

Initial Environmental Evaluation
for
Proposed Installation of a Boardwalk
on Prion Island, South Georgia



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NON-TECHNICAL SUMMARY

Prion Island is a rat free island with a unique assemblage of wildlife including vulnerable bird species. It has been designated as a Specially Protected Area (SPA) by the Government of South Georgia and the South Sandwich Islands (GSGSSI).

In 2005/06 season a total of 2547 people visited Prion Island. Visitors risk disturbing breeding birds and fur seals, and trampling areas of fragile vegetation and bird burrows. Also, it is difficult to gain access to the island during the fur seal breeding season due to the numbers of seals on the landing beach. GSGSSI propose a boardwalk on Prion to restrict visitors to a set path, reduce erosion and vegetation damage and provide a route across a beach that can be densely packed with aggressive fur seals.

The proposed boardwalk is a sectionalised, prefabricated design made from kiln-dried Coigue timber from Chile. It includes a landing step onto a jetty and a high walkway over the fur seal breeding area on the beach. Boardwalk sections lead from the back of the beach up the side of a gully to gain access to two separate boarded viewing areas on top of the island. The boardwalk will be covered with chicken wire to prevent slipping. The boardwalk has been designed so that damaged sections can be easily replaced and sections of, or the whole of the structure, can be removed from the island if required.

The alternatives to the proposed construction of a boardwalk on Prion Island include doing nothing, improvements in the path and alternative management approaches (including not allowing visitors to the island). Improvements to the access path combined with management controls such as restrictions to visitor access during the fur seal breeding season, a cap on visitor numbers and the use of observers offer viable environmental management alternatives to the construction of a boardwalk. Most of the alternatives suggested involve placing restrictions on visitor access to Prion Island.

The environmental impacts of the proposed boardwalk have been assessed. Due to the relatively small scale of the operation, many of the impacts, such as atmospheric emissions, light pollution and waste disposal are assessed as being low. The most significant temporary impacts of the proposed boardwalk construction are assessed as physical disturbance to sensitive wildlife and damage to vegetation and erosion during the construction of the boardwalk. The vegetation surrounding the boardwalk will largely recover and vegetation damage due to visitors will be reduced by the presence of the boardwalk. Possible injuries to seals may occur due to the boardwalk, but these would be addressed should they occur.

The most significant long-term impacts of the construction of the boardwalk will be the loss of wilderness and aesthetic value and the visual impact. Also the possible introduction of alien species due to the large amount of material which will be brought to the island is a serious risk. The boardwalk may result in increased fur seal access to the plateau area and consequent increased disturbance of breeding birds. Bird strikes may also occur, but this is considered unlikely if handrails are not used.

The current design is a significant structure and removal would be costly and difficult. Also, in practice, once infrastructure has been introduced it would be difficult to remove it without leaving traces of its previous presence. However, if the construction and operation were well executed and then removal was effected, then the overall impact could be considered as no more than minor or transitory.



1. INTRODUCTION

1.1 Purpose

Prion Island has been identified as having exceptional conservation value. It is a rat free island with high biodiversity and a unique assemblage of wildlife including vulnerable bird species. It has been designated as a Specially Protected Area (SPA) by the Government of South Georgia and the South Sandwich Islands (GSGSSI) in their recent review of environmental management (Pasteur and Walton, 2006).

Visitors to Prion Island risk disturbing breeding wandering albatross, giant petrels and fur seals, and trampling areas of fragile vegetation and bird burrows. Also, it is difficult to gain access to the island during the fur seal breeding season due to the numbers of seals on the landing beach.

In 2005/06 season a total of 2066 passengers and 481 staff and crew visited Prion Island (total of 2547 people on 34 cruise ship visits and 26 yacht visits). This represents an almost threefold increase in visitor numbers since the 2000/01 season (see section 4.7). The GSGSSI wishes to raise awareness of global conservation issues by continuing to allow visitor access to Prion Island but recognises that further measures are necessary to manage visitor movements on the island.

The GSGSSI have considered two main alternatives for access routes on Prion Island – a hardened path and a boardwalk. They have also considered different management approaches such as restricting numbers of visitors. These alternatives are discussed in section 3.

The proposed boardwalk design in this IEE includes a landing step onto a jetty and walkway over the fur seal breeding area on the beach with boardwalk sections up the side of a gully to gain access to boarded viewing areas on top of the island.

A prefabricated design is proposed to minimise the amount of time the construction team will need to spend on Prion Island. The boardwalk will be sectionalised so that damaged sections can be easily replaced and sections of, or the whole of the boardwalk structure, can be removed from the island at any time if required.

The primary purpose of constructing a boardwalk is to mitigate the effects of allowing visitor access to this sensitive site by reducing erosion and damage to vegetation and reducing any potential disturbance to breeding seals and birds caused by human visitors.

1.2 Legislation

1.2.1 South Georgia legislation

There is currently no legal requirement for environmental impact assessments to be undertaken before projects are approved on South Georgia. However, the Government is committed under the Environment Charter (see <http://www.sgisland.org/pages/gov/gov4.htm>), to ensure that environmental impact assessments, including consultation with stakeholders, are undertaken where appropriate.

The basis of GSGSSI policy on EIA are the procedures developed for the *Environmental Protocol to the Antarctic Treaty, Annex I*. The South Georgia: Plan for Progress (Pasteur and Walton, 2006) provides further details of South Georgia environmental management policies.

The *Falkland Islands Dependencies Conservation Ordinance (1975)* designates Prion Island an Area of Special Tourist Interest (ASTI), as part of the Bay of Isles ASTI. In 2000, the Environmental Management Plan for South Georgia (McIntosh and Walton) proposed Prion



Island as an Environmentally Sensitive Area. This designation has been reviewed in the South Georgia Plan for Progress (Pasteur and Walton, 2006) and Prion Island has been designated a Specially Protected Area. This will be incorporated into modern conservation legislation, which is in preparation.

1.2.2 International treaties

Britain is signatory to the multi-lateral Agreement on the Conservation of Albatrosses and Petrels (ACAP) and this has been extended to GSGSSI. This agreement seeks to conserve albatrosses and petrels by coordinating international activity to mitigate known threats to their populations. Five ACAP species breed at Prion Island: wandering albatross, light-mantled sooty albatross, southern giant petrel, northern giant petrel and white-chinned petrel.

A Forum was held in the Falkland Islands in March 2006 entitled ‘Albatross and Petrels in the South Atlantic: Priorities and Conservation’. Delegates discussed the identification of ACAP sites and Prion Island is likely to be nominated a key ACAP site at South Georgia (Sally Poncet, personal communication).

1.3 Background and consultation with stakeholders

The issue of visitor pressure on both Albatross and Prion Island has been under discussion for several years. The management of the islands was considered in the South Georgia Land and Visitor Management Report (Poncet, 2003a). This included a discussion of options for access routes. GSGSSI has also engaged with the International Association of Antarctica Tour Operators (IAATO) on this subject and with stakeholders worldwide through the public review of *South Georgia: Plan for Progress*.

In May 2005, GSGSSI announced that plans for a boardwalk were being considered, subject to an environmental impact assessment. Concurrently, during the review of the South Georgia Environmental Management Plan, stakeholders were invited to give their opinion on whether boardwalks should be used at sites with high visitor numbers (not specifically at Prion Island). The responses to this question (see Appendix 1) showed a range of opinions on this subject and highlighted many of the complexities of the issue.

Since May 2005, organisations (including IAATO and the South Georgia Association) and individuals have submitted letters to the Government raising concerns regarding the proposed boardwalk. These letters have been considered in the preparation of this IEE.

1.4 Visitor management at Prion Island

All visitors are required to apply to the GSGSSI for a permit to visit South Georgia. Prion Island has been designated as a Specially Protected Area (SPA) by the GSGSSI in their recent review of environmental management (Pasteur and Walton, 2006) and a site specific management plan will therefore be prepared for this site. An additional permit is required for visits to SPAs.

Visitors must abide by the guidelines of the annually updated online ‘Information for visitors to South Georgia’, which includes visitor conservation guidelines and an additional Code of Conduct for visiting Prion Island (see www.sgisland.org and Appendix 3). The Code of Conduct includes the following provisions:

- No more than one vessel visit per day
- Maximum of 65 people ashore at any one time
- Maximum visit duration of 4 hours



- Landings only on designated beaches; flagged route to be prepared by Expedition Leader from beach to main viewing stations prior to passenger landings
- Visitors in groups of maximum 11 passengers per experienced guide; only one group at wanderer nest or display site at any one time

Visitor management at Prion Island is based on self regulation of visitors by experienced and qualified expedition leaders and staff. Post visit reports are completed and returned to the Government Officer at King Edward Point after each visit.

