuel supply of 45,000 litres MGO) for the running of camp generators and construction generators, plant and vehicles, for the duration of the construction period. The increased fuel quantities are a potential risk at all stages of its transfer to Bird Island, its storage on the island and during daily refuelling. Any fuel spills or leaks have the potential to contaminate water, soil and flora and there is an increased risk of wildlife injuries or mortality through direct contact or through secondary contamination by ingestion of contaminated invertebrates.
Mitigation: All bulk fuel for use during this project will be supplied and transferred to Bird Island by BAS using the RRS JCR. The BAS Ships Refuelling Procedure for ship to shore bulk fuel transfer will be used. Fuel will be pumped into five robust self-bunded tanks (of 5,000 litre capacity), which will be specifically supplied and used for the storage of additional bulk fuel at Bird Island (see Fuel Handling and Spill response).
Representatives of BAS and BAM personnel, stationed at Bird Island, will undergo the BAS Oil Spill Response course. Prior to arrival at BI, all BAM staff will carry out at least one oil spill response drill during the construction period. Everyday refuelling will only be undertaken by BAM designated trained personnel and always in accordance with the BAM refuelling procedures (see Appendix 2 – BAM refuelling Procedures). In the event of any spill the BAS Station Leader will be informed and the BI Oil Spill Contingency Plan followed. Additional spill response materials will also be provided by BAM as indicated in 3.7.4.1.

7.1.4. Demolition of Beck House and Construction of new Beck House

i. **Potential Impact:** The demolition of the existing Beck House will produce a large quantity of waste materials that will need to be removed from Bird Island at the end of the project for safe disposal. There is a risk that the waste could cause harm to human health or to the wildlife if it is released into the wider environment.
Mitigation: The old Beck House has been constructed in a way that allows for it to be dismantled in a systematic way by removing all its component building parts including external cladding, timber and steel frame without causing major disturbance. There is no known asbestos within the building. The component parts can be bound together in flat manageable packages and stored in a designated area on the beach to await collection and removal at the end of the construction season. The BAM Site Waste Coordinator will have overall responsibility for managing all the waste and will ensure that it is correctly segregated, packaged, labelled and safely and securely stored until it is ready for removal for reuse, recycling or safe disposal. BAM staff will also carry out inspection of all storage areas for presence of seals prior to each shift. Care will also be taken to ensure that waste is appropriately packaged to avoid damage or scavenging by birds. All management of waste will be carried out

in accordance with the BAS Waste Management Handbook and with the BAM Site Waste Management Plan (Appendix 3 – BAM Site Waste Management Plan).

ii. **Potential Impact:** Concrete dust dispersal during the construction works could alter the pH values of the soil and could have a detrimental effect on plants and invertebrates.
Mitigation: Very few activities are likely to produce concrete dust dispersal during the construction period and therefore the risk is very low. All concrete foundations for Beck House will be imported pre-cast and, therefore, there will be no large scale use of wet trades on site. Only minimal mixing of cementitious materials will occur on site; this will be used as grout and scour protection during the establishment of the foundations and frame.

iii. **Potential Impact:** Possible light pollution caused by the construction works and additional buildings in the temporary site camp could cause disturbance or disorientation of birds and increases the risk of bird strikes on buildings.
Mitigation: No outside lights will be installed as permanent lighting for the operation of the new Beck House (except for emergency lighting). All buildings (permanent and temporary) will be fitted with black out blinds, which will be used at night-time to prevent internal light pollution escaping. No outside lights are intended to be used for the temporary accommodation.
Artificial external lighting will is not permitted between February and March to support any of the construction works as this would put small seabirds at risk of disorientation and strikes. However, towards the end of the construction season (April and May), the days will become duller and by May the hours of daylight will reduce to approximately 8.5 hours a day. At this time, most birds which are at risk of light pollution will have already fledged except for southern giant petrels and white-chinned petrels which are known to fledge at the start of May and therefore may still be vulnerable. It may be necessary to use artificial external lighting on dull/foggy days during the hours of daylight in April and May. The intention is that construction work will only take place during the hours of daylight. However, by May the hours of daylight will be reduced and there may be also be a need to carry out external works during one or two hours of darkness.
External artificial lighting will only be used under the following circumstances:
   - External artificial lighting will not be used in February or March.
   - The BAS Environment Office will be notified in advance of the requirement of artificial lighting and a justification provided.
   - External lights will be permitted during the hours of daylight in April and May on dull or foggy days.
   - Lighting in the hours of darkness will only be permitted in the month of May.
   - Any lighting used will be localised in the specific area of work (no flood lighting of the construction site is permitted).
   - Lights will all be angled downwards towards the area of work with the location, height and aim adjusted to prevent light spill.

- If appropriate, high pressure sodium lights (or other lights with similar spectra) will be used that have been demonstrated to have the least impact on birds[9].
- Lights will be immediately turned off if birds are observed flying near or above the lights.
- All lights will be immediately turned off as soon as the work is completed.
- Any bird disorientation or bird strikes will be recorded and reported to the BAS Environment Office via the AINME system with as much information about the incident as possible.

7.1.5. Extension of the existing jetty

i. **Potential Impact:** The existing scaffold jetty will be extended with new scaffold material a further 10 metres into the sea. This will require the use a safety boat to assist personnel in deep water which has the potential for possible pollution to the sea. The jetty will be extended by driving scaffold elements into the seabed which has a potential to damage or injure the benthic environment and organisms.
Mitigation: The motor boat will be inspected by the operator on a daily basis paying particular attention to fuel lines. Refuelling will only occur on land away from the water by BAM designated trained personnel. Scaffold elements will be driven into the sediment using a hand held post rammer with no power tools used and no planned blasting or dredging of the sea-floor. Although there will be some impact to the immediate area of the sediment where the scaffold elements are physically driven in, this is considered unavoidable and the overall disturbance to the benthos in the area of the jetty will be minimal.

7.1.6. Use of vehicles, plant and generators

i. **Potential Impact:** A number of vehicles, plant and generators will be used during the construction of Beck House (see detail in Table 4) and for the operation of temporary site camp. Atmospheric emissions and particulate fallout from the generators, plant and vehicles (which are powered by Marine Gas Oil (MGO)) will contribute to local and global atmospheric pollution.
Mitigation: Regular inspection and maintenance will be carried out to ensure all plant and generators operate efficiently. All staff will be instructed to turn off engines when they are not needed.

ii. **Potential Impact:** Many of the vehicles, plant and generators will require refuelling on a daily basis. This regular refuelling of small quantities of fuel has a high risk of

[9] Rodrigues A., Dann P, Chiaraia A. (July 2017). Reducing light-induced mortality of seabirds: High pressure sodium lights decrease the fatal attraction of shearwaters. Journal for Nature Conservation 39 (2017) 68-72

small spills and leaks occurring that could cause soil contamination and possible damage or mortality to local flora and fauna.
Mitigation: Representatives of BAS and BAM personnel stationed at Bird Island will undergo the BAS Oil Spill Response course. Prior to arrival at BI, all BAM staff will carry out at least one oil spill response drill. Everyday refuelling will only be undertaken by BAM designated trained personnel and always following the BAM refuelling procedures (see Appendix 2 – BAM refuelling Procedures). In the event of any spill the BAS Station Leader will be informed and the BI Oil Spill Contingency Plan followed. Additional oil spill response equipment will be provided by BAM and this will be available at all bulk fuel locations, at all areas of refuelling and with the vehicles or generators. All spills will be immediately reported to the BI Station Leader for immediate response and logged and reported through the BAS AINME system.

iii. **Potential Impact:** The running and occupation of the temporary camp involves the constant operation of a generator. The demolition of Beck House will involve the erection of scaffolding, the use of vehicles and plant and the removal and breaking up of concrete foundations. All these activities will produce noise and vibration which could potentially disturb fur seals and surrounding nesting and burrowing birds.
Mitigation: All noise producing works will begin well after the fur seal breeding season has ended and therefore nursing female seals and their pups will have moved away from the beach and retreated to the surrounding tussock grasses.
The area around Bird Island station has a lower concentration and diversity of bird species than elsewhere on the island due to the limited availability of suitable habitat caused by the impact of fur seals. This is especially the case for tussock located adjacent to the top of the beach where seals impacts may be greatest and birds are unlikely to nest. However, further up the surrounding hills burrowing white-chinned petrels and South Georgia pipits have been observed and black-browed albatross are known to nest on cliffs c. 200 m to the west of the station. Most known breeding birds are at far enough distance from the site to avoid any disturbance caused by noise or vibration from the generators and plant.
However, acoustic screens will be used to reduce noise, monitoring of noise will occur and a threshold limit set, which if exceeded will trigger all works to cease. All vehicles will be regularly maintained to ensure that they are operating as efficiently as possible and personnel will be instructed to turn off engines whenever they are not in use. Details on noise monitoring and mitigations are listed in Appendix 8 – Bird Island Monitoring Plan.

7.1.7. Interaction of construction works with local flora and fauna

i. **Potential Impact:** Possible encroachment on flora and disturbance to tussock grass through trampling or citing of equipment and materials.
Mitigation: All equipment, materials and accommodation units or containers will be positioned on the beach and not in areas of tussock or vegetation. All plant and

vehicles for Bird Island have been specifically selected to allow for the construction works to take place from the available beach without accessing the surrounding tussock grasses. However, it is not possible to be 100% certain that access will not be required until the vehicles are on the ground and conditions have been assessed. As such, three small areas of tussock have been identified as potentially at risk should vehicle access be required for. These are two small areas behind Prince House, where the new bulk fuel tank and the construction team drying room are to be installed and an area of tussock grass to the west of the new Beck House (see Figure 5). Therefore these three area have been identified as at risk and permission is requested to disturb or remove the tussock (and some soil) if plant/vehicle access is deemed necessary for the construction of Beck House and the establishment of the site camp. If tussock removal is required it will only be completed upon issue of the necessary WPA permit from GSGSSI and only once monitoring by a BAS Bird Biologist has been completed to ensure that no nesting birds are present.

ii. **Potential Impact:** The additional personnel on site could increase the risk of nests or burrows in the surrounding tussocks being disturbed or trampled on. The possible requirement for damage to identified areas of tussock grass by plant or vehicles as described above could also put local birds at risk.
Mitigation: All construction personnel will be briefed on the known locations of nesting or burrowing birds and instructed to stick to known trails to avoid accidental trampling or damage to nests or burrows. There are no known or observed ground nesting birds or white-chinned petrel burrows in the areas of tussock which have been identified for possible damage/removal. An inspection carried out BI staff in July 2017 did not identify any in the area. However, the birds tend to arrive on the island to begin burrowing and nesting in September each year. Once in their burrows they are notoriously difficult to monitor as their burrows go deep underground. As a precaution, it is suggested that the area of tussock to the west of Beck House be monitored by BI Biologists on a monthly basis until September and if any old burrows are identified that these should be closed up/sealed with rocks from the beach to prevent any white-chinned petrels from using them before their breeding season occurs. This would discourage any white-chinned petrels from burrowing in this area west of Beck House and potentially being disturbed or injured by any necessary damage or removal of tussock in the area. Please refer to the detailed monitoring plan in Appendix 8 – Bird Island Monitoring Plan.

iii. **Potential Impact:** The footprint of normal BAS operations during the construction period will increase as will the activity on the beach with increased personnel, vehicle and plant movement. This activity and movement may cause minor disturbance to the fur seal population by possible encroachment on their territory, may cause displacement of seals and also has the potential to cause injuries.
Mitigation: The redevelopment works will begin in early February by which time the peak fur seal breeding season will have ended and there will be fewer seals on the beach. Encroachment on the beach will be minimised by storing cargo in the

designated bulk storage area on the beach and by concentrating the temporary site camp buildings around the existing Bird Island buildings. To avoid disturbance to any remaining seals on the beach and to ensure the safety of the personnel, a temporary exclosure will be erected around the perimeter of the construction works to try and minimise interaction with seals on the beach. During this time, monitoring of the displacement of seals will occur, with particular attention being paid to nursing female seals and their pups to ensure that they are not disturbed. The BAM construction staff will be briefed and trained on how to behave near seals and to keep safe distances. All vehicles will be inspected before use to ensure that there are no seals within the vicinity that could be harmed. Please refer to the detailed displacement monitoring in Appendix 8 – Bird Island Monitoring Plan.

7.1.8. Interaction of construction and science works

i. **Potential Impact:** The BAM construction and BI station science teams will be in contact throughout the construction period. This interaction has the potential to cause disruption or interference with the stations long-term studies on birds and seals, disturbance of normal station operations and impact on the islands scientific values.
Mitigation: Communication and liaison between the BAM and BAS teams will be managed by the BAS BI Project Manager and BAM Construction Manager to ensure a smooth working relationship. On site, works will only begin after the fur seal breeding season has ended and, therefore, long term studies of seals will not be influenced. The construction works will be localised to the beach of Freshwater Inlet and will, therefore, not impact upon scientific activities elsewhere on the island. Appropriate and accessible storage will be provided for all Beck House equipment and, therefore, normal station operations should proceed smoothly. Although personnel numbers will increase on the island, the construction staff will have additional support facilities and accommodation and BI staff will continue to have access to normal Prince House accommodation and facilities. A catering manager will also be recruited to cater for both BI and BAM staff. The BAS BI project manager will be on site throughout the season to supervise all works and assist with good communication and working relationships.

7.1.9. Design of new Beck House

i. **Potential Impact:** In designing a new building there is a risk that the final design has a greater environmental impact than the current building. For example through an increased demand on energy requirements. However this impact has already been addressed with significant emphasis on sustainability and energy efficiencies being incorporated within the design phase of the project.
Mitigation: The new Beck House incorporates a number of design changes which are predicted to improve the efficiency of the station:

- All storage areas are located in single building for the ease and convenience of BI staff.
- Dedicated room for biosecurity checking of incoming goods (additional biosecurity inspections will minimise risk of introduction of non-native species).
- Dedicated room for storage of all waste (eliminates need for waste to be stored outside and exposed to elements).
- External walkway at same level as Prince House allows for ease of movement between buildings.
- Increased MGO held on station allows the station to be refuelled less frequently.
- Energy efficiencies such as increased rain harvesting (larger roof area allows more water to be collected) and energy metering to identify the buildings energy use and specific equipment energy use.
- Additional planned future energy efficiencies will be achieved by 2019/20through installation of a heat recovery system from the station generators.
- 60 year design life and construction methods and choice of materials allow for simple onsite maintenance.
- Assessment through BREEAM to meet targeted score of Excellent.

7.1.10. Operation of new Beck House

i. **Potential Impact:** There is potential when replacing a key logistics building on station that the day to day operation of the new building could have a greater environmental impact than the existing structures. However careful consideration of this impact during the design phase has minimised the risk of this impact occurring.

Mitigation: There will be no increase in the number of people on station at Bird Island as the accommodation facilities remain unchanged. However, the storage facilities (new Beck House) used by personnel will be larger and incorporate new work areas for biosecurity inspections and waste storage and include energy efficiencies that are expected to make the daily operation of the station more efficient. There will be no increase in the intensity of ship visits to Bird Island and it is in fact possible that the number of ship visits will decrease due to moving to a single vessel operation. The station will be capable of sustaining fewer vessel visits due to increased fuel held on station. The operation of the new station is not predicted to give rise to significant direct or indirect impacts.

7.2. Cumulative Impacts

A cumulative impact is the combined impact of past, present and future activities over time or space. Therefore, even though the individual impact may be small, the continuing effect may cause an accumulative impact.

For the past 60 years, the beach at Freshwater Inlet, has been subject to on-going periods of human occupation. The impacts of the redevelopment of the station will add to the impacts of the existing station facilities and the existing station and science activities at BI for the duration of the construction period. This includes waste production, water consumption, discharge of sewage and grey water to the sea, emissions to air, fuel spills and disturbance to the local wildlife. The operation of the redeveloped station is not predicted to give rise to significant direct or indirect impacts.