1.4.1 Description of current route taken by visitors

After landing by small inflatable boat the normal access route is across a pebble beach and then up a stream gully (see map). During the fur seal breeding season from mid-November to early January the beach crossing can be extremely hazardous due to the number of Antarctic fur seals (*Arctocephalus gazelle*). Males can be aggressive as they are holding territories and females may exhibit aggression as their natural maternal instincts are to protect their pups.

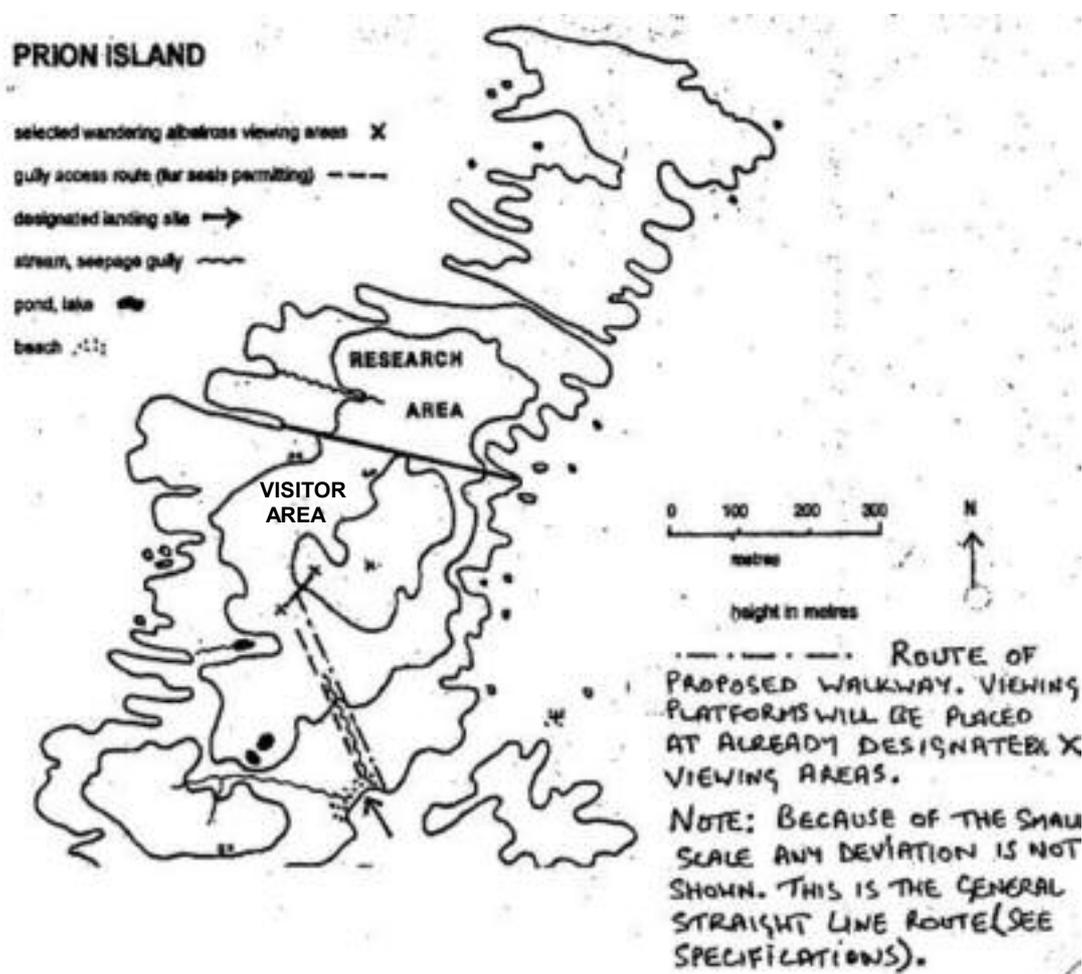


Figure 1. Map of Prion Island showing route of proposed walkway and location of viewing platforms

The lower stream gully is rocky and relatively easy going, though it can be wet and slippery. It has a rock base and there is no soil, so there is no issue with path damage. However, during the fur seal breeding season this area may be crowded with fur seals. Further up the gully, the rock is covered with mud and is quite wet and difficult to walk through. Towards the top there are lengthy muddy sections in the gully, which are knee deep in places.



From the top of the gully, visitors walk along a number of paths to the viewing areas shown on the map. Evidence of trampling of bird burrows has been reported and also general erosion.

1.5 Boardwalk research

Boardwalk facilities on Baffin Island, Canada, Bruny Island and Mt Wellington, southern Tasmania, sub-Antarctic Macquarie Island and Campbell Island, New Zealand were assessed during the planning of the Prion Island boardwalk. Measurements, notes of construction details and photographs of the general layouts were taken. At two sites boardwalks had been constructed above and through (Bruny Island) and at the side of (Macquarie Island) burrowing shearwater colonies. Both facilities have handrails throughout.

Common to all sites was the use of treated pine timber; some of this was becoming degraded, particularly in salty environments.

Boardwalks were built at the sub-Antarctic islands of Campbell (2km long) and Auckland (500m long) Islands to allow visitor access without damaging vegetation and soil. The Campbell Island boardwalk also provides access to royal albatross nesting sites. Observers or wardens also accompany visitors on all landings, and there is an annual visitor limit of 600 visitors. At Macquarie Island, 290m of boardwalk, steps and viewing platforms provide specifically for tourist ship visits. A 75m boardwalk and viewing platform was removed in 2002 as it was impinging on the growth of the king penguin colony at Sandy Bay (Parks and Wildlife Service, 2003). Wardens are responsible for annual maintenance of the boardwalks.

Boardwalks at the British Antarctic Survey base on Bird Island facilitate landings and access to the station. Fur seals are present in high density around the station area and occupy the boardwalks and the adjacent beach. The seals are used to people and generally move off the boardwalk when people approach.

Boardwalks have the advantage that they can be constructed across a habitat without interfering with natural drainage patterns and with little ground disturbance compared to other methods of path construction. However, they are generally expensive to construct, require maintenance, and can look obtrusive in open landscapes. Boardwalks are usually constructed either to provide a safe path across otherwise impassable terrain, or to protect fragile habitat (Agate, 2001).

1.6 Project management structure

The construction of the proposed Prion Island boardwalk will be carried out by a team of four people led by Mr Terrence ‘Scobie’ Pye during the latter part of the 2006/07 season.

Pye has 40 years experience in the building trade, serving 5 years apprenticeship as a carpenter. From 1971–78 he worked as a builder with the British Antarctic Survey spending 4 winters and 7 summers based at King Edward Point, South Georgia. During the period (2000–06) he visited Prion Island on 12 occasions in the capacity of a staff member aboard cruise ships, also conducting some research for the proposed boardwalk. He also has experience of working on other sub-Antarctic islands.



2. DESCRIPTION OF THE PROPOSED ACTIVITY

2.1 Location

South Georgia is a sub-Antarctic island situated around 1,400km east of the Falkland Islands.



Figure 2. Map to show location of South Georgia

Prion Island is located in the Bay of Isles at the north eastern coast of South Georgia.