7.3. Impact Matrix

This impact matrix provides a summary of the predicted environmental impacts. A measure of the likelihood of the impact occurring and its significance is estimated prior to the implementation of mitigating measures. The matrix summarises the proposed specific mitigating measures for each activity which are expected to reduce the likelihood of the impact occurring and therefore minimise the risk.

Table 10. Impacts Matrix identification and mitigations

Activity	Effect	Possible impact	Likelihood of impact occurring	Significance of impact	Preventative or mitigating measures
1. Importation and storage of construction materials, equipment and vehicles.	Possible importation of non-native species, including rodents	Ecosystem alteration if species became established. Increased competition Introduction of disease-causing microorganisms. Substantial decline in breeding bird population if rodents become established. Operational shut-down of station facilities for eradication measures. Reputational loss.	Low	High (if species become established)	Biosecurity guidelines to be followed: BAS Vehicle Cleaning Guidelines, SCAR/COMNAP Guidelines, CEP & BAS Biosecurity Handbook[10] will be followed, where appropriate. Close collaboration with construction partner to develop bespoke biosecurity measures in the form of the BAM Biosecurity Plan. All procedures include measures to ensure that soils, seeds and propagules are not transported to Bird Island. Vehicles, cargo and personal clothing must be cleaned prior to importation. Biosecurity inspection of cargo upon arrival at Bird Island.

[10] https://www.bas.ac.uk/wp-content/uploads/2016/12/BAS-Biosecurity-Handbook-2016-FINAL.pdf

Activity	Effect	Possible impact	Likelihood of impact occurring	Significance of impact	Preventative or mitigating measures
					If soil, seeds or propagules are accidentally imported then they must be carefully collected, removed and reported.
2. Camp site setup and personnel living in temporary site camp	Increased sewage discharge and grey water discharge to Freshwater Inlet	Possible introduction of non-native species Increased nutrient addition to Freshwater Inlet	Medium	Low	All sewage and grey water will be discharged in the sea below the low water mark and not in the direct vicinity of wildlife or terrestrial flora.
	Increased waste production	Possible harm to human health or danger to wildlife if scattered by wind.	Low	Low	All waste to be correctly packaged, labelled and removed from BI for reuse, recycling or safe and licensed disposal, in accordance with BAS Waste Management Handbook and BAM Site Waste Management Plan. Site to be cleared each day and checked for litter to prevent wind scatter.
	Heritage	None in the vicinity of the station as no areas of heritage are yet identified. Possible sealing sites are thought to exist on 'Main Bay'	Low	Low	BI personnel will carry out a heritage selection process (aided by BAS Archives) to identify any items of heritage importance. BAM personnel will be briefed on locations of suspected sealing sites and briefed not to walk over them, disturb them or handle or remove them.
3. Fuel transfer and storage	Fuel spills and leaks	Water contamination Soil contamination Contamination or mortality of flora/fauna in immediate area	Low	High	Ship to shore bulk fuel transfer will be carried out by BAS using tested standard working procedures. Only robust self bunded bulk fuel tanks will be used. BAS BI and BAM staff to attend the BAS Oil Spill Response Course. Appropriate oil spill

Activity	Effect	Possible impact	Likelihood of impact occurring	Significance of impact	Preventative or mitigating measures
		Possible secondary contamination to birds by ingestion of marine and terrestrial invertebrates Generation of fuel related waste (empty fuel containers, contaminated absorbents)			response materials available (additional provided for project) on site. Oil spill drills to take place at least once during construction period. Only designated trained personnel will handle and transfer fuel on site and all BAM refuelling procedures will be followed. BAS BI Oil Spill Contingency Plan to be followed in the event of any spill Additional oil spill response equipment will be provided and available at all fuel storage, fuel transfer and vehicle storage areas. Fuel spills to be reported to station leader and logged on the AINME
4. Demolition of Beck House and Construction of new Beck House (including foundation laying)	Increased waste production and temporary storage on site	Possible harm to human health or danger to wildlife if scattered by wind.	Low	Low	The old Beck House can be systematically dismantled by removing the steel cladding, timber and its frame with minimal disturbance. The deconstructed building elements will be bound together in flat manageable packages and stored in a designated area on the beach near the stone jetty in readiness for removal at the end of the construction season. If necessary, the waste storage area will be f covered with tarpaulins to prevent birds scavenging.
	Concrete dust dispersal	Alteration of pH values of soil	Low	Low	Minimal wet trades on site. All concrete foundations are pre-cast so no large scale

Activity	Effect	Possible impact	Likelihood of impact occurring	Significance of impact	Preventative or mitigating measures
		Physiological damage, bleaching or mortality of plants or invertebrates			mixing on site. Very small quantities of grout mixing may occur on site.
	Light pollution	Disturbance and disorientation of birds Increased number of bird strikes on buildings	Low	Medium	All station and temporary site buildings will have blinds that will be closed at night Outside lighting will not be used between February and March when vulnerable birds are at risk. Daytime artificial external lighting is only permitted in April and May and night time external lighting is only permitted in May when most vulnerable birds have fledged. The BAS Environment Office will be notified if lighting is required and a justification provided. Any lighting used will be localised in the specific area of work (no flood lighting of the construction site is permitted). Lights will all be angled downwards to the area of work with the location, height and aim adjusted to prevent light spill. High pressure sodium lights (or other lights with similar spectra) will be used. Lights will be turned off if birds are observed flying near the source.

Activity	Effect	Possible impact	Likelihood of impact occurring	Significance of impact	Preventative or mitigating measures
					All lights will be immediately turned off when not required. Any observed disorientation of birds or strikes due to light will be reported via the BAS AINME system.
5. Extension of existing jetty	Use of motor boat within the sea Scaffold elements driven into seabed	Possible pollution to the marine environment Damage to the benthic environment	Low	Low	The motor boat to be inspected daily whilst in use, paying particular attention to fuel lines. Refuelling to be carried out away from the water by designated trained personnel. Scaffold elements to be driven into the sediment using handheld tools only. No mechanical tools, blasting, dredging or intentional damage to the benthos planned. Minimal damage is only anticipated in the immediate area where the scaffold meets the sediment.
6. Use of vehicles, plant and generators	Atmospheric emissions	Very minor but cumulative contribution to regional and global atmospheric pollution Heavy metal and particulate fallout	High	Low	Carefully selected generators which balance efficiency and reduced emissions. Regular maintenance and daily checks to maintain vehicles and generators to highest standards Staff are instructed to turn off vehicles when not in use
	Minor fuel spills and leaks	Soil contamination Possible contamination, damage or mortality of flora/fauna in area Possible secondary contamination to birds by ingestion of marine invertebrates	Medium	Low	Fuel handling procedures to be followed on daily basis Designated trained personnel

Activity	Effect	Possible impact	Likelihood of impact occurring	Significance of impact	Preventative or mitigating measures
					Spill absorbent materials located at all refuelling points and with vehicles
	Noise and Vibration	Minor disturbance of seals Minor disturbance of nesting/burrowing birds	Medium	Low	Most seals will have left the beach and retreated to surrounding tussocks. Most breeding nesting and burrowing birds are at a far enough distance to avoid disturbance due to noise. Monitoring of noise will occur and activities will cease if the noise threshold is exceeded. Acoustic screens also used. See Appendix 8 – Bird Island Monitoring Plan
7. Interaction of construction works with local flora and fauna	Encroachment on surrounding vegetation	Damage to tussock and other plants due to temporary site camp, personnel, and movement of vehicles and access to construction site	Low	Low	Storage of cargo and temporary site camp equipment will only take place on the beach (not the tussock) There is no intention for any of the tussock to be damaged or removed as part of the construction of the temporary site camp establishment or the construction Beck House. Appropriate vehicles and plant have been selected to allow for all works to be completed without access to the tussock grass. However, if conditions on the ground require vehicles and plant to access the construction site from the west or the temporary site camp from the north then it may be necessary for some tussock and soil

Activity	Effect	Possible impact	Likelihood of impact occurring	Significance of impact	Preventative or mitigating measures
					to be damaged or removed. This will only occur in the areas which have been identified as at risk in this EIA and the necessary WPA permit issued to allow this. Any removal of tussock will only occur after monitoring by BAS Bird Biologists to ensure no nesting birds are present
	Disturbance of nesting/burrowing birds	Possible trampling of nests or burrows in surrounding tussocks Damage to tussock/soil habitat by plant or vehicles	Low	Medium	The tussocks in the vicinity of the station support a number of burrowing and nesting birds. All BAM personnel to be briefed on locations and areas in which they are permitted to walk. There are no known nests or burrows in the area of tussock adjacent to the Beck House construction. However, as a mitigation it is suggested that if any burrows are seen by BI Biologists before the white-chinned petrel breeding season (which begins in September) that they should be blocked with rocks or soil from the beach to prevent burrowing and nesting and potential disturbance by any soil or tussock removal.
	Minor disturbance to seals	Disturbance to seals during breeding/pupping Encroachment on fur seal territory through increased footprint Increased energy expenditure due to stress	Medium	Medium	All work will be carried out after the peak fur seal breeding season to minimise disturbance. Female seals and their pups will have moved away from the beach to surrounding tussocks. A temporary exclosure around the perimeter of the construction works will be

Activity	Effect	Possible impact	Likelihood of impact occurring	Significance of impact	Preventative or mitigating measures
		Displacement of seals Possible injury to seals through regular movement of vehicles			erected to discourage seals from approaching areas of work. Monitoring of seal displacement to occur Careful management by experienced station staff. Training / guidance to be provided to contractors. All vehicles to be inspected and wheels checked for presence of seals before the engine is started.
8. Interaction between construction works and BAS science works	Direct or indirect contact with BI station site, staff and scientific activities.	Disruption, interruption or interference with long-term studies on birds and seals. Interruption of normal station activity. Degradation of scientific values.	Low	Low	All works will begin after the peak fur seal breeding season. Construction works will be localised to Freshwater Inlet beach and will not impact with science activities elsewhere on the island Appropriate and accessible storage will be provided for all Beck House equipment. Construction staff will have additional support facilities and accommodation. Shared Catering Manager will cater for both BI and BAM staff.
9. Design of the new Beck House.	Change in energy demand, room layouts, accessibility and	In designing a new building there is a risk that the final design has a greater environmental impact than the current building. For example through an increased demand on	Low	Medium	Single building identified as most convenient for staff on site.

Activity	Effect	Possible impact	Likelihood of impact occurring	Significance of impact	Preventative or mitigating measures
	lifespan of building	energy requirements. However this impact has already been addressed with significant emphasis on sustainability and energy efficiencies being incorporated within the design phase of the project			Increased room sizes and allocation of new space for waste storage and biosecurity inspections. Improved walkways allow for ease of movement between Prince House and Beck House. Station holds increased fuel allowing for fewer ship visits. Energy efficient systems introduced. Building designed to 60 year life. Follows the BREEAM Model for sustainability.
10. Operation of the new Beck House	Change in energy demand, room layouts, accessibility and lifespan of building	Operation of new building could result in a greater environmental impact than existing structures. There is potential when replacing a key logistics building on station that the day to day operation of the new building could have a greater environmental impact than the existing structures. However careful consideration of this impact during the design phase has minimised the risk of this impact occurring.	Low	Medium	No increase in number of people on BI station. Daily operation of station made more efficient through design features listed above. Fewer ship visits to station

8. MONITORING & AUDIT REQUIREMENTS

The BAS BI Project Manager will be on site at Bird Island for the duration of the construction period. They will be responsible, with support from the Bird Island Station Leader, for carrying out day-to-day monitoring of the construction works and supervision of the BAM construction team and ensuring that the preventative and mitigating measures outlined in this EIA are implemented.

A number of environmental management activities will be implemented by, BAM, as indicated in the table below and as referenced in more detail in this EIA to ensure that monitoring and reporting of activities is captured. All findings will be reported to the BAS Environment Office.

When construction at Bird Island is completed, the station will be audited as part of the BAS Environment Office's routine auditing programme to evaluate and examine the following:

i. The impacts identified in the EIA were accurate;
ii. The mitigation measures and management and monitoring activities were effective.

Table 11. BAM Environmental Management and Monitoring Activities

Environmental Management Activity	Location in EIA	Person Responsible
Waste Management: Segregating, packaging, labelling, recording and storing all waste produced on site as per the SWMP and BAS WMH	Appendix 3 – BAM Site Waste Management Plan	BAM Site Waste Coordinator
Biosecurity: Checks and inspections at all stages of cargo and personnel movement	Appendix 4 – BAM Biosecurity Plan	BAM Environmental Lead and delegated to the: - BAM Construction Manager - Environmental Engineer - Biosecurity Inspectors
Fuel management: BAM are responsible for all daily refuelling of vehicles and generators.	Fuel Handling and Spill response and Appendix 2 – BAM refuelling Procedures	BAM designated and trained personnel for all refuelling
Oil Spill Response: BAM staff will respond to all oil spills and report all incidents to the BI Station Leader who will coordinate all responses to larger spills and submit reports via the BAS AINME	BAM Emergency Oil Spill Plan	BAM Construction Manager will report to BI Station Leader

Disposal of Cementitious Waste Water: Monitoring of disposal of waste water from the production of cement	Appendix 8 – Bird Island Monitoring Plan	BAM Construction Manager in consultation with BAS Environment Office
Seal Disturbance: Monitoring of seal disturbance and displacement on the beach	Appendix 8 – Bird Island Monitoring Plan	BAM Construction Manager in consultation with BAS Environment Office
Noise Generation: Monitoring of noise generation from demolition and construction	Appendix 8 – Bird Island Monitoring Plan	BAM Construction Manager in consultation with BAS Environment Office
Nesting and Burrowing Bird Disturbance: Monitoring of tussock near areas of construction for potential nesting or burrowing birds	Appendix 8 – Bird Island Monitoring Plan	BI Bird Biologist and BAM Construction Manager in consultation with BAS Environment Office

9. GAPS IN KNOWLEDGE & UNCERTAINTIES

Minor changes may be made to the proposed project during the final detailed design phase.

It is also possible that there may be changes to the proposed logistics and dates or unpredictable and difficult weather conditions which may impact when cargo and personnel arrive and depart from Bird Island. BAS will advise GSGSSI of any such changes as they arise and as necessary and to provide updates no how this may impact the project. If delays prevent the completion of the project as detailed in this EIA, then final internal fit out of the station can be completed by a small team of personnel the following summer season.

There is a lack of available regional climate modelling for Bird Island and South Georgia more generally. Therefore there are no detailed projections on the environmental consequences of climate change at the station locality.

The main uncertainty associated with this project is whether any white-chinned petrels or tussock nesting birds are likely to be nesting in areas of tussock that may be damaged during the construction works. Further monitoring will be carried out to establish the presence of any birds before the construction period.

10. CONCLUSIONS

This Environmental Impact Assessment identifies the requirement for the Bird Island redevelopment and the benefits it will provide to the operation of the station. The possible negative environmental impacts which may result from the activity are recognised and mitigation measures are outlined. Provided that the mitigation measures are carried out then the impacts will be minimised, tolerable and without long-term effect.

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12. AUTHORS OF THE EIA

This EIA was prepared by Anna Malaos with input from Kevin A. Hughes and Clare Fothergill (British Antarctic Survey Environment Office) and Neil Goulding (BAM Environmental Manager).

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13. ACKNOWLEDGEMENTS

We are grateful for the input and information provided by the following:

- Information on BAS logistics was provided by Joe Corner, BAS.
- The current energy, water and fuel data were provided by Andy Binney, BAS.
- Information and advice on the cultural heritage of Bird Island was provided by Robert Burton.
- Information on the construction detail, including the BAM Site Waste Management Plan and Refuelling Procedures were provided by Neil Goulding, BAM Environmental Manager.
- Advice on nesting and burrowing birds was provided by Andrew Wood, BAS.