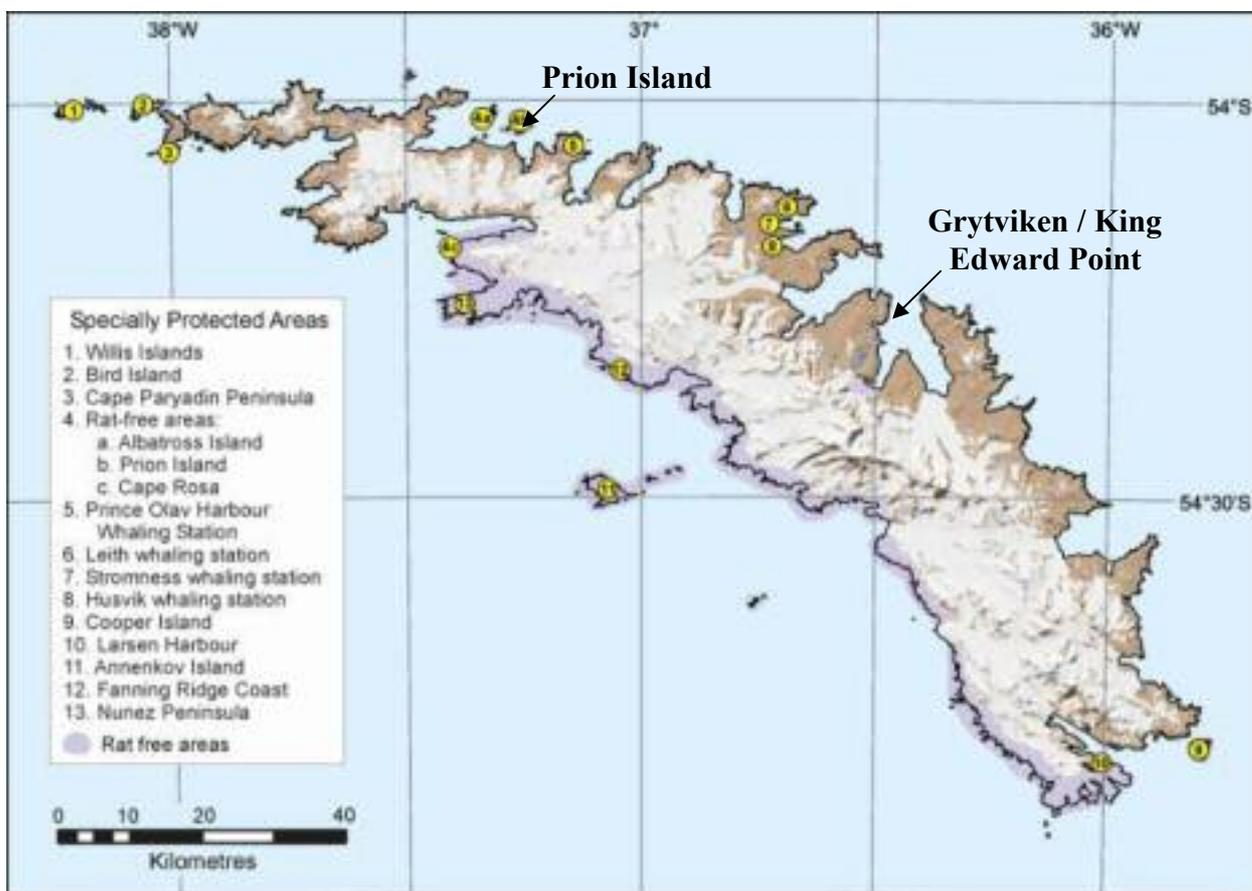


Figure 3. Map to show location of Prion Island



2.2 Principle characteristics of the proposed activity

2.2.1 Aims and Objectives

The primary aim of the design is to protect the environment of Prion Island, whilst allowing visitor access, both in the short and long term future. More specific objectives include:

- Provide safe and easy access to wildlife viewing areas.
- Confine visitors to set walkways, without deviation from these.
- Allow damaged vegetation to recover and stop bird burrows being trampled.
- Provide clearly defined viewing distances from wildlife.

Once the boardwalk has been built, visitors will be able to access Prion Island without disturbing breeding fur seals on the beach. They will not actually touch the ground on the island and therefore will not cause erosion, damage to vegetation or trample on bird burrows. The path and platforms will allow safe access, whilst maintaining the minimum viewing distances to avoid disturbance of the vulnerable breeding albatross. The boardwalk will enable clear and effective management of visitors to minimise the environmental impacts of their visits.

2.2.2 Prefabrication

The design complies with standard, safe building practices and is similar to visitor boardwalk facilities elsewhere. However, one key design difference is the sectionalised structures (in 3m sections), allowing easier and quicker on-site assembly and greater flexibility in determining final positioning and configuration. This has allowed for the sections to be prefabricated off site to reduce time spent on Prion Island.

All sections are bolt fixed together and can be easily repositioned if a wandering albatross changes nest position and the walkway is deemed too close, replaced for maintenance purposes or removed altogether. Viewing platforms are assembled using a series of boardwalk sections locked into place.

In total there are 345m (115 sections, 3m x 0.9m) of boardwalk, with 10 passing places, 2 viewing platforms (4.5m x 3m), and a small jetty (6.3m x 3.6m) for small boat landings.

2.2.3 Timber for construction

After considering various timber types, including treated pine, a species of South American beech, Coigue, (*Nothofagus dombeyi*), was chosen. This timber is available from Chile and is recommended for wet areas because of its great durability, strength and hardwearing characteristics, and is virtually knot free. It has been kiln dried. As a natural untreated timber there is no risk of chemical toxins leaching out, but there is an increased risk of introduction of alien species (see section 5.3). Coigue quickly fades to a grey colour and requires very little long term maintenance compared to softwoods, including treated pine.

2.2.4 Specifications

- All support posts to pass through peaty substrate down to solid ground.
- Handrails on steps and other structures where necessary for visitor safety, but positioned where these would not cause obstruction to bird flight paths.
- Boardwalks to be erected away from the stream gully, leaving this as a natural feature, but avoiding any burrowing bird colonies.
- Each platform will have 5 x boardwalk sections locked in place to form viewing deck.
- All structures to be bolt fixed together.



- All ironmongery to be hot-dipped galvanised finished.
- Heavy duty galvanised chicken wire mesh to be attached to all walkways and viewing platforms for non-slip application.
- Passing places (10) to be provided along walkways.
- Gates to be provided at the shore end of the raised beach section and where the beach section leads to the jetty.
- Beach section to be elevated to avoid fur seals.
- All other boardwalks, viewing platforms and passing places to be installed as close as possible to ground level.

2.3 Boardwalk construction

The boardwalk has been designed so that no one actually stands on the island, but only on the jetty or boardwalk area.

Research conducted on sub-Antarctic Marion Island assessed the reactions of breeding wandering albatross to approaches by a human on foot. At 5m from the nest, twice as many birds stood and/or vocalised as at 15m (de Villiers, 2005). This highlights the need to maintain strict viewing distances. The Prion Island Code of Conduct states a minimum viewing distance from wandering albatross and giant petrels of 10m for birds on nests and 25m from displaying wandering albatross. IAATO guidelines state a minimum of 5-10m from nesting seabirds, 10m from nesting wandering albatross, 25m from displaying wandering albatross and 25-50m from nesting giant petrels. The boardwalk will be constructed taking these viewing distances into account.

2.3.1 Jetty

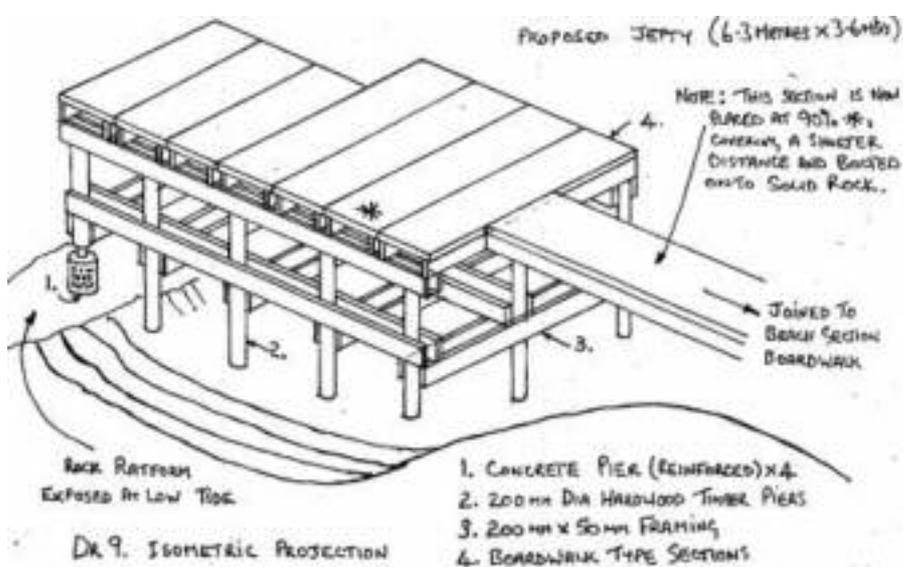
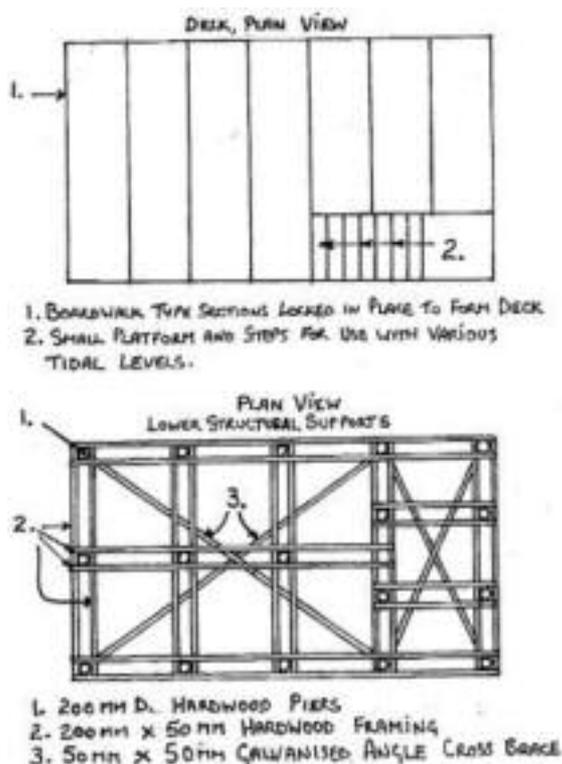