14. Appendices

Appendix 1 - Bird Island Construction Programme

Appendix 2 – BAM refuelling Procedures

Appendix 3 – BAM Site Waste Management Plan

Appendix 4 – BAM Biosecurity Plan

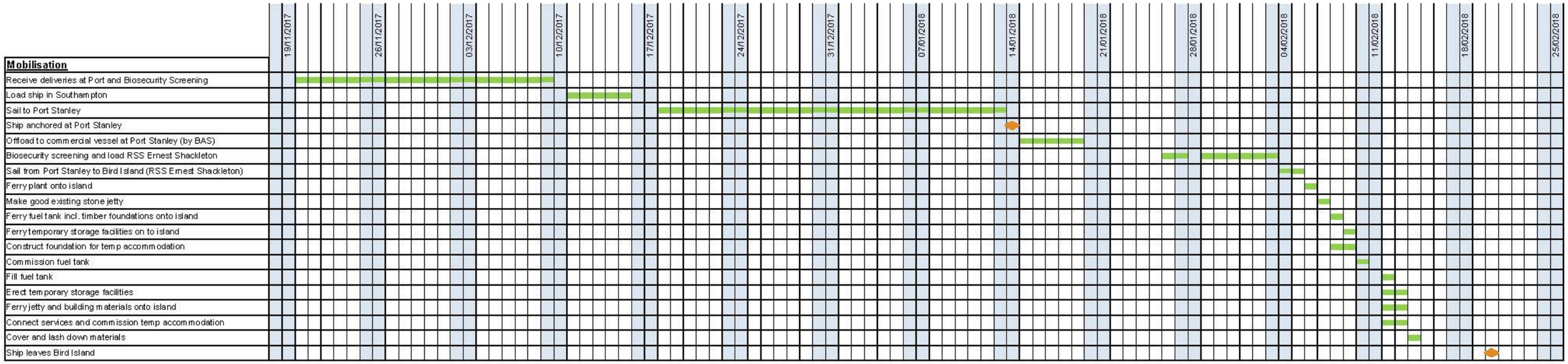
Appendix 5 – Flora of Bird Island

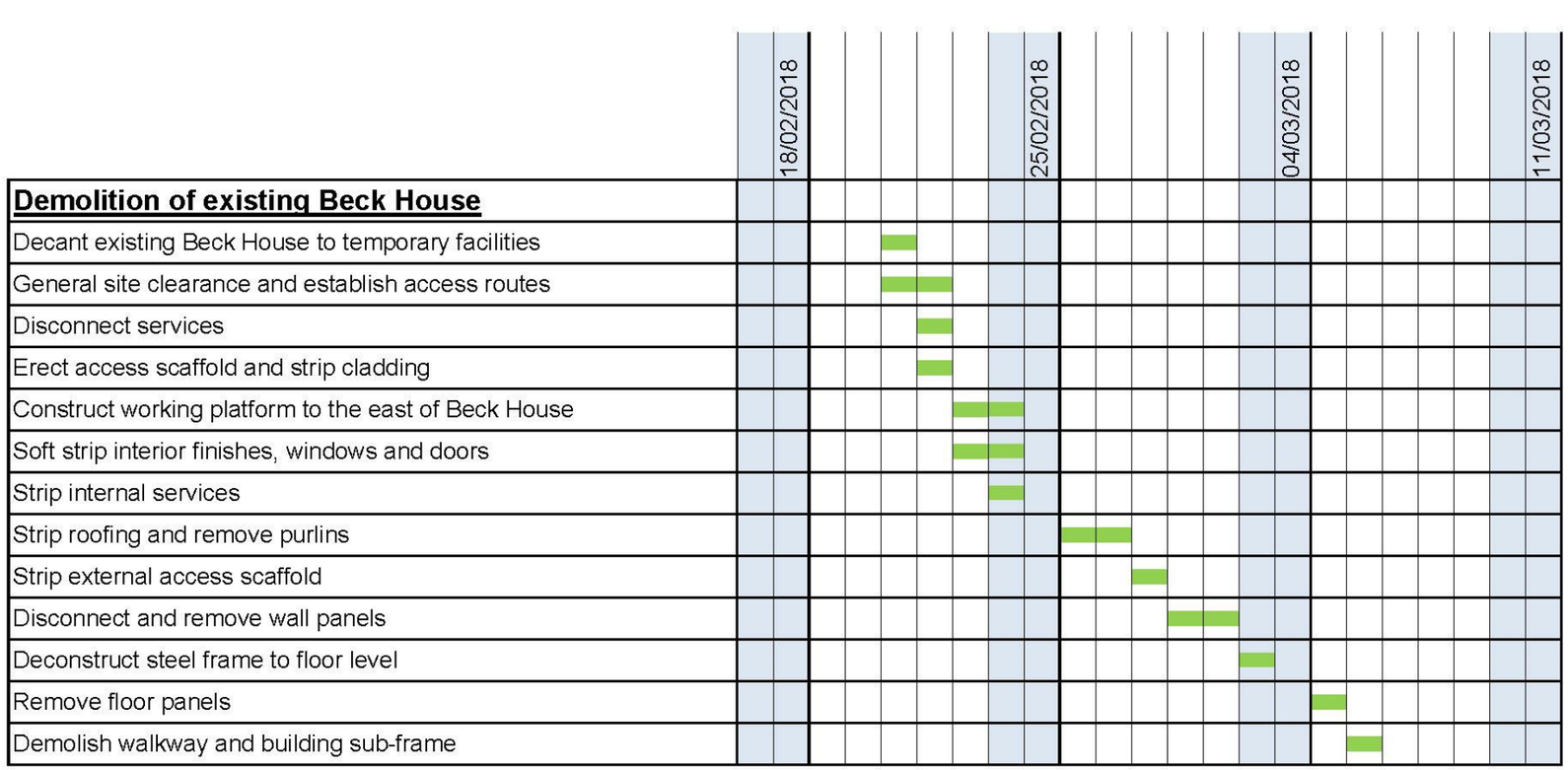
Appendix 6 – Terrestrial and Freshwater invertebrates recorded from Bird Island

Appendix 7 – Avifauna of Bird Island

Appendix 8 – Bird Island Monitoring Plan

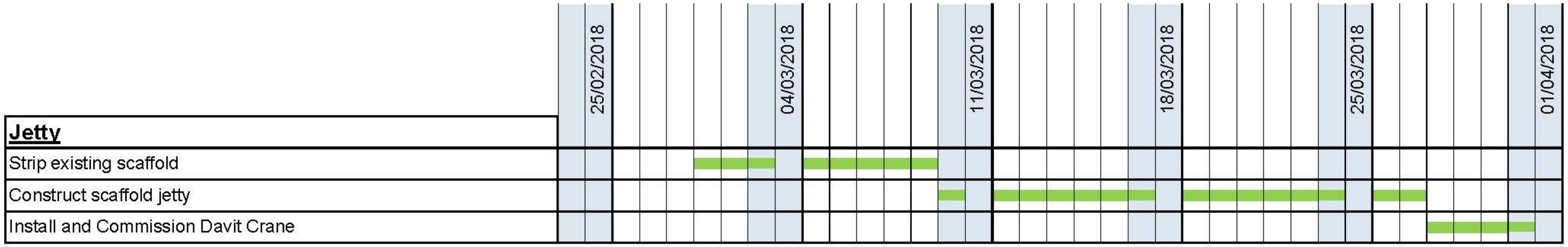
14.1. Appendix 1 - Bird Island Construction Programme

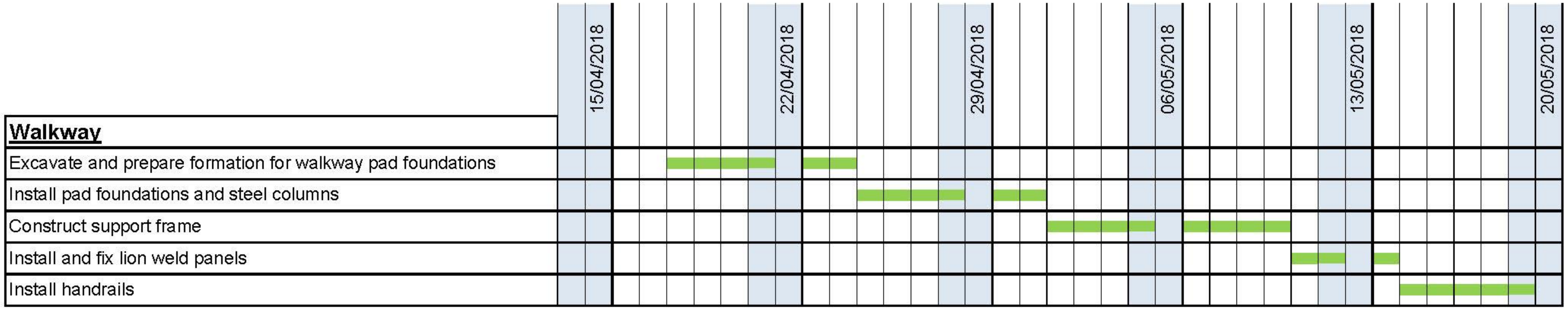


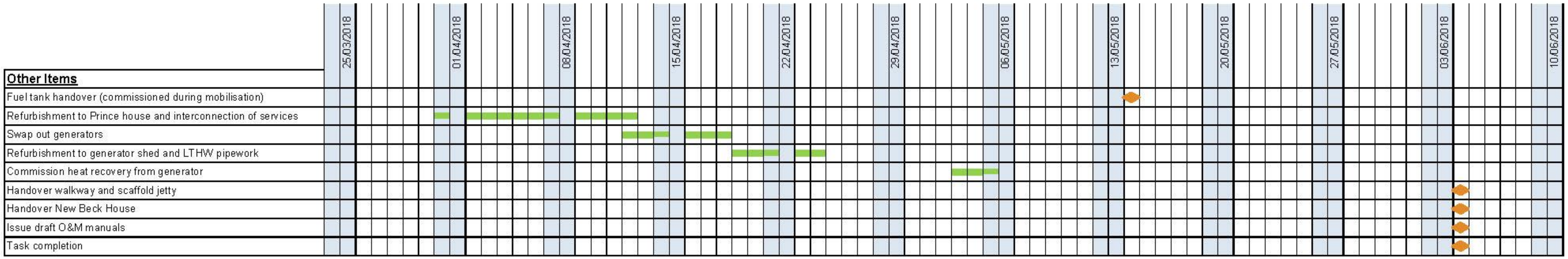


New Beck House	11/03/2018	18/03/2018	25/03/2018	01/04/2018	08/04/2018	15/04/2018	22/04/2018
Substructure							
Site clearance, protect services and divert stream							
Excavate and prepare formation for pad foundations							
Install pad foundations and precast channel for stream							
Erect steel sub-frame							
Grout collars							
Superstructure							
Install floor cassettes							
Install structural wall panels							
Construct internal partition walls (assume prefab)							
Erect external access scaffold							
Install roof trusses and position water tank							
Install roof coverings							
Install external wall cladding, flashings and gutters							
Remove external scaffold							

New Beck House	08/04/2018	15/04/2018	22/04/2018	29/04/2018	06/05/2018	13/05/2018	20/05/2018	27/05/2018
Internal fit-out								
Building weather tight								
Install plasterboard and insulation								
Fix wall closures, door thresholds								
Install joinery 2nd fixes								
Install fixed furniture and racking								
Internal finishes and decorations								
Snagging								
Relocate material from temporary stores								
MEP Services								
Install trunking and H&V duct work to ceiling void								
Install LTHW pipework and fittings								
Fit out water tank room and install rain water harvesting pipework								
Install electrical cabling, voice and data								
Complete intumescent seals and infiltration test								
Install luminaires and electrical fittings								
Install fire dampers								
Fit out workshop and gym								
Install sprinkler system								
Install building management systems								
Testing and commissioning								


25/02/2018
04/03/2018
11/03/2018
18/03/2018
25/03/2018
01/04/2018
Jetty
Strip existing scaffold
Construct scaffold jetty
Install and Commission Davit Crane


15/04/2018
22/04/2018
29/04/2018
06/05/2018
13/05/2018
20/05/2018
Walkway
Excavate and prepare formation for walkway pad foundations
Install pad foundations and steel columns
Construct support frame
Install and fix lion weld panels
Install handrails


25/03/2018
01/04/2018
08/04/2018
15/04/2018
22/04/2018
29/04/2018
06/05/2018
13/05/2018
20/05/2018
27/05/2018
03/06/2018
10/06/2018
Other Items
Fuel tank handover (commissioned during mobilisation)
Refurbishment to Prince house and interconnection of services
Swap out generators
Refurbishment to generator shed and LTHW pipework
Commission heat recovery from generator
Handover walkway and scaffold jetty
Handover New Beck House
Issue draft O&M manuals
Task completion

14.2. Appendix 2 – BAM refuelling Procedures

Refueling from the New 15,000 Litre Tank.

Before Refueling

- Ensure that spill kits are available and within easy reach of the refueling location.
- Ensure that a suitable fire extinguisher (CO_2, dry powder or foam) is available and within easy reach of the refueling location
- Make sure the item to be refueled is as close to the tank as possible but allows access to the bowser hoses.
- Switch off item of plant to be refueled and remove the keys.
- Ensure no other sources of ignition are present.

Refueling

- Put on PVC gloves
- Unlock the bowser
- Undo the diesel cap from the item of plant
- Take an absorbent pad from the spill kit or use a plant nappy to catch any drips from the fuel hose.
- Place the fuel hose into the diesel refilling point on the item of plant.
- Start the diesel delivery pump.
- **Do not** use the latch on the delivery hose and walk away from the refueling operation.
- **Do not** fill the diesel tank to the brim; allow a little room to prevent spillage on uneven ground

After Refueling

- Place the diesel delivery hose back into the compartment within the tank, ensuring any drips are collected by the absorbent pad or plant nappy.
- Relock the tank
- Place fuel cap back on the item of plant refueled.
- Place any diesel contaminated PPE or spill kit material in the oil contaminated waste drum.

Refueling from the Diesel Caddy.

Before Refueling

- Ensure that spill kits are available and within easy reach of the refueling location.
- Ensure that a suitable fire extinguisher (CO_2, dry powder or foam) is available and within easy reach of the refueling location
- Make sure the diesel caddy is as close to the item to be refueled as possible.
- Ensure the diesel caddy is on firm level ground.
- Switch off item of plant to be refueled and remove the keys.
- Ensure no other sources of ignition are present.

Refueling

- Put on PVC gloves
- Open the diesel caddy
- Undo the diesel cap from the item of plant
- Take an absorbent pad from the spill kit or use a plant nappy to catch any drips from the fuel hose.
- Place the fuel hose into the diesel refilling point on the item of plant.
- Pump the fuel from the caddy into the item of plant.
- **Do not** fill the diesel tank to the brim; allow a little room to prevent spillage on uneven ground

After Refueling

- Place the diesel delivery hose back into the compartment within the diesel caddy, ensuring any drips are collected by the absorbent pad or plant nappy.
- Close the diesel caddy
- Place fuel cap back on the item of plant refueled.
- Place any diesel contaminated PPE or spill kit material in the oil contaminated waste drum.
- Return the diesel caddy to either the fuel storage by the generator shed or to the diesel tanks behind Prince House.

14.3. Appendix 3 – BAM Site Waste Management Plan

Site Waste Management Plan

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 Smart – the web-based sustainability monitoring and reporting tool

Project reference	BAA.4001
Project title	Bird Island, Beck House Rebuild
Client	Natural Environmental Research Council – British Antarctic Survey
Principal contractor	BAM
Site waste coordinator / Environment engineer	Neil Goulding
Contract value	
Address/location	Bird Island Research Station, Bird Island, South Georgia Lat. 54°0'0"S, Long. 38°2'59"W
Project description	Demolish and rebuild Beck House. Demolish and rebuild the existing jetty. Install additional MGO storage tank.
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 Bird Island 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.

The most up-to-date version of the BAS Waste Management Handbook will be used by the Site Waste Coordinator to ensure that all waste is handled, packaged and consigned appropriately.

(See Appendix 1 for roles and responsibilities.)

Legislation

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.

The BAS Environment Office ensures that BAS is compliant with the Hazardous Waste Regulations for all of BAS waste returned to the UK from Antarctica.

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:

Methods of construction	Beck house is to be a modular building formed: • Precast foundation pads • Steel floor frame • Timber frame for walls and roof • Prefabricated wall and roof panels. The Bird Island Jetty will be extended using scaffold and board.
Pre-fabrication off site	All wall, floor and roof panels for Beck House will be prefabricated including the insulation. Roof trusses will be partially pre-fabricated. Foundation pads are to be pre-cast.
Re-use on site	All re-usable demolition and construction materials will be offered to the Station Manager for re-use within the Bird Island Research Station. The BAS BI Project Manager will inform the Environment Office, at the time, of any materials which will be left on site.

Forecast of the types and quantities of waste

It is estimated that this site will produce the following types and quantities of waste: Tbc following development of design.

Excavation Waste

Type of Waste	EWC Code	Estimated Quantity (Kg)				Waste Management Action in Detail	Storage Arrangements
		Total	Re-Use	Recycle	Dispose		
Inert Soil and Stone	17 05 04	33	33			Stockpile and redistribute across the site upon completion of the works.	Stockpile

Construction Waste

Type of Waste	EWC Code	Estimated Quantity (Kg)				Waste Management Action in Detail	Storage Arrangements
		Total	Re-Use	Recycle	Dispose		
Sewage (37.5kg/man/day)	20 03 06	30,000			30,000	Discharged directly into the sea	N/A
Grey Water		75,000			75,000	Discharged directly into the sea	N/A
Food Waste – Compostable	20 01 08	100			100	Boiled in pressure cooker before being discharged into the sea	N/A

Food Waste – Non-Compostable and egg shells	20 01 08	50			50	Frozen and stored in Griff bin. Returned to the UK for Incineration	Griff Bin
Unused Packaged Food		50			50	Store in crate or carton marked “UEs” (Unused Edibles) and return to the UK for disposal by incineration.	Crate or carton marked “UEs”
Tin Cans (Food) and Aluminium Foil	17 04 07	50		50		Washed, compacted and stored in 205ltr drum painted green or FIBC with recycling logo and marked ‘Aluminium and Steel Cans’. Returned to the UK for recycling.	Green 205 letter Drum or FIBC marked ‘Aluminium and Steel Cans’
Recyclable Plastic Food Containers	20 01 39	25		25		Washed, compacted and stored in FIBC marked with recycling triangle and ‘PLASTICS’. Returned to the UK for recycling.	FIBC marked ‘PLASTICS’
Non-Recyclable Plastic	21 01 39	25			25	Washed and stored in FIBC. Sent to Interserve FI for disposal by landfill.	FIBC with orange FI stencil
Recyclable Cardboard Food Containers (Tetra Pak)	20 01 01	10		25		Washed and stored in FIBC with green stencil, marked “TETRA-PAK”. Returned to the UK for recycling	FIBC marked ‘TETRA-PAK'
Food Contaminated Containers	22 01 39	25			25	Washed and stored in 205ltr drum. Returned to the UK for disposal by incineration	205 ltr Drum

Cooking Oils	20 01 25	5		5		Stored in original container or 205 ltr drum painted orange and marked “WASTE COOKING OIL”. Sent to Stanley Services, FI for recycling.	Original container or 205 ltr drum marked “WASTE COOKING OIL”
Alkaline Batteries	20 01 33	1		1		Tape up terminals. Separate into the different types where practicable. Bag and labelled accordingly. Pack bags into separate sections of a plastic-lined UN nefab box filled with vermiculite. Paint the case yellow, stencil with green recycling triangle and mark the top and sides with the case number and “ASSORTED WASTE BATTERIES, NON REGULATED”. They do not require hazard labels under the IMDG code for shipping. Consign to the Environmental Manager in the UK.	Yellow UN nefab box
Clothing / Textiles	20 01 10	5		5		Stored in FIBC with green recycling stencil, marked “WASTE TEXTILES FOR RECYCLING” and returned to the UK	FIBC marked “WASTE TEXTILES FOR RECYCLING”
Cardboard	20 01 01	20		20		Broken down, baled and stored in FIBC with green recycling stencil and labelled ‘CARDBOARD’. Returned to the UK for recycling	FIBC marked ‘CARDBOARD’
Glass	17 02 02	2		2		Washed and stored in green 205 ltr drum marked “WASTE GLASS” and returned to the UK for recycling	Green 205 ltr drum marked “WASTE GLASS”

Ferrous Metal	17 04 05	20		20		Preferably secured to pallet or in a clean 205 ltr drum (painted orange) and sent to Interserve, FI or returned to the UK for recycling. Segregate ferrous and nonferrous where possible. A separate WTN available from the SL must be completed for all waste consigned to Interserve	Pallet or orange 205 ltr drum
Paper	20 01 01	5		5		Re-use on site for packaging where suitable. Store in FIBC marked “PAPER” and with the recycling triangle. Return to the UK for recycling	FIBC marked “PAPER” and with the recycling triangle.
Timber	17 02 01	63	21	21	21	Wood that can be used on station should be given to the Station Manager. Other wood is stored in wooden crates and marked “WASTE WOOD”. Returned to the FI for disposal	Wooden crates and marked “WASTE WOOD” for the FI
Plastic	20 01 39	5		5		Compacted and stored in FIBC marked with recycling logo and the word “PLASTICS”. Returned to the UK for recycling.	FIBC with recycling logo and “PLASTICS”
Oil	13 02 07	200			200	Store in 25 ltr plastic containers painted orange and marked “WASTE LUBRICANT” and with the recycling triangle. Sent to Stanley Services for recycling.	Orange 25 ltr plastic container marked “WASTE LUBRICANTS” and with the recycling triangle

Oil Filters	16 01 07	5			5	Empty oil filter and store in yellow 205 ltr drum marked “OIL FILTERS” and “UN 3077 Class 9 Environmentally Hazardous Substance, solid, n.o.s.”. Return to the UK for disposal.	Yellow 205 ltr drum marked “OIL FILTERS” and “UN 3077 Class 9 Environmentally Hazardous Substance,
Oil Contaminated Rags	15 02 02	2			2	Store in 205 ltr drum painted yellow and labelled “WASTE OILY RAGS”. Allocate hazard class 4.2, UN no. 1856. Return to the UK for disposal	205 ltr drum painted yellow and labelled “WASTE OILY RAGS”
Aerosols	16 05 04 16 05 05	5			5	Seal tops of aerosols with packing tape and place in a plastic lined UN approved case filled with vermiculite and painted yellow with the words “WASTE AEROSOLS” on the top and sides. 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	Yellow plastic lined UN approved case marked “AEROSOLS”
Detergents and Disinfectants	20 01 30	2	2			Offer to Bird Island Station Manager. If not required keep in original bottles, seal in bag and pack in UN approved case filled with vermiculate. Paint it yellow and mark WASTE “DETERGENTS AND DISINFECTANTS”. Return to the UK for disposal	In original bottles within a yellow UN approved case marked WASTE “DETERGENTS AND DISINFECTANTS”
Fluorescent Tubes	20 01 21	3			3	Store in original cardboard box within a polythene lined wooden box labelled “WASTE / FLUORESCENT TUBES” and returned to the UK for disposal.	Store in original cardboard box within a polythene lined wooden box labelled “WASTE /

Paint and thinners	20 01 27 20 01 28	10	10			Paint is to be offered to the Station Manager at Bird Island for re-use. Unwanted cans paint is to be stored in a yellow UN approved case filled with vermiculite and marked “WASTE PAINT” or “WASTE PAINT RELATED	yellow UN approved case marked “WASTE PAINT” or “WASTE PAINT RELATED PRODUCTS”

Demolition Waste

Type of Waste	EWC Code	Estimated Quantity (Tonnes)				Waste Management Action in Detail	Storage Arrangements
		Total	Re-Use	Recycle	Dispose		
Concrete	17 01 01	30		30		Foundation blocks from Beck House to be kept as solid blocks. Return to the UK for recycling	Store as concrete blocks
Timber*	17 02 01	6.298		3.149	3.149	Wood that can be used on station should be given to the Station Manager. Other wood is stored in wooden crates and marked “WASTE WOOD”. Returned to the UK for disposal	Wooden crates and marked “WASTE WOOD”
Glass*	17 02 02	0.23		0.23		Retain as window panels. Offer to Station Manager. If not required, store in container and return to the UK for dismantling and recycling.	Container
Styrofoam*	17 06 04	0.12			0.12	If loose, fix to pallet and return to the UK for disposal	Pallet
Celotex (PIR)*	17 06 04	0.35			0.35	If loose, fix to pallet and return to the UK for disposal	Pallet
Mixed metals*	17 04 07	13.506		13.506		Cladding sheets and scaffold tube to be offered to Station Manager. If not required, secure to	Green Pallet

						pallet painted green and return to the UK or FI for recycling	
Rockwool*	17 06 04	0.32			0.32	If loose, store in 205 ltr drum labelled “WASTE INSULATION” and return to the UK for disposal	205 ltr drum labelled “WASTE INSULATION”
Plasterboard*	17 08 02	3.32			3.32	If loose, fix to pallet and return to the UK for disposal	Pallet
Cement Board*	17 08 02	0.67			0.67	If loose, fix to pallet and return to the UK for disposal	Pallet
Aquapanel*		1.22			1.22	If loose, fix to pallet and return to the UK for disposal	Pallet
Fluorescent Tubes	20 01 21	0.003			3	Store in original cardboard box within a polythene lined wooden box labelled “WASTE / FLUORESCENT TUBES” and returned to the UK for disposal.	Store in original cardboard box within a polythene lined wooden box labelled “WASTE / FLUORESCENT TUBES”
Electrical Cable	17 04 10	0.01		10		Stored in 205ltr drum marked with recycling logo. Returned to the UK for recycling.	205ltr drum marked with recycling logo
Electrical Switches and Sockets	20 01 36	0.01		10		Stored in 205ltr drum marked with recycling logo. Returned to the UK for recycling.	205ltr drum marked with recycling logo
Plastic (electrical trunking and water pipes)	20 01 39	0.01		10		Stored in 205ltr drum marked with recycling logo and the word “PLASTICS”. Returned to the UK for recycling.	205 ltr Drum marked with recycling logo and “PLASTICS”

*Where possible, prefabricated panel are to be stored in a container and the waste elements segregated in the UK.

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**
• Beck house to be a modular design with panel pre-fabricated in Europe.	• All waste materials to be offered to the Research Station Manager for re-use within the station. The BAS BI Project Manager but inform the Environment Office in order to receive approval of waste materials remaining on site for reuse.
• Accurate measurement, and minimal wastage will be allowed when ordering materials	•
• 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 in the UK	•

Excavated material (soil & stones)	
Reduction measures	**Reuse measures**
• Trenches to be sheeted rather than battered to reduce excavated material	• Excavated soil and stone to be distribute on site
Timber	
Reduction measures	**Reuse measures**
• Beck house to be a modular design with panel pre-fabricated in Europe.	• All waste materials to be offered to the Research Station Manager for re-use within the station. The BAS BI Project Manager will inform the Environment Office in order to receive approval of waste materials remaining on site for reuse.
• Reusable plastic/metal hoardings to be used	•
• Reusable plastic pallets to be used	•
Metals	
Reduction measures	**Reuse measures**
• Beck house to be a modular design with panel pre-fabricated in Europe.	• All waste materials to be offered to the Research Station Manager for re-use within the station

Packaging, Labelling, Transfer and Shipping Documentation

It is essential that waste materials are securely packaged, are clearly marked and have the appropriate documentation attached. The following procedures should be followed to ensure consignments are safe for handling and are transported according to legal requirements.

Packing

Containers

A variety of containers will be supplied by BAM and will be available for packing waste as listed in the table below.

Type of Waste	Container	Waste
Non-Hazardous Inert	Flexible intermediate bulk bags, (FIBCs) – with green recycling logo	Segregated dry recyclable waste (e.g. paper, card, plastics, cans, tetra-pak etc.)
	Flexible intermediate bulk bags, (FIBCs) – with orange FI lettering	Waste materials for landfill in the Falkland Islands
	NB FIBCs should not be used for general cargo	
	Old 205 ltr AVTUR drums	Oil filters, cooking oils, glass
	Pallets	Wood waste and scrap metal
	Skips	Scrap metal (but preference is on a pallet where possible.
Hazardous	Old 205 ltr AVTUR drums	Waste fuel (not petrol), lubes, oil and oily rags
	Old petrol drums	Only for waste petrol
	Wooden containers and crates (lined with plastic)	Fluorescent light bulbs and WEEE waste
	UN approved boxes	Batteries, aerosols and empty paint containers
	UN approved 25l, 30l or 60l metal and plastic drums	Waste chemicals
	Yellow Griff bins	Clinical waste

Packaging Materials

Packaging materials that have been sent in containers carrying items to bases should be reused as much as possible. For example:

- Vermiculite (for all liquids);
- Shredded paper;
- Bubble wrap; and
- Cardboard.

Packing Groups and UN Approved Packaging

All hazardous waste must be packed in correct Group I, II or III packing containers (see Appendix 3). The packing groups are based on the degree of danger associated with the material.

- Packing Group I Materials are highly dangerous
- Packing Group II Materials are of medium danger
- Packing Group III Materials are of low danger

All enquiries for general hazardous materials packaging and transportation should be directed Joe Corner (BAS BI Project Manager), jorn@bas.ac.uk

UN approved packaging guarantees the item has been tested to ensure that the contents will not leak when under pressure, in a stack or when dropped. All UN approved packaging bears the UN mark of approval.

Packing Hazardous Waste

Liquids

Hazardous liquid wastes are generally transported in UN approved 25, 30 or 60 litre chemical drums. Check the drums for leaks and that the seals on caps are intact. Be particularly vigilant when using dented or rust-marked drums.

Solids

UN approved cartons or crates should be used to return solid hazardous waste or small bottles containing hazardous liquids.

All contents must be sealed in a heavy gauge plastic liners and sufficient vermiculite to protect the contents and absorb any spillage. Do not overload boxes or cases.

A copy of the Bill of Lading (BOL) sealed in a plastic wallet must be securely taped to the outside of any container containing hazardous wastes. The following should be considered when packing hazardous waste:

- previous hazardous cargo labels and markings must be removed or painted over (not just crossed out);
- do not paint over container dimensions or UN marking (shown above);
- all sides (except the bottom) of the package must be labelled;
- all sides (except the bottom) must have the appropriate hazard class labels; and
- top and upper part of containers should be painted yellow.

Manual handling

All waste is man-handled several times over, from when it is first disposed of and packaged on base, to being loaded onto BAS vessels in the Antarctic, offloaded in the UK or FI, loaded onto waste contractor lorries and then offloaded at its final disposal point.

It is essential therefore to pack waste appropriately to avoid injury to those handling it. The following points should be considered by anyone involved in packing waste:

- FIBC's should be checked prior to being hoisted by crane onto BAS vessels to ensure that they do not contain sharp objects which may injure handlers or tear bags;
- Boxes and crates must be in good condition and not overloaded;
- Waste loaded onto pallets should be carefully packed to ensure there are no sharp edges and that protruding nails or screws are removed;
- Old fuel drums should be fully drained and wiped with absorbents to ensure no vapours or liquid remains;
- Drums should not be over-filled as they become too heavy for people to easily handle;
- When storing liquids in drums, space should be allowed for expansion at warmer temperatures; and
- Drums that have been fitted with a lid and ring clamp must not be lifted using drum lifting clamps; instead they should be netted when loaded by crane.