Figure 4. Plan of proposed jetty

The proposed jetty is 6.3m long, with a maximum width at the shore end of 3.6m (see Figure 4) and approximate height of 1.8–2.4m from the sea floor. The tidal range is around 1m. Reinforced concrete will be set onto a rock platform (exposed at low tide) to support four of the 200mm diameter hardwood piers. The remaining 13 piers will be bolted onto rock using rock drills. Where the piers cannot be bolted in they will be dug in to post holes and repacked. These piers will be strengthened with 200mm x 50mm timber framework.



A small platform with steps at the seaward end of the jetty will allow passengers to disembark (and re-embark) from small boats onto the jetty at lower tidal levels.

The proposed jetty will provide sufficient area for 11 passengers and their guide to congregate and arrange their belongings etc., before proceeding across the beach section of the boardwalk. There will be no handrails around the jetty.

A hinged gate, secured with barrel bolts, will lead from the jetty to the beach section.

Figure 5. Plan view of jetty (above) and supports (below)

2.3.2 Beach section of boardwalk

The beach section is approximately 15m long at an elevation of around 1.2-1.5m above beach level in order to allow fur seals to pass underneath. As the beach section will be elevated, handrails are necessary for visitor safety. The height of the handrails will be 0.9m. Standard practice is to have vertical supports for handrails placed at set centres, which vary usually from 1.2 –1.5m between centres. The total height of the structure will therefore be around 2.1–2.4m. This is similar to fur seal viewing platforms used for scientific study on Bird Island.

The beach section of boardwalk will be supported by 100mm x 100mm posts attached by galvanised post support angle brackets to sleepers buried in the beach stone (see Figure 6).

There will be a hinged gate at either end of the raised beach section to prevent fur seals from accessing it. The gates will be hinged with tee hinges and secured with barrel bolts, all ironmongery to be galvanised.

The beach section will lead from the jetty to the tussac immediately to the right of the gully that is currently used for access.

The beach and jetty parts of the boardwalk could be removed in the future as it is relatively accessible, not built near to vegetation and not in the immediate locality of nesting birds.

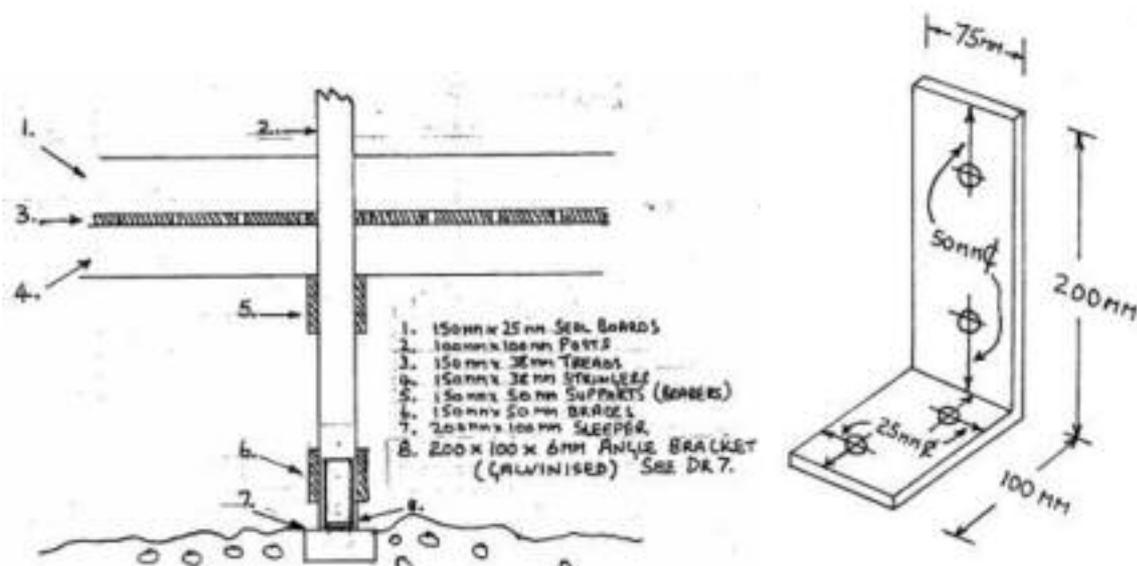


Figure 6. Beach section of boardwalk and beach section post brackets (right)

2.3.3 Gully section

From the tussac immediately to the right of the gully, the boardwalk will continue upwards, staying away from the concentration of prion burrows further to the right. The boardwalk will be at the height of the tussac or below it. At no time will the boardwalk be within 50m of any nesting birds on the route up the island. Areas most commonly used by albatross for mating dances will also be avoided. Passing places will be included to allow groups coming down to pass those going up, without anyone having to step off the boardwalk.

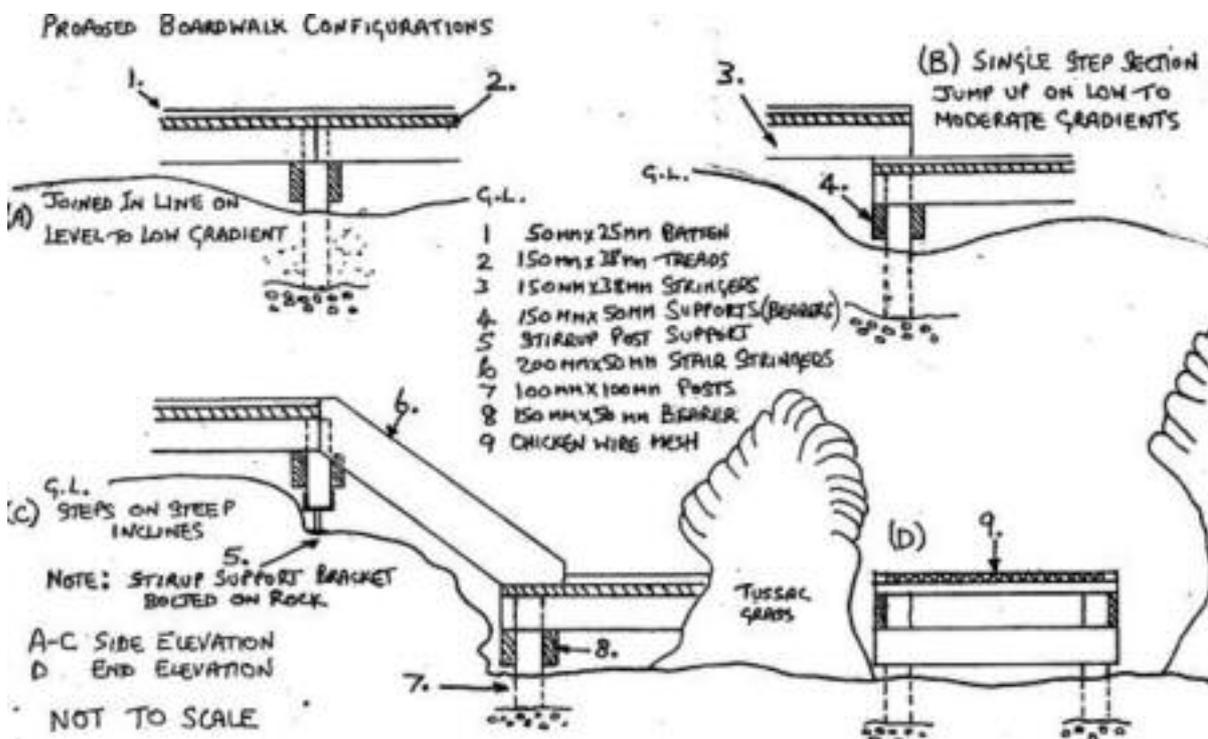


Figure 7. Proposed boardwalk configurations



A series of steps will be used where the ground becomes steeper. Handrails have been proposed for these sections for safety reasons and, if fitted these would be no higher than normal tussac level. The natural topography of Prion Island lends itself to placing steps and handrails in positions behind and below the height of tussac and rock cover, so that these fixtures will not be a threat to bird flight paths.

The boardwalk will be fixed to the ground using 100mm x 100mm posts dug in to the level of the solid substrate. This is important for the lawns or soft flat areas where it is a mat of vegetation floating on mostly water. In some areas it will be possible to use stirrup support brackets bolted directly onto rock. Further details can be seen in Figure 7 and Figure 8.

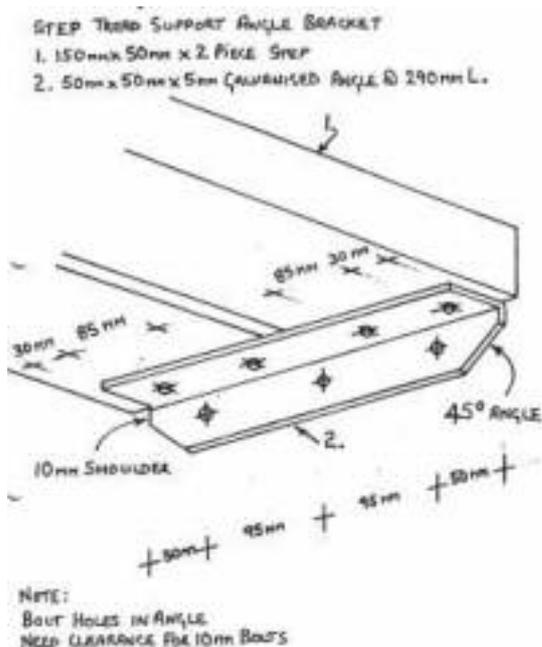


Figure 8. Step tread support angle bracket

2.3.4 Route from top of gully area to viewing platform

This is likely to be a fairly gradual section of boardwalk. Boardwalk and passing places will be installed as close as possible to ground level and therefore will not require handrails. On the plateau path will fork into two paths, leading to two separate viewing platforms

2.3.5 Viewing platform

Two viewing platforms, 4.5m x 3m in area, will be constructed close to ground level and without handrails. These will be sited so that wandering albatross nesting and display sites are visible, but at a distance of at least 10m from nesting seabirds and 25m from displaying wandering albatross and giant petrels to minimise bird disturbance by visitors.

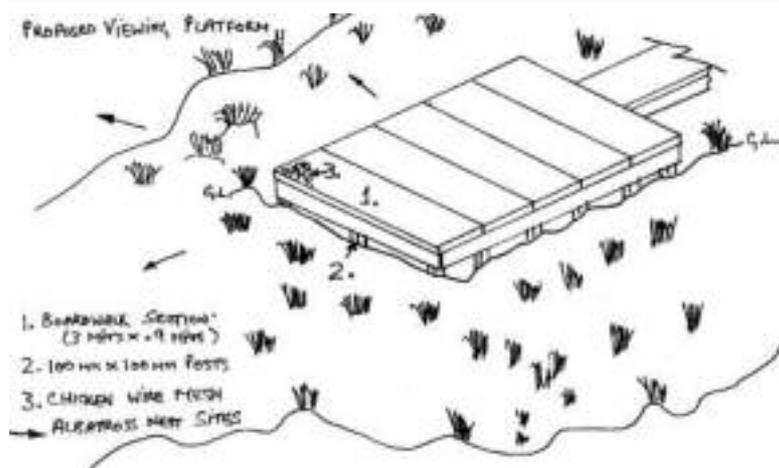


Figure 9. Proposed viewing platform

2.4 Area of disturbance

2.4.1 Camp area

It is proposed that the four-person work team establish a small, compact camp on Prion Island utilising three small ‘Weatherhaven’ shelters. The camp will be situated on an area of flat raised beach terrace clear of vegetation and generally free of wildlife, well back and above a main landing beach where fur seals congregate.

No water or other resources will be taken from the island. Fresh water will be shipped in with food supplies. A quantity of bottled water will also be used.

2.4.2 Area of operations

The work will be restricted to southern half of the island. It will include the landing beach area and nearby camp and the areas where the boardwalk will be constructed: a pathway to the right of the gully leading to the viewing areas at the top of the island (see section 1.4.1).

The construction of the boardwalk will cause disturbance to an area of up approximately 1500m². This includes around 20m x 30m for the camp and storage area and the 345m x 0.9m boardwalk with approximately 1m either side for fixing works. There will be relatively more disturbance in the beach area, where there is no sensitive vegetation and less sensitive wildlife.

2.4.3 Duration and intensity

The construction phase on Prion Island is planned for a two month period during the latter part of the summer season, from February to March. Dates are dependent on shipping schedules and some flexibility will be built in to account for adverse weather conditions.

2.4.4 Fuel storage and refuelling

Fuel for cooking will be Liquefied Petroleum Gas (LPG) used in conjunction with a caravan type stove. It will be transported in cylinders.

A small Honda four stroke ‘silent’ generator will be used, fuelled with unleaded petrol. The generator will be mainly used in the camp, lower boardwalk and beach areas. There will be a spare generator for back up in case of failure.

Two 205l drums of petrol will be taken to Prion Island. Drums will be on stands within a small lined fuel bund to contain any spills. A small pump will be used to transfer spillage back into a spare empty container, taken ashore for that purpose.



2.5 Transport

Some materials are already at KEP. These and the rest of the equipment and personnel will be transported on the Fishery Patrol Vessel MV Pharos to Prion Island. From KEP to Prion Island, transport will be via a Fishery Patrol Vessel. A sea truck or small landing craft will be used to take the cargo ashore, requiring approximately twenty runs. It is likely that around two days will be required to put all cargo and stores ashore and set up the construction camp. All materials will be cleaned and checks made for rats before loading, after loading and before unloading.

No land vehicles will be used for this project.

2.6 Site waste collection and disposal

All waste, except human waste, will be sorted, separated, compacted and stored in suitable container bins, then removed from the island. Wet garbage will be triple bagged and tins crushed. Care will be taken to prevent littering or waste being blown away.

Regular removal of waste will be arranged via passing ships. Waste removed will be documented and will be in line with South Georgia policy.

2.6.1 Sewage and domestic waste water

A lime pit toilet, similar to those used in some areas of National Parks in Tasmania and in Canada, will be used. The prefabricated timber cubicle will have a bolted door and a pit directly beneath the cubicle. The pit will be kept covered so that insects cannot fall into it. At the end of the construction period, the cubicle will be dismantled and the pit will be filled in so that there is at least 50cm of compacted soil covering the waste. There should be at least 1m between the bottom of the pit and the ground water level and it will be located so that water drains away from it. Lime, a strong disinfectant, will be used to control odours.

Domestic waste water (grey water) will result from washing, food preparation and ablution activities. Grey water will be discharged to the ground away from any freshwater sources, or to the sea. It will not be put in the pit toilet.

2.7 Visitors to Prion Island during boardwalk construction

It is envisaged that visits to Prion Island will continue during the boardwalk construction. However, all building works will be out of bounds and taped off during all ship visits. Access for visitors would be along the existing route.

2.8 Annual maintenance activities

Inspection will be required each season. Maintenance work would be undertaken during the latter part of the summer.

In future seasons and with the continuing decline in the wandering albatross population, there may not be nesting albatross close enough to the viewing platforms for visitors to see. Sections of the boardwalk may then need to be moved.

The boardwalk will not last forever and at some stage will need to be replaced or removed. This should be taken into account at the planning stage and should be part of the site-specific management plan for this site.



3. ALTERNATIVES TO PROPOSED ACTIVITY

The primary purpose of constructing a boardwalk on Prion Island is to reduce any potential disturbance to breeding birds and seals and reduce erosion and damage to vegetation caused by human visitors. The purpose is therefore to reduce some of the environmental impacts caused by visitors to the island.

A number of alternatives to the construction of a boardwalk have been considered including no specific action, alternative types of access route and alternative management approaches.

The following alternative types of access route to the proposed boardwalk construction are considered:

1. Designated route based on existing path with marker flags to clearly define the path and viewing areas
2. Designated route based on existing path using local materials to construct a hardened path where necessary
3. Alternative routes

The following alternative management approaches are considered:

1. Close Prion Island to visitors
2. Restrict visitor numbers
3. Do not allow visitors during fur seal breeding season
4. Find alternative, less sensitive mainland site for visiting nesting wandering albatross
5. Find alternative sites to reduce the impacts of visitors at any one site
6. Use Government observers to accompany all visits to the island

3.1 Do not proceed and continue to allow increasing level of visitor access

Prion Island is a sensitive visitor site and has been identified by the Government as a Specially Protected Area to provide a high level of protection, due to its special conservation interest. In 2005/06 a total of 2547 people (34 cruise ships and 26 yachts) visited this small island.