Storage

It is extremely important that waste ready for shipment is stored appropriately i.e. according to the hazard it may create. This could be inside the designated waste store, in an ISO container, or outside on the dockside. If waste is stored outside it must be secured in case of strong winds (in particular empty drums), and properly sealed to prevent ingress of water. Hazardous wastes must be kept in the designated storage facilities on base. Drums should always be stored upright in designated waste stores on the stations and ships.

N.B. Lithium Batteries are a FIRE HAZARD when wet and must be kept dry at all times!

Labelling

Each consignment of waste must be appropriately colour coded and clearly marked with the type of waste it contains. In addition each consignment must have a BAS case number.

For hazardous waste the cases must also be marked on the outside with the following information:

- Proper shipping name (PSN)
- UN hazard class label(s)
- Flashpoint (if applicable)
- UN number

This information can be found listed in the 'Hazcheck' software tools used on BAS stations or from Joe Corner (BAS BI Project Manager), jorn@bas.ac.uk.

As an example, a drum containing waste methanol/water mixture would be recorded as:

- ***waste methanol mixture (methyl alcohol) / water >70%***
- ***hazard class 3***
- ***flashpoint 20°C***
- ***UN No 1230***

If the waste has a primary hazard and a subsidiary risk then both hazard labels must be stuck onto the package.

The *Approved Carriage List* (Health and Safety Executive, 1994), available on stations and ships, contains a comprehensive listing of chemicals and hazardous substances.

Colour Coding

All containers carrying waste should be colour coded to reflect the final disposal location and waste contractor. For solid containers this will involve painting the tops and upper part of the sides of the unit. FIBC's are generally ready supplied with a colour code in the form of a green recycling logo or with orange 'FI' lettering on the side. **All old labels and hazard markings for any previous contents must be removed or painted over.**

Type of Waste	Colour Coding	Disposal Locations
Non-hazardous landfill	Orange	Falkland Islands N.B Liaison with BAS must occur before consigning to the FI
Fuels and oils	Orange with recycling logo	Falkland Islands N.B Liaison with BAS must occur before consigning to the FI
Resale items	No colour	Falkland Islands N.B Liaison with BAS must occur before consigning to the FI
Recyclables	Green plus recycling logo	UK
Hazardous waste, radioactive materials and other chemicals	Yellow	UK

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

All hazardous cargoes shipped into BAS stations are identified by one of the UN hazard classes. Check the Materials Safety Data Sheet (MSDS) for information on how to pack and transport the cargo appropriately.

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.

Case Numbers

Case numbers are usually assigned by the Station Leader or Chief Officer. These numbers should be marked on each side of the consignment for ease of handling when loading and offloading the waste. Case numbers are **not** required for waste sent for disposal in FI but they **are** required for resale items for the FI. Resale items do not need to be colour coded.

Shipping Documentation

What is a Bill of Lading (BOL)?

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 BAS BI Project Manager.

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 (m^3)	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 - all BAM produced waste will have the prefix BAM so a waste BOL from BI will look like this: BAM/BI/C/18/90xx
- 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 (m^3) per item
- Estimated value (if applicable)

Under no circumstance should Antarctic waste be consigned to Cambridge. BAS does not have a licence to receive imported waste at Cambridge.

Waste to be sent to the UK should be consigned to the Environment Manager – "UK" (not Cambridge).

Submitting a BOL

Before loading waste onto a ship, the BAS BI Project Manager must e-mail copies of the relevant BOLs to the Senior Shipping Officer at BAS, Cambridge and to the Chief Officer of the vessel taking the waste. The BOLS must have the prefix BAM to identify the waste as BAM produced.

The Chief Officer must notify the BAS Falkland Islands Logistics Co-ordinator of details of the incoming waste shipment to the Falkland Islands. Wherever practicable, the Falkland Islands Logistics Co-ordinator must inform the contractors of the types and quantities of waste to be off-loaded at least three working days prior to collection and haulage in the Falkland Islands.

The Senior Shipping Officer ensures that copies of the waste BOLs being consigned to the UK are provided to the Environmental Manager. The Environmental Manager then informs the contractor of the waste to be offloaded in the UK.

BOLs for hazardous wastes

A BOL must be prepared for each individual case/drum of hazardous waste. However, there may be times when large numbers of drums of identical size and content may be included together on one single BOL. Contact the Senior Shipping Officer in advance if you plan to include more than one drum on a BOL.

The information listed in the Labelling Section must be included on a hazardous waste BOL.

All enquiries for general hazardous materials packaging and transportation should be directed to Joe Corner (BAS BI Project Manager), jorn@bas.ac.uk

Documentation for Interserve

The BAS BI Project Manager must confirm that waste can be accepted by the FI before waste is consigned to Interserve.

Waste Transfer Notes

As of 2013, each consignment of waste being sent to Interserve in the Falkland Islands must be accompanied by a Waste Transfer Note (WTN). This is a legal requirement to meet the Duty of Care Regulations which the producer of waste (BAM) and the receiver of waste (Interserve) must complete. **Only inert, non-recyclable, non-hazardous waste should be sent to Interserve.**

The following information should be included on each form.

Section 1 - Waste Details:

Choose the relevant details from the table below to complete Section 1 of the form. Only one type of waste should be listed on each WTN.

Description of Waste	Definition – (for info only)	Waste Codes
Wood Waste	Untreated wood or wood cuttings (unsuitable for reuse)	20. 01. 38
Wooden Packaging	Containers - wooden, crates - wooden, empty used containers. Packaging -wooden, broken pallets, timber – untreated. Wood, wooden containers – contaminated. (unsuitable for reuse)	15. 01. 03
Mixed Domestic Waste	General admin, commercial, industrial office waste. (non recyclable)	20. 03. 01
Mixed Metals	Ferrous & non ferrous mixed scrap (preferably segregated)	20. 01. 40
Construction & Demolition Waste	Bricks, building rubble, aggregates, ceramics, gravel, hardcore, road metal, rubble	17. 01 07

Section 2 – Description of Container

Fill in the details of the weight and type of container of each consignment of waste. The details describing the waste on the WTN should match those completed on the BOL. The '*Date of collection*' section is to be completed by FI Logistics Coordinator once collection from the ship has been arranged.

Section 3 – Transferee

To be completed by Interserve in the FI's.

Section 4 - Transferor

To be signed by the BAS BI Project Manager or a delegated person. The SIC code for the BI project is 41.20/1 (Construction of Commercial Buildings). It is the responsibility of the BAS BI Project Manager to ensure that the WTN is correctly prepared and sent to both the FI Logistic Coordinator and the Ship's Chief Officer prior to the consignment being loaded onto the ship.

On arrival in the FI's the consignment of waste will be collected by Interserve directly (if offloaded at Mare Harbour) or by a third party (if offloaded at FIPASS). The WTN must include an accurate description of waste, which should be identical to the description provided on the BOL. Both the WTN and the BOL must accompany the waste until Interserve confirm receipt of the consignment by signing the bottom of the form. The fully completed WTN should be kept on file by the FI Logistics Coordinator.

Project close-out review

This section of the plan is completed prior to the project close-out review, and discussed as part of the review meeting. The estimated quantities are drawn from the table in section 2, and reconciled against the actual quantities removed from site as detailed in BAM SMaRT.

Comparison of estimated and actual quantities

Actual waste quantities from BAM SMaRT. Will be issued upon completion

Source and type of waste	EWC Code	Estimated quantity of waste (tonnes)	Actual quantity of waste (tonnes)
Excavation waste			
Hazardous excavated material	17 05 03*		
Non-hazardous soil and stones	17 05 04		
Inert soil and stones	17 05 04		
Construction (skip) waste			
Concrete	17 01 01		
Mixed hardcore	17 01 07		
Timber	17 02 01		
Glass	17 02 02		
Plastic	17 02 03		
Mixed metals	17 04 07		
Other mixed construction waste	17 09 04		
Hazardous construction waste	Various		
Mixed municipal waste	20 03 01		
Demolition waste			
Concrete	17 01 01		
Bricks	17 01 02		
Mixed hardcore	17 01 07		
Timber	17 02 01		
Glass	17 02 02		
Plastic	17 02 03		
Mixed metals	17 04 07		
Other mixed demolition waste	17 09 04		
	Totals	0	0
		Difference	0

Delete / add waste streams as appropriate by double clicking on this table.

Explanation of any deviation from the original plan

Appendix 1 Roles and responsibilities

The Employer's Representative will:

- Appoint a Principal Contractor
- Provide the Principal Contractor with details of all decisions taken before the site waste management plan was drafted on the nature of the project, its design, construction method or materials employed in order to minimise the quantity of waste produced on site
- Ensure a construction phase SWMP is produced
- Is responsible for transportation and disposal of all waste generated by BAM at Bird Island except sewage and grey water.

The agent for the Principal Contractor will:

- Ensure the SWMP for the construction phase is produced, and distributed to all staff and subcontractors
- Ensure the BAS Waste Management Handbook is distributed to all staff responsible for waste handling, packaging and consignment
- Ensure that within three months of project completion:
  - that the plan has been monitored on a regular basis
  - section 5.1 is completed comparing estimated quantities with actual
  - section 5.2 is completed to explain any deviation from the plan
  - section 5.3 is completed to estimate the cost saving that have been achieved
- Keep a copy of the SWMP for a minimum of two years after project completion

The site waste co-ordinator / environmental engineer for the Principal Contractor will:

- Produce the construction phase SWMP prior to works starting on site
- Obtain from the client details of all decisions taken before the site waste management plan was drafted on the nature of the project, its design, construction method or materials employed in order to minimise the quantity of waste produced on site, for inclusion in the construction phase SWMP

- Keep a copy of the SWMP on site and display in suitable locations for information
- Review the plan monthly and update where necessary to accurately reflect progress
- Ensure the following waste data is recorded within BAM SMaRT when any waste is removed from site:
  - a description of the waste, including the 6 figure EWC code
  - the name of the company collecting the waste (waste carrier)
  - the site where the waste is being taken to (waste destination)
  - the quantity of the waste and whether it was;
  - reused on site
  - taken for reuse at an exempt or standard permit site
  - taken to a transfer station for segregation and onward recycling
  - taken to a dedicated recycling facility
  - sent to landfill (only if all other options have been discounted)
- Ensure details of recycling figures for the transfer stations used within the region are obtained and entered onto BAM SMaRT on a quarterly basis
- Ensure details of all waste carrier registration numbers, environmental permit numbers and exemption references for the carriers and disposal sites used within the region are checked and sent to the area environment advisor for input onto BAM SMaRT
- Is responsible for packaging all waste produced by BAM at Bird Island in accordance with this SWMP and the BAS Waste Management Handbook

14.4. Appendix 4 – BAM Biosecurity Plan

Antarctic Construction Partnership – Bird Island			bam
Employer	NERC/British Antarctic Survey	Project Number	BAA4002
Tech Adv	Ramboll	Document Number	BAA4002-BAM-ZZ-BIS-RC-YE-0001
Contractor	BAM Nuttall	Revision	P-03

Bird Island Biosecurity Plan

Reference Sheet

Document Number	Description
BAS	Biosecurity Handbook

Revision History

Revision	Date	Revision Description
P-03	18-07-17	Incorporating BAS comments
P-02	01-06-17	Incorporating BAS comments and checklists
P-01	10-03-17	First Draft

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

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

 0.17

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 introduction of invasive species, including vertebrates, invertebrates and plants, has greatly altered the ecosystems of many sub-Antarctic islands.

Future increases in human presence in the sub-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 Government of South Georgia and South Sandwich Islands Wildlife and Protected Areas Ordinance (2011) legislates to minimise the risk of non-native species introductions to the islands, and BAM is obliged to conform to this legislation.

BAMs projects in the Antarctic and sub-Antarctic cover several locations of distinct biological diversity. It is essential that we take all necessary precautions to prevent the introduction of non-native species to Bird Island from other locations, including from Europe, South America or any of the BAS Research Stations or logistics hubs.

This document provides guidance on the measures to be taken when moving plant, materials or personnel to Bird Island.

1.1. Prohibited items

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

- 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,meat, herbs or spices 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 and Responsibilities

- **BAM Environmental Lead:** Neil Goulding neil.goulding@bamnuttall.co.uk, +44 07770 223441
    - Overall environmental management responsibility for the BI project
    - Ensures that the designers, suppliers, buyers and construction team are aware of the biosecurity requirements covered in this document
    - Responsible for nominating and training all Biosecurity Inspectors
    - Responsible for training the Environmental Engineer
    - First point of contact for all queries or questions from BAM staff or BAS personnel on environmental or biosecurity issues.

- **BAM Construction Manager:** Lloyd Wickens lloyd.wickens@bamnuttall.co.uk, +44 7771 913923
    - Overall responsibility for all construction at Bird Island including the mobilisation and demobilisation
    - Responsible for appointing the Environmental Engineer from within the BI site team
    - Overall responsibility for ensuring that all cargo is biosecure before it is offloaded to Bird Island

- **BAM Environmental Engineer:** TBC (appointed from within the BI 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 Bird Island
    - 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 BI construction team and at least one BAM staff member responsible for checking cargo at packing and loading stages in the UK and FI)
    - 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 all port where materials are loaded
    - Report to the BAM Environmental Lead unless at BI in which case reports to the Environmental Engineer

- **All BAM Personnel**
  - All personnel are responsible for ensuring that their personal belongings have been biosecurity checked and do not contain any of the listed prohibited items.
  - All personnel will complete biosecurity checklist 1 (at the end of this document.)

2. Pre-departure Biosecurity

2.1. Personal Biosecurity

- Immediately before leaving home for Bird Island or South Georgia, 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. A visual check of all clothing should also be carried out paying particular attention to Velcro, gaiters, pockets, turn-ups in trousers and hoods of jackets (see Checklist 1).
- Footwear should be cleaned (inside and out) including the treads on soles to remove soil, seeds or any other plant material.
- Personal clothing and equipment shall also be checked on the ship prior to arrival at South Georgia.
- Avoid picking up soil, seeds and other propagules on your clothing during travel to South Georgia or Antarctica (i.e. be careful to ensure clothing and shoes are clean after walking in the countryside in the Falkland Islands or around Punta Arenas).
- If possible, immediately before entering South Georgia or Antarctica wear new 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 and as close to departure as possible to minimise risk of spiders or other insects taking refuge.
- Before handing in any personal items or cargo to the BAM Logistics Stores in the UK, Netherlands or Chile for transportation to Bird Island, ensure that it is clean and free of soil and propagules.

2.3. Cargo Packing Areas

Plant and materials bound for the Bird Island project will be loaded onto ships at Rotterdam, Southampton, Punta Arenas or Falkland Islands. 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 all cargo packing areas (see 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, wasps nests, spider webbing and spider cocoons 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, except when in use.
- Cargo will be stored inside, where possible.
- Shipping containers should be stored on concrete surfaces (as opposed to bare earth). If containers are not stored on hard surfaces, additional checks shall be made to ensure they are free from soil and biological material prior to on-ward transportation.

2.4. 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 new 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) are acceptable 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.

2.5. 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, cladding, scaffolding poles, etc.). All break bulk cargo must be clean and free of soil and biological material before loading on the ship or offloading at a station. Therefore, all items of break bulk cargo, including packaging, shall be visually inspected for signs of rodent gnawing or rodent ingress or signs of invertebrates such as spider webbing, cocoons or guano. Cargo shall also be checked for any soil or biological material and if found the item shall be cleaned. A specific checklist for break bulk items must be completed and is detailed in Checklist 7. During off loading, 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.