This volume of visitation throughout the summer season is causing an increased risk of disturbance to breeding wandering albatross, giant petrels and burrowing petrels, damage to areas of fragile vegetation and disturbance to breeding fur seals (see section 4.7).

The likely environmental effects of allowing an unregulated increase in visitor numbers, and the potential for direct impacts on breeding albatross and other species, indicate that some form of management of visitors to Prion Island is required and the “do nothing” option is rejected.

3.2 Alternate design for access route to plateau viewing sites

3.2.1 Designated route based on existing path with marker flags to clearly define the path and viewing areas

Expedition Leaders are required to mark out the path to the viewing areas with flags before visitors come ashore for each vessel visit. The extent to which the route is flagged and whether the viewing areas are flagged is not specified. As observers are not used, there is no guarantee that this always takes place and how effective it is as a management procedure.

Having a permanently marked route would ensure consistent use of the same path and viewing areas. The choice of the exact route should be made by a footpath expert in conjunction with a person with good local knowledge of the vegetation and wildlife. This option would reduce the spread of erosion by making sure that visitors walked along a set path and stayed within a



prescribed viewing area. It would make it easier for guides to control visitors as the boundaries would be clearly marked. Small, low, flexible marker flags are less likely to cause damage to flying birds than fixed wooden structures (the New Zealand Department of Conservation are trialing flexible fibreglass and plastic poles for use on sub-Antarctic Campbell Island). Flags would also make the path clear if it was snow-covered.

This would be an improvement in the current situation, but would not solve the problem of access across the beach during the fur seal breeding season without disturbing the seals. Also, the existing path is difficult to negotiate and very muddy in places. With the continuous high volume of visitation, the path would continue to degrade and access would become increasingly difficult for all but the most agile.

Impacts of construction: there would be very little impact as, with good planning, marking out the path could be done in one day with very little disturbance to wildlife, damage to vegetation or possible introduction of alien species.

Impacts of operation: marking the path would decrease disturbance to breeding birds and the extent of damage to vegetation and burrows, but it may increase path erosion and increase the risk of visitor accidents.

As a single management measure, this is not a suitable alternative. It could be considered in conjunction with reducing visitor numbers and not allowing visitors during the fur seal breeding season (see 3.3.2 and 3.3.3).

3.2.2 Designated route based on existing path using local materials to construct a hardened path where necessary

The existing path accesses the top of the island via a stream gully which has a rocky bottom. This path is very good in the lower section, but higher up the gully mud overlies the rock. The path could be improved using some fairly standard footpath techniques such as drainage improvements combined with removal of material to the base rock and breaking up some of the rock to improve the steeper sections. This could be done manually, but would be quite physical work.

To avoid the muddy sections of the upper part of the gully, the path could be routed out of the gully to the tussac bank on the side where there are no bird burrows. The tussac soil here is robust and would support a path covered in beach stone (S. Poncet, 2004). The choice of the exact route should be made by a footpath expert in conjunction with a person with good local knowledge of the vegetation and wildlife. The path would continue to the selected viewing areas and would be reinforced with beach stone where necessary.

Although this would be a permanent path, it would have a low visual impact. Low flexible marker flags could be used to mark the path and ensure that visitors use the correct route if it is snow covered.

Considerable amounts of beach material may be required to reinforce the path and movement of this material from the beach to the top of the gully would be difficult as it would have to be carried without the use of vehicles to avoid disturbance to wildlife. Some levelling of the path may be required.

Impacts of construction: this option would require a small team to work on the island for a couple of months, as with the boardwalk construction, so would have similar impacts in terms of camp etc. as the boardwalk construction. The area of operations would also be similar. As mostly local material would be used for making the path, there would be significantly less risk of introducing alien species, compared to the proposed boardwalk construction.



Impacts of operation: The path would be aesthetically more acceptable than a boardwalk as it would blend in with the environment and would be made of local materials. There would be no direct risks to wildlife associated with the path (i.e. compared with impacts of boardwalk described in section 5.7).

This would be a permanent path and it would not be easy to move it if birds changed their nesting locations. Inspection and maintenance of the path would be required on an annual basis. Heavy use may result in erosion and reinforcement work may be required.

This option does not solve the problem of disturbing fur seals during the breeding season in order to cross the beach and lower part of the gully. It would therefore be best conducted in conjunction with not allowing visitors during the fur seal breeding season (see 3.3.3). If visitors were allowed during the fur seal breeding season, then building a jetty and boardwalk across the beach could be considered, joining onto the path in the gully.

3.2.3 Alternative routes

The proposed boardwalk follows a route from the beach to the side of the gully and then onto the plateau. Here, the boardwalk forks, with separate tracks leading to two different viewing platforms.

Visitors are likely to go out to and return from each platform, which may cause congestion and passing problems and increase the likelihood of people stepping off the boardwalk. Having a continuous boardwalk with a loop which goes past both viewing areas may be more effective in keeping visitors on the set path. However, it may result in the need for more boardwalk sections and therefore increased costs and construction impacts.

In the absence of a detailed map of the proposed route, including the location of nesting birds, it is difficult to assess this alternative effectively. The choice of the exact route should be made by a footpath expert in conjunction with a person with good local knowledge of the vegetation and wildlife, and should include the consideration of using a continuous loop on the plateau section.

3.3 Alternative management approaches

3.3.1 Close Prion Island to visitors

This alternative would eliminate any possible impacts which may be caused by visitors and visitor infrastructure and therefore there would be no need for a boardwalk. This alternative presents the lowest environmental impact to Prion Island. However, if Prion Island was closed to visitors, then it is likely that visitors would go to other sites to see nesting wandering albatross (see section 3.3.4).

3.3.2 Restrict visitor numbers

In 2005/06 a total of 2547 people visited Prion Island. This compares to a maximum of 600 tourist and non-government visitors permitted to visit New Zealand sub-Antarctic islands per season and 750 per season at Macquarie Island (both of which have boardwalks).

Limiting the number of visitors permitted to go to Prion Island to a fixed level is likely to reduce the impacts on both vegetation and wildlife. Cruise ship companies could organise special “wandering albatross” cruises which have the added bonus of allowing visitors to see the wandering albatross, rather than having this as a standard part of South Georgia visits. This would highlight the “precious” nature of visiting nesting wandering albatross. It would be helpful if a review of tourists could be undertaken, to see what percentage of tourists



visiting South Georgia are really interested in visiting nesting wandering albatross. The need for a boardwalk on the island could then be reassessed.

It should be noted higher visitor numbers do not necessarily mean greater environmental impacts and that good management of visitors is a key factor (see 3.3.6). It only takes one visitor to disturb a wandering albatross. This alternative could be considered in conjunction with improvements to the path as suggested in sections 3.2.1 and 3.2.2.

3.3.3 Do not allow visitors during fur seal breeding season

During the fur seal breeding season, which is from approximately mid-November to mid-January, the landing beach at Prion Island is very densely packed with fur seals and is impossible to cross without causing disturbance to the fur seal harems. There is also a risk of injury to passengers and staff.

The fur seal breeding season is also the most sensitive period for breeding wandering albatross, when nests are established and eggs laid.

Permits to visit Prion Island could be restricted to the period outside the breeding season. This would remove the need for a jetty and boardwalk over the beach. Also, this may result in a decrease in overall visitor numbers to Prion Island, reducing the visitor pressure. A boardwalk may therefore not be necessary and simple improvements to the path (sections 3.2.1 and 3.2.2) may suffice.

3.3.4 Find alternative less sensitive mainland sites for visiting nesting wandering albatross

Prion Island has become the main visitor site on South Georgia for viewing nesting wandering albatross. This is mainly due to ease of access by ship, good landing beach and relatively easy access to the viewing sites. Prion Island is currently the only approved visitor landing site where visitors are able to view nesting wandering albatross.

There were 43 recorded breeding pairs of wandering albatross on Prion Island in 2004, compared to 948 on Bird Island and 155 on Albatross Island. The total count for South Georgia was 1553 pairs (Poncet, 2004).

There are a number of “non-pristine” sites on South Georgia where there are wandering albatross, despite the presence of rats, but they are quite remote and rarely visited by cruise ships. Also, access at some sites is limited (as at Prion Island) by the high density of breeding fur seals. However, if a suitable site were found, the installation of a boardwalk, if required, may have a lower environmental impact at a “non-pristine” mainland site than at Prion Island.

One such site is Elsehul, at the north-west end of South Georgia, where wandering albatross nest on the higher slopes (16 breeding pairs; Poncet, 2004). There is an abundance of wildlife here, but there are no pipits or burrowing petrels. The terrain is steep and muddy and during the fur seal breeding season it is almost impossible to land and the slopes behind are steep and difficult to negotiate (Poncet and Crosbie, 2005). Boardwalk infrastructure would be required to access nesting albatross at this location. A feasibility study would be needed to further investigate whether this is a viable alternative.

3.3.5 Use alternative sites to lessen the impacts of visitors on any one site

In the Bay of Isles there are seven other rat-free islands where wandering albatross and pipits nest. The most suitable for cruise ship landings may be Inner Lee, smaller in surface area than Prion and a site that was visited on a few occasions by cruise ships in 1997-98 and 1998-99 (Poncet, 2003a).



Another option would be to allow visitors to go to Bird Island, where the British Antarctic Survey (BAS) operates a permanent research station. There is a jetty at this site with permanent boardwalk access from the beach to the station. The birds and seals are used to the presence of people due to the long-term human presence and on-going monitoring research at this site. Whilst allowing frequent visits by large cruise ships would clearly be disruptive to research, a certain number of visits by smaller vessels, with agreement from BAS, may be a possible alternative.

Spreading the visitor load over three or more locations would reduce the visitor impacts on Prion Island and therefore the need to construct visitor infrastructure. However, it would direct visitor impacts to other sensitive sites.

3.3.6 Use observers to accompany all visits to the island

Observers could be required to accompany all visits to Prion Island in order to ensure strict adherence to the Code of Conduct and any future site management requirements. New Zealand Department of Conservation observers accompany all non-governmental visits to the New Zealand sub-Antarctic islands (see <http://sea.unep-wcmc.org/sites/wh/subantar.htm>).

The current management policy on South Georgia is that “any vessel may, at the discretion of the Commissioner, be required to carry a Government approved observer at the expense of the operator.” Due to the number of visits to Prion Island, a suitably qualified observer could be based at King Edward Point during the summer and could accompany each visit to Prion Island. This would ensure that all visits met with the required standards set out in the site management plan.

3.4 Combination of alternatives

Different approaches to the access routes and management of visitors on Prion Island have been discussed above. Obviously not allowing visitor access to Prion Island would have the least environmental impacts. Many of the other alternatives have advantages and disadvantages, but if used in combination, may provide viable alternatives to a boardwalk. Examples of possible alternative access routes and management measures which could be used in combination are shown in Table 1:

Access routes	Suggested additional management measures
Flagged path	Restrict visitor numbers; do not allow visitors during fur seal breeding season; use observers for cruise ship visits
Hardened path	Do not allow visitors during fur seal breeding season
Hardened path with jetty/boardwalk across beach	Restrict visitor numbers
Jetty/boardwalk with some sections of hardened path in gully and on plateau	

Table 1. Alternatives to proposed boardwalk

However, impacts at other sites on South Georgia may increase (see 3.3.4 and 3.3.5) as most of these alternatives involve placing restrictions on visitor access. These alternatives need to be developed and assessed in more detail to evaluate their impacts in comparison with the proposed boardwalk.



4. INITIAL ENVIRONMENTAL REFERENCE STATE OF PRION ISLAND

4.1 Location

Prion Island (54°01'S, 37°20'W) is situated in the Bay of Isles, which is off the north-east coast of South Georgia. It is just over a kilometre long and around 500m wide (see Figure 1). It is a near pristine wilderness site, which has no built structures or introduced species. There are some minor and localised impacts resulting from visitor activity, such as erosion of the route to the wandering albatross breeding area. It has been identified as a “Specially Protected Area”.

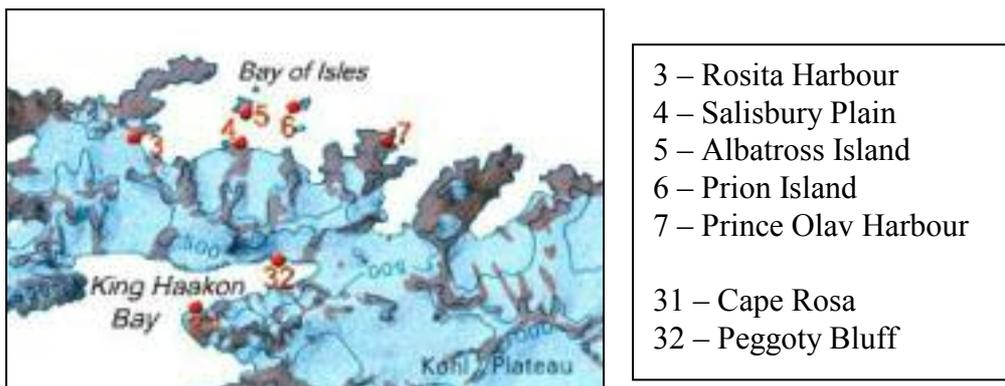


Figure 10. Location of Prion Island

4.2 Geology and geomorphology

The bedrock of Prion Island is part of the Cumberland Bay formation, made up of sandstones. Most of the island is covered with vegetation, with only one significant area of bare ground in the south-east part of the island.

The central part of the island is around 50m above sea level and the ground is predominantly tussac-covered. Cliffs surround most of the coastline rising to 15-25m above sea level (Poncet and Crosbie, 2005).

4.3 Hydrology

There are several small streams on Prion Island. There are three small ponds on the south part of the island, which feed into a stream, and a number of smaller isolated pools. There is no permanent ice on the island.

4.4 Climate

Prion Island is on the sheltered northeast coast of South Georgia and is likely to have a similar mean temperature and rainfall to those recorded at Grytviken, which has a mean annual temperature of 1.8°C and total annual precipitation of 148cm.

Conditions are changeable and temperatures vary considerably from day to day, with summer temperatures varying from around +5 to +10°C. Wind speeds are generally high, with monthly averages of 7–10 knots. Katabatic winds and violent squalls are a feature of South Georgia weather. Snow cover usually lies down to sea level during winter and sea ice may form around the island.

4.5 Flora

The ground cover on Prion Island is predominantly tussac (*Parodiochloa flabellate*; see map below; green shading). Some of the tussac has been degraded by penguin and fur seal activity



(indicated by brown shading). The blue shaded area indicates tussac and moss community, where tussac is dominant. Moss species include *Polytrichastrum strictum*, *Chorisodontium aciphyllum*, *Acaena magellanica* and *Syntrichia robusta*. Moss is dominant in some areas (orange shading), with tussac as sub-dominant species. In these areas soft moss banks may form on rocky substrate, mainly composed of *Chorisodontium aciphyllum* (Scott and Poncet, 2003).

There are small areas of *Deschampsia antarctica* and mosses which grow on flat, waterlogged areas with patches of tussac, *Callitriche antarctica*, *Colobanthus quitensis* and *Acaena spp.* (yellow shaded on map). These areas are particularly vulnerable to damage by visitors.

Erosion and damage to vegetation have been noted in the muddy areas at the top of the stream gully path and to a lesser extent around the bird viewing areas. A significant amount of erosion and vegetation damage is caused by fur seals (see section 4.6.1).

Kelp (*Macrocystis pyrifera*) grows around the coastal fringes of much of Prion Island, providing habitat for smaller marine flora and fauna.

4.6 Fauna

4.6.1 Seals

Elephant seals (*Mirounga leonine*) and fur seals (*Arctocephalus gazelle*) breed on Prion Island, both making full use of the landing beach on the south-east side of the island.

Elephant seals, the largest seal species, breed during the winter months from September to November. The mature males arrive at the breeding beaches around mid-August to compete in aggressive, bloody battles for the best harem sites. The females arrive at the beginning of September and give birth a few days later. They nurse their pups for three weeks and then mate before returning to sea (Poncet and Crosbie, 2005). By the time that visitors arrive at the beach in November, the elephant seal pups are almost ready to go to sea. Visitor impacts to the local elephant seal population are therefore likely to be low. Seals return to the beach to moult around January to March.

Fur seals begin their breeding season in November, when males compete in aggressive battles for territories on the beach. Females come ashore in mid-November, giving birth within a couple of days and nursing their pups for around 5-8 days. She then mates and returns to sea to forage for food for several days, returning to nurse her pup for two days and then going to sea again. This pattern of foraging and nursing continues until the pup is weaned after around 4 months, in late March (Poncet and Crosbie, 2005).