2.6. Small Plant & Tools

Prior to packing any previously used small tools or small plant items for transport to Bird Island research Station (or between BAS 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 Checklist 3:

- Plant items are to be placed on a clean concrete or asphalt hard standing.
- Plant is to be cleaned externally using high pressure steam or hot water 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.
- A domestic residual insect spray (e.g. Doom, Raid formulated as residual – not knock down) should be used in the crannies and crevices of vehicles to kill any harbouring spiders and other invertebrates.
- 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/spiders). This information is to be recorded for auditing purposes (see 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 prior 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.

2.7. 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 that could contain plant fragments, seeds, invertebrates or invertebrate eggs. Prior to loading any item of large mechanical plant for transport to Bird Island Research Station, the following procedure is to be followed (see Checklist 4).

- Plant items are to be placed on a clean concrete or asphalt hard standing.
- Plant is to be cleaned externally using high pressure steam or hot water 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 item has a cab, upholstery and mats should be brushed and/or vacuum cleaned to remove any soil or biological material. Where mats and seat covers are removable then cleaning under them should also be carried out.
- 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, insects and spiders).
- 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. A domestic residual insect spray (e.g. Doom, Raid formulated as residual – not knock down) should be used in the crannies and crevices of vehicles to kill any harbouring spiders and other invertebrates.
- Motorised plant is to have its engines started before loading, to ensure rats and mice are not living in the engine compartments.

2.8. Construction materials

The following 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.

2.8.1. Aggregate

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 soil, seeds, invertebrates and other propagules can easily become entrained during production and transport.

There is no plan to use aggregates for the re-development of Bird Island. However an appropriate aggregate management strategy has been agreed as part of this Biosecurity Plan in the event that there are any changes to the agreed construction methods. The management strategy takes steps to reduce the risk of non-native species and propagule introduction at each stage of aggregate production, transport and use. With this objective in mind, a best practice management strategy should involve the following steps:

- 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.

2.8.2. Timber

Timber will be a key construction material for the project at Bird Island. Timber products may also be required for packaging materials. Due to the risk of infestation by pests the following precautions must be observed before timber can be imported to South Georgia:

- All timber is free of bark.
- 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.

2.8.3. Cladding panels

Beck House will be clad with profiled steel sheets. When stacked for storage and transport small voids between the steel sheets could become contaminated by invertebrates. Checks shall be made when packing and shipping these materials to ensure that no invertebrates or their eggs are hidden between the sheets. The bundles of cladding will be wrapped in heavy duty polythene (0.2mm thick).

2.8.4. Scaffold tubes

Scaffold tubes will be used to form the structure of the new jetty at Bird Island. The hollow sections form an ideal place for invertebrates or rodents to hide Scaffold tubes will be cleaned using a pressure washer, taking care to clean any invertebrates or their eggs from the inside of the tubes.

2.9. ISO Containers and Bunk-a-bin accommodation units

Prior to packing and loading any ISO, Bunk-a-bin units or other sealed container for transport to Bird Island Research Station, the following procedure is to be followed (see Checklist 5).

- Shipping/accommodation containers must be stored on concrete surfaces (as opposed to bare earth).
- Shipping/accommodation 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. If deemed necessary by the nominated Biosecurity Inspector, containers shall be washed inside and out before being sent to South Georgia and Antarctica.
- Prior to being sealed for the last time before being sent to South Georgia, containers (except those containing fresh foods) shall be fumigated using a single-use pyrethrum fogger, to eradicate any invertebrates within.

2.10. Fresh food

BAM is responsible for providing its own welfare facilities for the works at Bird Island, however the provision of food to the BI team and BAM construction personnel will be taken over by BAS and managed as per the BAS Biosecurity Handbook.

Fresh foods (eggs, fruit, and vegetables) imported to Antarctica and South Georgia may contain soil, insects, slugs, caterpillars, invertebrate eggs, mould and/or other microorganisms (fungi and bacteria).

- Fresh fruits and vegetables should be sourced from suppliers pre-washed, so that the produce is provided to Bird Island soil-free.
- Food packaging material (cardboard boxes, sacks, plastic wrapping, etc.) contaminated with food, soil, invertebrates, blood and/or egg shell, white or yolk, should be packaged and stored until removal/incineration on the ship.

In addition to fresh foods some alcohols, (particularly beer), when spilt can harbour insects in the damp cardboard packaging. Any alcohol purchased by BAM should be inspected for split cans and potential insect infestations of packaging.

2.10.1. Prohibited Foods

The following fresh food items are prohibited from import to Bird Island.

- Broccoli
- Cauliflower
- Lettuce
- Kale
- Spinach
- Cabbages (white cabbage and red cabbage are acceptable providing the outer leaves are removed)
- Leeks
- Globe artichokes
- Celery

These loose leafy vegetables are difficult to inspect for non-native incursions and should therefore not be ordered. Please note that root vegetables should only be ordered if they are pre-washed and do not contain surface soil (see Checklist 6).

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 must have rodent boxes with poison bait that are inspected before, during and after each port visit.
- Insect sticky traps must be placed in food storage areas, and replaced when necessary.
- Electric UV insect killers must also be used in food storage areas.
- Biosecurity inspections of all ship and Bird Island station cargo (and in particular, fresh foods) should be undertaken prior to loading (see checklists 3, 4, 5, 6).

3.1.1. When in Port

- Ships must have rat guards on the mooring lines.
- The gangway must be lifted at night, or if lowered, lit with flood lights. An ultrasonic rat deterrent must be available and be switched on.
- External doors and windows must 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 tender must 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, seeds and other propagules. Spot check shall be undertaken to ensure compliance by either a biosecurity inspector or the environmental engineer.
- 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, disinfectants 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, timber and cladding, shall be visually inspected for signs of rodent gnawing or rodent ingress and signs of spider webbing or guano by the BAM Environmental Engineer. 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 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.

3.2.3. Vehicles and Large Mechanical Plant

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

3.2.4. 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 (see Checklist 5).

3.2.5. Fresh Food

With the exception of sealed pre-packaged fresh produce transported between Stanley and King Edward Point (which is checked within the KEP biosecurity facility), all produce shall be checked for invertebrate infestation and excessive mould before it is off-loaded to the station. A record of these checks shall be made and kept for auditing purposes (see Appendix B, Form 1 Fresh produce inspection). If invertebrate infestation and excessive mould is found (as described in 4.4.2.2 of this plan), the fresh food shall not be off-loaded to the station.

4. Biosecurity on Arrival at Bird Island

As per the usual procedure stated in the BAS Biosecurity Handbook, bait stations will be placed at the jetty for the duration of all cargo offloading and a minimum of ten bait stations between the jetty and station buildings and all cargo storage areas which will be checked regularly.

4.1. Personnel Disembarkation

- Personnel disembarking at Bird Island or elsewhere in South Georgia or Antarctica must adequately clean their clothing, personal belongings and boots before they leave the ship and upon returning to the ship (see Checklist 1).
- 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 Bird Island. Pay particular attention to the treads in soles, the shoe tongue, lining or any Velcro fastenings.
- All personnel must use the boot washing facilities at the gangway (provided by the vessel) to disinfect their footwear before disembarkation.

4.2. Inspection of Cargo

External surfaces shall be checked to ensure they are free of soil, biological material and signs of gnawing, or other routes of rat ingress. Those opening any ISO containers upon arrival, should stay vigilant for signs of invertebrates or rodents and have insecticide spray to hand (Please note that any use of insecticides, other than for biosecurity, is not authorised without the appropriate permit). When opening cargo boxes, remain vigilant for imported soil or biological material.

4.3. Aggregate

- On arrival at Bird Island, aggregate should be contained within sealed packaging and stored in a demarked area (preferably hard standing/concrete or on a tarpaulin) until it is ready to be used.
- 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. Fresh food

Fresh produce can present a high risk of introductions, so biosecurity checks at various stages of the supply chain are important to stop non-native species getting though. Therefore, all imported fresh fruit and vegetables must be inspected and infested and/or contaminated items disposed of.

4.4.1. Fresh food packaging

- In compliance with International Standards for Phytosanitary Measures No. 15 Regulation of Wood Packaging Material in International Trade (2009) pallets and wooden boxes used in the shipping of fresh produce must be made from de-barked wood.
- In the event of interception of wood with bark the box and contents must be returned immediately to the importing vessel.
- All cartons, boxes and other containers must be examined, inside and out, for signs of quarantine pests and hitch-hikers such as wasps, caterpillars, earwigs, ants or other insects.
- In addition, packaging containing alcohol (particularly beer) should be inspected for split cans as beer-soaked packaging can harbour insects.

4.4.2. Fresh produce inspection

4.4.2.1. Inspection protocol upon arrival at Bird Island

- See Checklist 6
- Fresh produce should be checked aboard the ship before off-loading to Bird Island.

- Once off-loaded to the station, the fresh produce inspection is to occur within a designated biosecurity facility, or previously prepared room.
- The area used for inspection must be clean and free of clutter. Adequate lighting and space must be made available.
- Ensure any electric UV fly zappers are switched on.
- Ensure that any doors and windows are closed.
- Insecticide spray and bags, to contain any contaminated or infested produce, must be at hand.
- **EVERY INDIVIDUAL ITEM OF FRESH FOOD MUST BE INSPECTED.**
- Fruit and vegetables must be inspected externally for any signs of infestation by quarantine pests, such as holes of entry or exit of larvae or symptoms of disease. Any such signs must be followed up by cutting the fruit or vegetable to confirm the presence of the pest or disease concerned.
- The discovery of a single piece of fruit or vegetable that contains an insect or mite (specimens alive or dead) means that the chances of further non-native species being present is high. Therefore, it is essential that the high quality of inspection is maintained. It may be helpful to employ several people to undertake the inspection. To ensure high quality inspection and mitigate against the effects of fatigue, for each individual inspector it may be appropriate to limit the duration of each continuous inspection period to less than 30 minutes at a time.

4.4.2.2. Inspecting for quality

- Quality concerns the state of the produce and whether it is considered fit for the purpose for which it is intended (examples of poor quality would be excessively rotten onions or green potatoes).
- Where more than 20% of inspected fruit or vegetables in a bag or box is found to be affected at levels greater than 20% of the fruit/vegetable surface the entire bag or box must be returned to the importing vessel.

4.4.2.3. Inspection Report

- Every box or bag of produce must be inspected and records kept for auditing purposes (see the Fresh Produce Inspection Form in Appendix B). These sheets must record accurately:
  - the origin of the fresh fruit and vegetables (e.g. the Falkland Islands, South America or UK)
  - the quantities of each fresh fruit and vegetable type
  - the proportion of each fruit and vegetable type found to be contaminated or infested
- Should any invertebrates be found, close-up photographs should be taken and attached to the inspection report and also submitted as part of an Accident, Incident, Near-miss and Environment (AINME) report. Reports must also be made to the Government of South Georgia and South Sandwich Islands via the Bird Island Station Leader.

- The Inspection Reports should be kept on file and copies should be made available to the BAS Environment Office, at the end of the season for auditing purposes.

4.4.2.4. Disposal of contaminated or infested produce

- Produce must be inspected as soon as possible after receipt from the importing vessel and contaminated or infected produced disposed of as soon as possible.
- Infested or contaminated produce should be isolated in sealed containers from non-infested produce from the moment of identification and labelled as "infested" until disposal in accordance with the BAS Waste Management Handbook.
- Small amounts of infected or contaminated produce should be isolated in the freezer (low temperatures will kill invertebrates and stop further decomposition). If larger volumes of contaminated or infested material are discovered, isolation can take the form of sealing in black bin-liners (double bagged) prior to disposal at the earliest opportunity.
- Depending upon the volume, contaminated or infested items must be either:
  - rendered sterile at the station by autoclaving in a pressure cooker (small volumes)
  - returned to the vessel that supplied the food for disposal on board (large volumes)

4.4.3. Fresh food storage

- When fresh foods arrive on station, they must be stored in designated areas, preferably under cool conditions (fridge, cool storage area).
- Food storage areas must have operational electric UV insect killers.
- Sticky insect traps must be deployed in food storage areas. Traps must be checked monthly and replaced as necessary.
- Food storage areas must be cleaned regularly (weekly) to remove any organic material.
- See Checklist 6

4.4.4. Routine fresh food disposal

UNDER NO CIRCUMSTANCES SHALL FOOD OR FOOD SCRAPS BE FED TO LOCAL BIRDS OR SEALS

At Bird Island, the majority of uncooked food waste (peelings, scraps, etc.) must be pressure cooked before it is discharged to the sea. However, the following foods are the exception:

- Foods that decompose slowly (bones, fats, orange peels, tea bags, onion skins, etc.) should be frozen and stored in Griff bins for incineration on the ship or the UK. Do not dispose of in the sea.
- Poultry waste (meat, eggs and egg shells) can carry avian viruses which endanger Antarctic birds. To reduce this risk only de-boned poultry is sent to BAS stations. Waste poultry products must be boiled for 10 minutes to kill microorganisms and then must be frozen and stored along with other foods for later incineration on ship (where available) or the UK. Do not dispose of in the sea.

4.5. General Awareness

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

- biosecurity breaches
- evidence of non-South Georgia soil importation
- non-native species colonisation, including within buildings
- rats or rodents
- spiders or other invertebrates

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. If a rodent is seen then action must be taken immediately and the Station Leader informed in order for the BI Rodent Contingency Plan to be put into immediate action (see Appendix C).

5. Export and Exit from Bird Island

Transport of cargo, equipment, vehicles and personal belongings from Bird Island to other locations in South Georgia, Antarctica, FI or the UK must be inspected, cleaned and as free of soil as practically possible before leaving BI.

If materials are being transported to another South Georgia or Antarctic station then all the necessary checks and inspections must also be carried out again on the ship before offload can occur.

The relevant checklists must be used during export from station and prior to offloading to a new location.

6. Non-conformances

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

- A near miss / environmental incident report will be produced and this report will be provided to BAS 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.

- In addition to the BAS reporting system, Environmental Incidents must also be reported to the Government of South Georgia and South Sandwich Islands via the Bird Island Station Leader.

- In the event of a non-conformance, the BAS Environment Office will review any incidents, breaches or incursions and consult with the GSGSSI. The BAS Environment Office will then communicate any decisions and any necessary course of action or response. All communication will be fed back to the following personnel at BI for coordination on site: BAS BI Project Manager, BAS BI Station Leader and the BAM Construction Manager.

- Examples of biosecurity breaches may include, but are not limited to, the following:
  - Non-Bird Island soil or biological material (e.g. weeds) found on vehicles or other plant after unloading at Bird Island
  - 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 parking 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 South Georgia and 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 and Government of South Georgia legislation and could lead to serious consequences for the responsible individual and BAM.

BAM personnel will use the following checklist to reduce the risk of importing non-native species:

Personal Biosecurity Checklist	✓
All clothing is either new (i.e. straight out of the packet) or 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 NOT 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.

Name of Inspector		**Signature**	
Weekly Cargo Packing Area Biosecurity Checklist	**Yes/No**	**Date checked**	**Any subsequent action or other notes**
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 stores 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 1-2 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 or South Georgia. Checks prior to off-loading shall be simple visual checks as described for all general cargo. Where practically feasible, then a domestic insecticide spray should be used on any crevices or crannies to kill any harbouring invertebrates. 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 Bird Island.

The completed checklists will be stored on file and made available for auditing purposes either by BAM or by 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)		
Insect spray in crevices (as possible)		

Biosecurity Checklist 4. 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. The following checklist and the procedures listed in Section 2.7 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		
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		

Biosecurity Checklist 5. ISO Containers and Bunk-a-bin accommodation units

All ISO containers and bunk-a-bins 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 ISO container and bunk-a-bin consigned to Bird Island 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.

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 or Bunk-a-bin	**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 (pressure washed as much as possible prior to loading onto ship)		
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 container or Bunk-a-bin 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 container or Bunk-a-bin 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: Fresh produce

This checklist is for guidance only and does not have to be saved on file. However, it is compulsory for the Fresh Produce Inspection Form in Appendix B to be completed for each consignment of fresh food.

Name of Inspector		**Signature:**		**Notes (including details of any associated AINME reporting)**
Before arrival at Bird Island				
Imported fresh food does not include loose leafy vegetables or other prohibited foods*				
Imported poultry has been previously de-boned				
Root vegetables have been pre-washed and do not contain surface soil				
Before off-loading from the ship, fresh produce was checked for infestations, rot and soil.				
Alcohol (particularly beer) is inspected for any split cans as spilt beer in packaging can harbour insects.				
Fresh food inspection facilities at Bird Island				
The room is clean and clutter free with adequate light and space				
Available electric UV fly zappers are switched on				
Door and windows are closed before commencing checks				
Insecticide spray and bags are available in case of incursions				
The mandatory *Fresh Produce Inspection Form* is available for completion				
Freezer space and/or bags are available for isolation of infested or contaminated produce				
Fresh food storage areas at Bird Island				
Food is stored in designated food storage area				
Food storage areas are clean				
Electric UV fly zappers are switched on				
Sticky insect traps are deployed and functional				

*Broccoli, cauliflower, lettuce, kale, spinach, cabbages (white cabbage and red cabbage are acceptable providing the outer leaves are removed), leeks, globe artichokes, celery

Biosecurity Checklist 7 - All break bulk items (any item which is not containerised and not covered by a specific checklist)

All break bulk (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 B: Biosecurity forms

Form 1: Fresh Produce Inspection

Fresh produce can present a high risk of introductions, so all imported fresh fruit and vegetables must be inspected and infested and/or contaminated items disposed of. A record of checks must be kept for auditing purposes and submitted to the Station Leader who in turn will submit the forms to the Environment Officer at the GSGSSI.

Station	
Date	
Importing vessel	
Name of person undertaking inspection	

	Produce type	**Container type**	**Origin of produce**	**Quantity (weight or no. of items)**	**Proportion in unsatisfactory condition**	**Notes** E.g. any infestation, disposal method, AINME report number, etc.
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Appendix C: BI Rodent Contingency Plan

If a rodent (or signs of rodent activity) is observed at Bird Island then action must be taken immediately. Inform the BI Station Leader who will coordinate implementing the Rodent Contingency Plan

<table>
<tr>
<td>TIER 1

Normal state of monitoring: Bird Island rat free

General precautions:

● Good housekeeping

● Education. Ensure all staff are aware of both the natural and human-mediated routes by which rats could reach Bird Island

● Awareness. Remain vigilant of field signs (e.g. droppings, footprints in soft mud) at all time throughout the island

Specific precautions to prevent human-mediated introductions:

● BI station leader (SL) to liaise with all vessels landing at BI

● Maintain sign at BI jetty informing visitors of need for vigilance</td>
<td colspan="2">TIER 2

Confirmed rat sighting, or high probability of one or few individuals</td>
<td>TIER 3

Confirmed establishment of rats on Bird Island

● Environment Office to consult with GSGSSI on implementing a rat eradication programme

● Prepare press brief in consultation with BAS Press Office.</td>
</tr>
<tr>
<td></td>
<td>TIER 2a

Human-mediated introduction

Rat associated with cargo or evidence of rats around the station

● Immediately move suspect cargo containing rat into a sealed room, or return to ship

● Take any immediate action to exterminate rat, e.g. heavy object or poison bait

● Report the incident to the BAS Environmental Office (AINME report) and GSGSSI Environment Officer. Provide additional</td>
<td>TIER 2b

Natural/island-wide introduction

Evidence of rats away from the station, or on station when no current ship activity

● Record the time and location of any evidence of rats on the island

● Immediately report any sightings or evidence to the BI SL, BAS Environmental Office and GSGSSI Environment Officer.

● Inform the rest of the base personnel of the finding and</td>
<td></td>
</tr>
</table>

● Deploy and monitor bait stations at jetty and base buildings throughout summer period of shipping activity (bait with wax block) ● Deploy additional 10 bait stations across approx. 2.5 ha area around station during early-season cargo operations when seal activity is low (bait with wax block) ● Report any non-conformity using the AINME system Specific measures to monitor for natural introductions ● On-going island-wide monitoring programme. Maintain the regular check of rat bait boxes (baited with wax blocks). Any suspected gnawing should be reported and poison bait inserted to confirm presence of rats (Tier 2)	information or request further advice as appropriate ● Deploy bait stations, with poison bait, in suspected area outdoors. Hand broadcast a further poison over the immediate 2.5 ha area ● Initiate weekly monitoring of island–wide bait boxes (which should have wax blocks replaced with poison bait)	ask for enhanced vigilance for signs of rats ● Make an internal and external inspection of all huts and station buildings for signs of rats. Repeat weekly ● Deploy bait stations, baited with poison, around the island ● Check all bait boxes at least once every week for evidence of rats ● Continue regular checking and re-baiting boxes until no further evidence of rats has been observed	
Be prepared to move to Tier 2	Move to Tier 2b if evidence of rats is found away from the station, *OR* Stand down response when there is no further evidence of rats, and following consultation with BAS Environmental Office.	Be prepared to move to Tier 3, *OR* Stand down response when no further evidence of rats, and following consultation with BAS Environmental Office.	

14.5. Appendix 5 – Flora of Bird Island

Vascular plants

1.	*Acaena magellanica*
2.	*Acaena tenera*
3.	*Callitriche antarctica*
4.	*Colobanthus quitensis*
5.	*Colobanthus subulatus*
6.	*Deschampsia antarctica*
7.	*Hymenophyllum falklandicum*
8.	*Montia fontana*
9.	*Poa flabellata*
10.	*Ranunculus biternatus*
11.	*Rostkovia magellanica*

Lichens

1.	*Cetraria islandica*
2.	*Cladia aggregate*
3.	*Cladonia bellidiflora*
4.	*Cladonia carneola*
5.	*Cladonia furcate*
6.	*Cladonia gracilis*
7.	*Cladonia phyllophora*
8.	*Cladonia pyxidata*
9.	*Cladonia squamosal*
10.	*Cladonia rangiferina*
11.	*Cornicularia aculeata*
12.	*Cornicularia epiphorella*
13.	*Cystocoleus ebeneus*
14.	*Hypogymnia lugubris*
15.	*Leptogium menziesii*
16.	*Mastodia tesselata*
17.	*Massalongia carnosa*
18.	*Platismatia glauca*
19.	*Pseudocyphellaria endochtysa*
20.	*Pseudocyphellaria freycinetii*
21.	*Psoroma hypnorum*
22.	*Sphaerophorus globosus*
23.	*Sphaerophorus melanocarpus*
24.	*Stereocaulon alpinum*
25.	*Stereocaulon glabrum*
26.	*Usnea antarctica*
27.	*Usnea fasciata*
28.	*Xanthoria elegans*

Mosses

1.	Amblystegium sp.
2.	*Andreaea depressinveris*
3.	*Andreaea nitida*
4.	*Andreaea fuegiana*
5.	*Andreaea regularis*
6.	Barbula sp.
7.	*Bartramia patens*
8.	*Brachythecium austro-salebrosum*
9.	*Brachythecium glaciale*
10.	*Brachythecium majusculum*
11.	*Brachythecium subpilosum*
12.	*Breutelia integrifola*
13.	Bryum sp.
14.	*Calliergidium austro-stramineum*
15.	*Calliergon sarmentosum*
16.	*Campylium polygamum*
17.	*Catagonium politum*
18.	Ceratodon sp.
19.	*Chorisodontium aciphyllum*
20.	*Conostomum pentastichum*
21.	Dicranaceae spp.
22.	*Dicranoloma hariotii*
23.	*Dicranoloma subimponens*
24.	*Dicranoweisia cf. grimmiacea*
25.	*Distichium capillaceum*
26.	Ditrichum sp.
27.	*Drepanocladus cf. uncinatus*
28.	Funariaceae sp.
29.	*Holodontium inerme*
30.	Hygroamblystegium sp.
31.	Hypnum sp.
32.	Isopterygium sp.
33.	*Muelleriella crassifolia*
34.	*Philonotis acicularis*
35.	*Philonotis scabarifolia*
36.	*Plagiothecium falklandicum*
37.	*Pohlia cruda*
38.	*Pohlia inflexa*
39.	*Pohlia nutans*
40.	*Pohlia wahlenbergii var. glacialis*
41.	*Polytrichum alpestre*
42.	*Polytrichum alpinum*
43.	*Pottia austro-georgica*
44.	*Psilopilum trichodon*

45.	*Racomitrium austro-georgicum*
46.	*Racomitrium crispulum var. crispulum*
47.	*Racomitrium heterostichoides*
48.	*Racomitrium lanuginosum*
49.	*Racomitrium pachydictyon*
50.	*Racomitrium striatipilum*
51.	*Racomitrium willii*
52.	*Schistidium apocarpum*
53.	*Schistidium hyaline-cuspidatum*
54.	*Schistidium rivulare*
55.	*Schistidium syntrichiaceum*
56.	Sciaromium sp.
57.	*Skottsbergia paradoxa*
58.	*Tortula filaris*
59.	*Tortula geheebiaeopsis*
60.	*Tortula robusta var. robusta*

LIVERWORTS

1.	*Acrobollus ochrophyllus*
2.	*Adelanthus integerrimus*
3.	*Adelanthus lindbergianus*
4.	Allisonella sp.
5.	Anastrophyllum sp.
6.	Anthelia sp.
7.	*Barbilophozia hatcheri*
8.	*Blepharidophyllum densifolium*
9.	*Cephalozia badia*
10.	*Cephalozia skottsbergii*
11.	*Cephaloziella varians*
12.	*Clasmatscolea cookiana*
13.	*Clasmatscolea gayana*
14.	*Clasmatscolea vermicularis*
15.	Cryptoshilia sp.
16.	Diplophyyllum sp.
17.	*Evansianthus georgiensis*
18.	*Herzogobryum atrocapillum*
19.	*Herzogobryum teres*
20.	*Herzogobryum vermiculare*
21.	*Jamesoniella colorata*
22.	*Lepidozia cuspidate*
23.	*Lepidozia fuegiensis*
24.	*Leptoscyphus abditus*
25.	*Leptoscyphus expansus*
26.	*Lophozia propagulifera*

27.	*Marchantia beteroana*
28.	*Marchantia polymorpha*
29.	*Pachyglossa dissitifolia*
30.	*Pachyglossa fissa*
31.	Plagiochilia sp.
32.	*Riccardia georgiensis*
33.	*Riccardia granulate*
34.	*Riccardia papillosa*
35.	*Roivainenia jacquinotii*
36.	*Schistochilia aberrans*

Fungi

Discomycetes	
	Hymenoscyphus chloophilus
Basidiomycetes	
	Agrocybe semiorbicularis
	Coprinus martini
	Galerina moelleri
	Hypholoma elongatum
	Phaeogalera stagina
	Psilocybe inquiline
	Favolaschia antarctica
	Omphalina antarctica

14.6. Appendix 6 – Terrestrial and Freshwater invertebrates recorded from Bird Island

Arachnids

Spiders Araneae		
	Micryphantidae	
		Notiomaso australis

Mites Acarina (mites and ticks)

Mesostigmata		
	Parantennulidae	
		Davacarus gressitti
	Laelapidae	
		Ayersacarus tilbrooki
		Androlaelaps pachyptilae
		Stevacarus claggi
		Stevacarus evansi
	Eviphididae	
		Thinoseius hirschmanni
	Rhodacaridae	
		Gamasellus rykei
		Gamasellus racovitzai
		Gamasellus antarcticus
		Gamasellus gressitti
		Hydrogamasus watsoni
	Veigaiidae	
		Cyrthydrolaelaps watsoni
		Veigaia claggi
	Rhinonyssidae	
		Rhinonyssus rhinolethrun
		Rhinonyssus schelli

	Ichthyostomatogasteridea	
		Asternolaelaps sp.
Metastigmata		
	Ixodidae	
		Ixodes kerguelenensis
		Ixodes uriae
Prostigmata		
	Eupodidae	
		Eupodes minuties
		Stereotydeus reticulatus
		Stereotydeus longipes
	Rhagidiidae	
		Rhagidia gerlachei
		Rhagidia leechi
	Ereynetidea	
		Ereynetes macquarensis
	Bdellidea	
		Bdellodes georgianensis
		Bdellodes rhachia
		Pyemotidae
		Bakerdania rugosa
		Bakerdania equisetosa
Astigmata		
	Alloptinae	
		Alloptes obtusolobus
		Echinacaruis rutidus
		Brephosceles gressitti
		Brephosceles marginiventris
		Brephosceles diomedei
	Freyanidae	

		Diomedaranus gigas
	Avenzoariidae	
		Promegninia pedimana
		Zachvatkinia sp.
		Scutomegninia phalacrocoracis
	Saproglypliidae	
		Neocalvolia claggi
Cryptostigmata		
	Podacaridae	
		Halozetes marinus
		Halozetes littoralis
		Halozetes belgicae
		Alaskozetes antarcticus
		Antarcticola georgiae
		Podacarus auberti
	Ceratozetidae	
		Edwardzetes elongates
		Magellozetes antarcticus
		Porozetes polygonalis

Springtails Collembola

Onychiuridae	
	Tullbergie bisetosa
Neanuridea	
	Setanodosa steineni
	Friesea grisea
Isotomidae	
	Cryptopygus antarcticus
	Sorensia subflava
	Setocerura Georgiana
	Parisotoma octooculata
Smithurus	
	Smithurus jonesi

Beetles Coleoptera

Staphylinidae	
	Crymus antarcticus
	Halmaeusa atriceps
Perimylopidae	
	Perimylops antarcticus
	Hydromedion sparsutum

Flies Diptera

Trichoceridae	
	Trichocerca relegationis
Chironomidae	
	Parochlus steineni
Sciaridae	
	Lycoriella caesar
Helomyzidae	
	Paractora trichosterna
Sphaeroceridae	
	Antrops truncipennis

Fleas Siphonaptera

Pygiopsyllidae	
	Notiopsylla kergulelensis
	Notiopsylla enciari
	Parapsyllus magellensis

Chalcid wasps Hymenoptera

Mymaridae	
	Notomymar aptenosoma

Moths

Lepidoptera	
	Agrostis ipsilon

Fairy shrimp

Anostraca	
	Branchinecta gainii

14.7. Appendix 7 – Avifauna of Bird Island

Species	Arrival			Copulation			Laying			Hatching			Brooding			Fledging		
	First	Mean	Last	First	Mean	Last	First	Mean	Last	First	Mean	Last	First	Mean	Last	First	Mean	Last
Chinstrap Penguin								10/11			30/12						15/02	
Gentoo Penguin	Resident							26/10			31/11			01/01			02/03	
Macaroni Penguin	14/10	14/10	23/10					26/11			25/12			14/01			25/02	
Wandering Albatross	09/10	29/11		24/11	14/12	03/01	10/12	24/12	08/01	27/02	11/03	30/03	01/04	12/04	23/04	20/11	15/12	15/01
Grey-headed Albatross	15/09	26/09	07/10	23/09	28/09	05/10	12/10	19/10	31/10	24/12	30/12	05/01				10/05	19/05	17/06
Black-browed Albatross	25/09	13/10	26/10	11/10	15/10	19/10	19/10	27/10	11/11	26/12	03/01	11/01				15/04	28/04	09/05
Light-mantled Sooty Alb.		05/10						20/10		31/12	06/01	10/01	18/01	21/01	24/01	15/05	28/05	13/06
Southern Giant Petrel							30/10	10/11	24/11	30/12	10/01	23/01	24/01	31/01	09/02	26/04	10/05	22/05
Northern Giant Petrel							23/09	03/10	10/10	22/11	30/11	11/12	14/12	01/01	23/01	14/03	20/03	30/03
Cape Pigeon								30/11			15/01						05/03	
Dove Prion							06/12	16/12	25/12	22/.01	30/01	14/02				06/03	20/03	30/03
Fairy Prion	Resident							01/11		24/12	29/12	01/01				11/02	15/02	19/02
Blue Petrel							23/10		31/10	08/12	11/12	20/12				22/01	27/01	04/02
White-chinned Petrel	01/09	10/09	30/09				13/11	22/11	10/12	13/01	20/01	28/01				09/04	21/04	09/05
Wilson's Storm Petrel	12/11		01/12				15/12	06/01	27/01	14/02	20/02	08/03					25/03	
Black-bellied Storm Petrel								20/12			31/01						05/04	
Grey-backed Storm Petrel								15/12			20/01						20/03	
South Georgia Diving Petrel	27/10						07/12	12/12	31/12	04/01	28/01	30/01				04/03	14/03	02/04
Common Diving Petrel							20/10	24/10	07/11	14/12	18/12	31/12				04/01	09/02	14/02
Blue-eyed Shag	Resident						Late November			Late Dec- early Jan						Late February		
South Georgia Pintail	Resident			Sep - Mar			Nov	Dec	Mar	Nov	Jan	Mar				Jan	Feb/Mar	Apr
Brown Skua	07/09			07/11		09/12	04/11	26/11	20/12	18/12	26/12	20/01				10/02	19/02	03/03
Snowy Sheathbill																		
Kelp Gull	Resident																	
Antarctic Tern																		
South Georgia Pipit																		

14.8. Appendix 8 – Bird Island Monitoring Plan

Bird Island Monitoring Plan

Introduction

The monitoring activities at Bird Island detailed in this section are generally those that will require collection of information or on-going data to be used for decision making on site and in some cases in consultation with the Environment Office at BAS.

Other environmental management activities will be implemented which are not included in this monitoring plan but will be included elsewhere in the Project Execution Plan and EIA. Examples include: discharge to watercourses, condition of plant and equipment, fuel/chemical storage areas, waste segregation and storage, waste transportation, waste disposal, emergency spill kit checks, emergency arrangements (e.g. practice drills), non-native species monitoring, oil spill response, etc.

Monitoring activities:

a) Neutralisation of cement contaminated water
b) Wildlife displacement
c) Noise from site demolition and construction activities
d) White-chinned petrel presence in tussock adjacent to construction site

A. Neutralisation of cement contaminated water

1	**Monitoring type**:
	pH of cement contaminated water
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 must be neutralised using citric acid.
3	**Methodology used** (equipment, thresholds)
	A calibrated pH meter (HACH HQ40d Multi portable meter with a rugged pH gel probe) will be used to ensure waste water has a neutral pH (7.0) before release into the marine environment. The pH shall be measured in three separate batches taken from the volume of water that has been neutralised.
4	**Designated person undertaking the monitoring**
	BAM Construction Manager (Lloyd Wickens)
5	**Period over which monitoring will occur**
	Production of cement, and therefore generation of alkali waste water, will only occur for a limited number of tasks, including when grouting in foundations and securing vertical columns on concrete cladding. Therefore monitoring only needs to occur when waste water is generated.
6	**Frequency of monitoring**
	Prior to all disposal of cement contaminated waste water
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 citric acid added 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 at the end of the season. • Date and time • The volume of neutralised waste water released to the environment • The pH of the water
9	**Method of communicating results to the Environment Office**
	The monitoring data must be presented to the Environment Office in a report four months after the commencement of the construction work at Bird Island. 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 completed. BAM will need to determine how the release occurred and implement measures to prevent release reoccurring in the future.

10	**Relevant mitigation measure**
	• Use of cement or products containing cement (e.g. concrete, mortar, etc.) is to be kept to the minimum practicable. • Employ tool and equipment cleaning methods that require use of as little water as practicable. • Ensure all water contaminated with cement is contained safely prior to neutralisation and subsequent disposal.

B. Wildlife displacement

1	**Monitoring type:**
	Wildlife displacement (manual movement of seals away from areas of operation)
2	**Description of the monitoring activity**
	1. Monitoring of general displacement of wildlife during the set up of the camp and construction of site fence exclosures. 2. On-going monitoring of female fur seal displacement events. Such events may include the movement of female seals to allow cargo movement around the inlet area.
3	**Methodology used (equipment, thresholds)**
	It is recognised that the initial set up of the site will displace some wildlife. Fencing shall be used to create an exclosure to prevent wildlife access to the camp and construction site. 1. <u>Initial displacement linked to site set-up</u> To record the number of animals displaced, photographs must be taken looking North, South, East and West across the (i) camp and (ii) construction sites immediately before the commencement of cargo off-loading <u>and</u> immediately after the erection of the fence exclosures around the Beck House construction site and camp site. The photographs shall be provided to the BAS Environment Office within 1 week of the establishment of the camp in order to establish the number of animals displaced by the initial set up activities. 2. <u>On-going recording of the displaced female fur seals</u> Personnel and vehicle movement will be required outside the fenced exclosures. In general, adult female fur seals nursing pups are most vulnerable to disturbance and displacement. Wildlife disturbance shall be kept to a minimum, but under some circumstances, disturbance of nursing female fur seals may be unavoidable. Example may include: where it is not possible to transport cargo around a female fur seal safely. Once the fence exclosures are established the following thresholds shall apply: • No more than two adult female nursing fur seal displacement events per day, averaged over a week It is anticipated that seal pups will be curious and unperturbed by the increased activity on the station and therefore it is expected that a greater number of seal pups will require moving during the period of construction. For this reason movement of seal pups should not be recorded, but these should be moved out of harm's way as appropriate.
4	**Designated person undertaking the monitoring**
	BAM Construction Manager (Lloyd Wickens)

5	**Period over which monitoring will occur**
	1. Initial monitoring: Photographs will be taken before and after the establishment of the fenced exclosures in order to record the initial displacement. 2. Daily Monitoring: Recording of displaced female fur seals shall be undertaken during the period after the exclosures have been established, and for the remainder of project via a dedicated 'Displacement Log'.
6	**Frequency of monitoring**
	Female fur seal displacement events must be recorded following every occurrence. It is envisioned that number of reports may decline as the quantity of wildlife decreases with the approach of winter.
7	**Action(s) should any thresholds be exceeded**
	The construction work should be commencing at a time (mid Feb 2018) when the area should have declining numbers of seals. Should the thresholds be exceeded, then BAM shall contact the Environment Office within 24 h to discuss the feasibility of further mitigation measures.
8	**Recording and management of monitoring data**
	The Contractor shall maintain, on site, a 'Displacement Log' recording all fur seal displacement events. For each displacement event, record the following information: • Date and time • Approximate location (e.g. 10 m from the back door or Prince House) • Names of those staff involved • Reason for displacement (e.g. vehicle movements, failure of fences separating wildlife from demolition/construction activities) The 'Displacement Log' shall be copied to the BAS Environment Office every 4 weeks.
9	**Method of communicating results to the Environment Office**
	1. Photographs of the camp and construction locations shall be taken immediately before and after the establishment of the fence exclosures and should be provided to the Environment Office within 1 week. 2. The 'Displacement Log' will be sent to the BAS Environment Office every 4 weeks or within 24hrs of any displacement which exceeds the threshold. 3. Any wildlife injury or fatality associated with the building work should be reported immediately to the Environment Office and an AINME report submitted within 24 h. All work specifically related to the injury/fatality incident will cease immediately and will only re-commence upon communication and guidance from the BAS Environment Office. 4. Any persistent failure of fencing/exclosures or other methods to prevent access by wildlife to the building site should be reported using the AINME system
10	**Relevant mitigation measures**
	• Avoid construction and cargo movement activities during the hours of darkness • Where cargo is being moved between fenced off areas, a dedicated observer shall be appointed to ensure interactions with wildlife is avoided.

	• Fences shall at all times be kept well maintained and in good condition sufficient to keep wildlife excluded. • Fur seal pups may have little regard for vehicles and may put themselves at risk. People operating in the area shall remain vigilant for all wildlife, but fur seal pups in particular.

C. Noise from site demolition and construction activities

1	**Monitoring type:**
	Noise from site demolition and construction activities
2	**Description of the monitoring activity**
	While the general construction work is not considered likely to be overly noisy, some elements of the work such as use of a hydraulic breaker to remove existing foundations or impact driver may produce noise levels of up to 94dB(A) at 10 m. The period during which the work will be undertaken has been scheduled not to coincide with the peak seal breeding season. Therefore, the ambient noise level on the beach should decline as the season progresses. Fur seals and birdlife on the beach adjacent to Bird Island Research Station have the capacity to move away from noisy areas if they find them disturbing. When noisy equipment needs to be used, commencement of the activity will be done in such a way as to allow the animals to move away before continuous use of the equipment. Southall et al., 2007[11] proposes a Sound Pressure Level (SPL) of 109 dB re 20µPa (peak) for TTS in pinnipeds in air exposed to single pulses and there is little evidence at what level TTS may occur with continuous noise. H. Brumm 2013[12], Dooling et al., 2008[13] and Saunders et al. 1974[14] state that noise levels above approximately 93 dB(A) SPL cause a temporary elevation of a birds hearing threshold and can mask important communication signals. Therefore, a threshold level of 85 dB(A) is to be employed, which is 8dB below the level at which the onset of Temporary Threshold Shift occurs in avian species. The lower of the two thresholds has been chosen and applied as a measure both for monitoring birds and seals. This level will be measured on the raised walkway, level with the beach at high tide, which lies beyond the area covered by any acoustic screens. This represents the extent to which wildlife can retreat from the construction site in the direction of the sea, but still remain on land. This is a distance of approximately 35 m from the construction site. The point of measuring is also significantly closer than the nearest knowing nesting birds which nest approximately 100m away from the construction site. It is anticipated that the maximum noise level from construction plant will be 94 dB(A) SPL at 10m. Although this noise will attenuate in air by 3dB per metre, in order to ensure that noise levels at the monitoring location are below the 85dB(A) threshold, acoustic blankets will be available to screen noise at source. These will deployed by affixing them to well secured metal fence panels. The acoustic blankets provide up to

[11] http://sea-inc.net/assets/pdf/mmnoise_aquaticmammals.pdf
[12] H.Brumm (ed.), Animal Communication and Noise, Animal Signals and Communication 2, Springer-Verlag Berlin Heidelberg, 2013
[13] Dooling RJ, Dent ML, Lauer AM, Ryals BM (2008) Functional recovery following hair cell regeneration in birds. In: Salvi RJ, Popper AN, Fay RR (eds) Hair cell regeneration, repair and protection, vol 33. Springer Handbook of Auditory Research
[14] Saunders JC, Dooling RJ (1974) Noise-induced threshold shift in the parakeet (Melopsittacus undulatus). Proc Natl Acad Sci USA 71:1962–1965

	14dB attenuation. With these mitigation measures in place, it is not anticipated that the noise threshold will be reached.
3	**Methodology used (equipment, thresholds)**
	Use of a calibrated Norsonic 140 sound level meter with real-time 1/3 octave band filters. The equipment shall be operated by an appropriately trained individual and evidence of training supplied to the BAS Environment Office. Evidence of equipment calibration shall also be supplied to the BAS Environment Office.
4	**Designated person undertaking the monitoring**
	BAM Construction Manager (Lloyd Wickens)
5	**Period over which monitoring will occur**
	During entire build period
6	**Frequency of monitoring**
	Continuous. BAM must ensure all batteries are kept charged and data is downloaded at an interval recommended in the equipment operations manual.
7	**Action(s) should any thresholds be exceeded**
	Activities must cease and noise management reassessed. If thresholds are exceeded, noisy activities should not be undertaken simultaneously, but rather rescheduled to reduce the noise. Acoustic screens must be used to further reduce noise levels.
8	**Recording and management of monitoring data**
	1. Noise data must be backed up once downloaded from measuring equipment to ensure data is not lost 2. Noise thresholds must be programmed into the noise recorder, so that the designated person on site is alerted should thresholds be exceeded.
9	**Method of communicating results to the Environment Office**
	Should mitigation measures and practices be insufficient to keep noise levels below the threshold, contact must be made with the BAS Environment Office within 48 hours to discuss further options. A summary of the monitoring data must be presented to the BAS Environment Office in a report four months after the commencement of the construction work at Bird Island. The raw data files must also be made available and sent to the BAS Environment Office every 4 weeks.
10	**Relevant mitigation measures**
	• Keep noise generation to the minimum practicable • When undertaking activities known to generate high noise levels (e.g. breaking up of concrete foundations, use of impact driver, etc.), BAM shall ensure that these activities are not done simultaneously.

	• Deploy acoustic screens when undertaking activities known to generate high noise levels (e.g. Soundex acoustic curtains or Echo Barrier noise screen). • Before commencing use of particularly noisy equipment (e.g. hydraulic breaker or impact driver) consideration shall be given to the impact upon wildlife. Animals are likely to move away from the noise source at the commencement of the activity. To allow this to occur, the noise source should be operated for c. 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 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. If the equipment is not used for a period (e.g. 15 minutes) wildlife may start to approach the site again. In this case, repeat the earlier process (i.e. short burst of c. 30 second operation), to provide the wildlife an opportunity to move away again, before commencing more continuous operation.

D. White-chinned petrel presence in tussock adjacent to construction site

1	**Monitoring type:**
	White-chinned petrel presence in tussock adjacent to the construction site
2	**Description of the monitoring activity**
	Monitoring shall be undertaken to determine the presence of any burrows adjacent to the construction site and the number of white-chinned petrels (if any) residing in any located burrows. Construction work shall not commence until this monitoring work has taken place.
3	**Methodology used (equipment, thresholds)**
	The first arrival date for white-chinned petrels is during the month of September. A walkover visual survey will be undertaken in the area once a month in July, August and September before any potential birds begin to burrow. Should any burrows be found during this time then they will be closed/blocked with rocks from the nearby beach to prevent any birds from using any pre-existing burrows adjacent to the construction site. In December (15-25), a survey will be conducted and should any burrows be found then the number of white-chinned petrels shall be determined using a technique whereby a recording of a white-chinned petrel call is played at the entrance to a burrow. Any response from inside the burrow indicates the presence of a white-chinned petrel. Call play back techniques only work for a limited period during which the birds will respond, so it will not be possible to use this technique later in the season once work has commenced on site. However, this monitoring will indicate if any birds are present and therefore will be at risk from the construction activities.
4	**Designated person undertaking the monitoring**
	BAS: Bird Island bird biologist
5	**Period over which monitoring will occur**
	Monthly survey July to September 2017 and call play back techniques 15-25 December 2017
6	**Frequency of monitoring**
	3 surveys (July – Sept) and single monitoring event in December
7	**Action(s) should any thresholds be exceeded**
	N/A
8	**Recording and management of monitoring data**
	Number of located and blocked burrows and number of call responses from burrows will be recorded
9	**Method of communicating results to the Environment Office**
	The monitoring data shall be presented to the Environment Office in a brief report within a week of the data being collected.

10	**Relevant mitigation measures**
	• Any burrows located before the breeding period will be closed to prevent birds from nesting adjacent to the construction site and being exposed to any potential disturbance. • Do not trample the tussock adjacent to the construction site. • Do not drive machinery over the tussock adjacent to the construction site or anywhere else on the island • Do not excavate the tussock adjacent to the construction site unless in accordance with a permit from the Government of South Georgia and South Shetland Islands.