Fur seals were hunted almost to extinction by the early 20th century. Their numbers have now recovered and continue to increase. They have become so numerous that space has become limited and consequently the seals move inland and encroach onto the nesting and display sites of the wandering albatross. They also cause significant vegetation damage and erosion, including damage to nest sites of burrowing petrels. The area of the island affected by fur seals is increasing each year and the damage caused is more significant than likely impacts caused by visitors to Prion Island (S. Poncet, personal communication).

Long-term studies at Bird Island show that fur seals have not influenced the breeding success of wandering albatrosses. However, wandering albatross breeding for the first time are more likely to choose nest sites with fewer fur seals (Croxall *et al* 1990). On Albatross Island displaying birds and non-breeders were observed mainly on the upper inland areas away from fur seals (Poncet, 2003a).



Figure 11. Fur seals on southern part of Prion Island, close to wandering albatross nest site (Sally Poncet)

Preliminary results indicate that the effect of fur seals on the distribution of wandering albatross nest sites is significant. Further research and analysis of the data is required before definite trends can be identified and to allow assessment of the potential for fur seals to limit the nesting habitat of wanderers and other species such as pipits, blue petrels and pintails (Poncet, 2003a).

Interactions between visitors, fur seals and wandering albatross have been observed, where visitors have caused fur seals to move closer to fledgling wanderers, causing the birds to move away from their nest area (S. Poncet, personal communication).

Map key	Species	Latin name	Notes
ES	Elephant seal	<i>Mirounga leonina</i>	Breed on landing beach
FS	Fur seal	<i>Arctocephalus gazella</i>	Breed on landing beach and encroach on nest sites inland
G	Gentoo penguin	<i>Pygoscelis papua</i>	Around 1000 pairs; breed on tussac/mud behind landing beach. Some may nest on plateau
DG	Dominican gull	<i>Larus dominicanus</i>	Nest in coastal cliffs
HP	Northern giant petrel	<i>Macronectes halli</i>	A few nest in plateau area
GP	Southern giant petrel	<i>Macronectes giganteus</i>	Nest on plateau often near to wandering albatross
BS	Brown skua	<i>Catharacta lœnbergi</i>	Around 20 pairs nesting all over island
SA	Light-mantled sooty albatross	<i>Phoebetria palpebrata</i>	Several pairs nest on coastal cliffs on east and west coasts
WP	White-chinned petrel	<i>Procellaria cinerea</i>	Nest in burrows in tussac gullies along north-west coast
UP	Common diving petrel	<i>Pelecanoides urinatrix exsul</i>	Nest on tussac slopes along northern cliffs
AP	Antarctic prion	<i>Pachyptila desolata</i>	Nest in burrows in tussac knolls
★	Wandering albatross	<i>Diomedea exulans</i>	43 pairs; declining; nest mainly on plateau
	South Georgia pipit	<i>Anthus antarcticus</i>	All over island; nest beneath tussac
	South Georgia pintail	<i>Anas georgica georgica</i>	Nest beneath tussac

Table 2. Mammals and birds on Prion Island

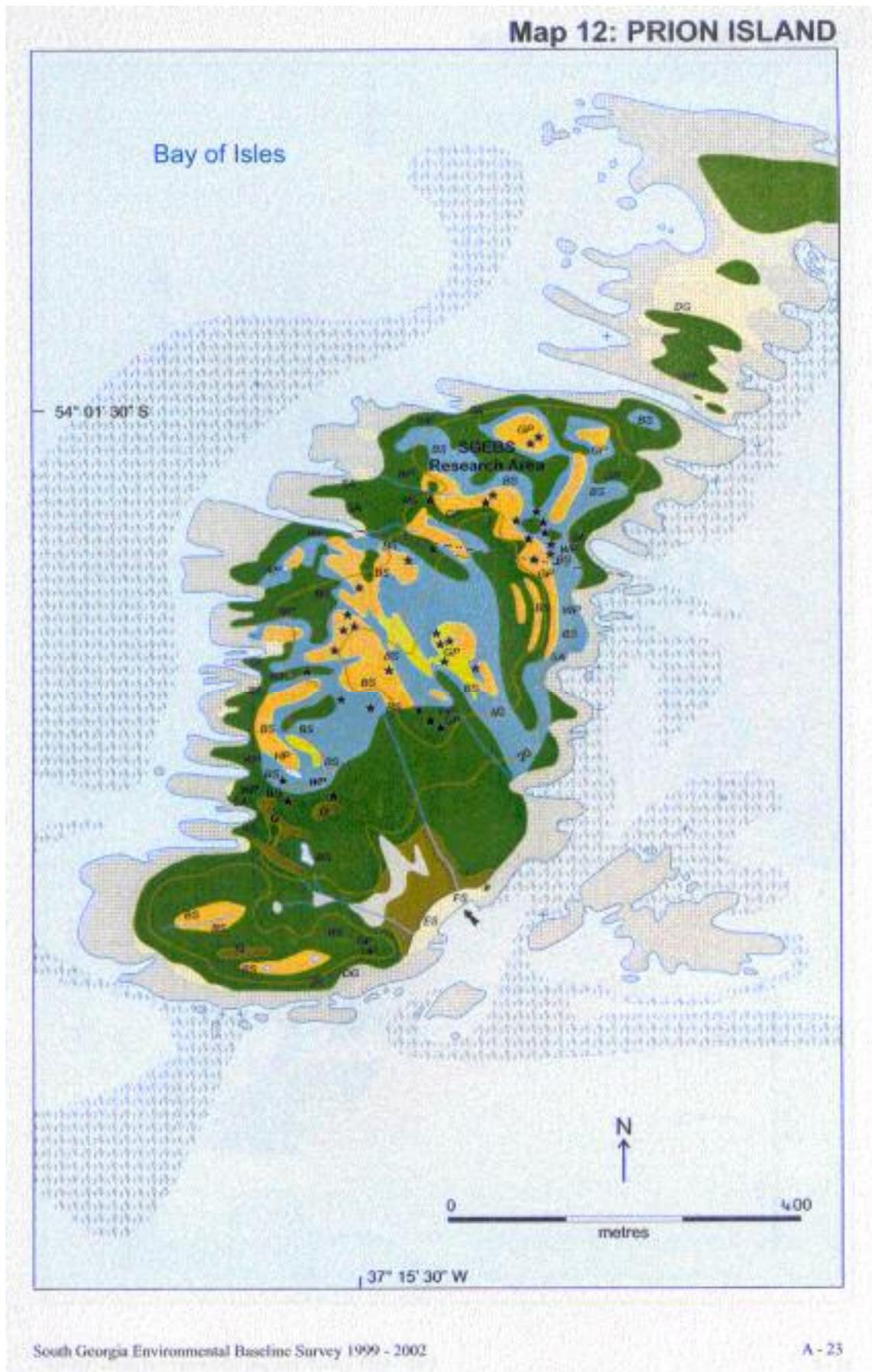


Figure 12. Environmental Mapping Report: map of Prion Island (Scott and Poncet, 2003)



4.6.2 Birds

The birds which breed on Prion Island are shown in Table 2, together with some notes on their numbers and breeding habitat where known (Poncet and Crosbie, 2005). Locations of breeding birds are shown on the map in section 4.5 (the key for the birds is shown in Table 2).

All of these birds breed during the summer months and some are present all year. The longest breeding cycle, that of the wandering albatross, is a two year cycle. Wandering albatross (*Diomedea exulans*) lay eggs during December, incubate during January and February and chicks hatch in March. During the winter months, chicks stay at the nest site, fledging the following summer from mid-November to January.

The population of wandering albatross at Prion Island has decreased from 52 pairs in 1999 to 43 pairs in 2004 (Poncet, 2004). Monitoring indicates that the decline in population at Albatross and Prion Island (6%) is higher than the decline at Bird Island (1%) (Poncet, 2003a).

The other bird species on Prion Island breed on an annual cycle, the longest of which is that of the light-mantled sooty albatross (*Phoebastria palpebrata*), which lays eggs in October, incubates for two months, hatching in early January and fledging in May (Poncet and Crosbie, 2005). Overall, the most important months for incubating and hatching are December and January.

Burrowing petrels, including white-chinned petrels (*Procellaria cinerea*), common diving petrels (*Pelecanoides urinatrix exsul*) and Antarctic prions (*Pachyptila desolata*), are abundant on Prion Island. They nest in a network of tunnels underground in soft soil to avoid skua predation and maintain a stable nest temperature. They come and go from their nests during the night. Tunnels may be collapsed by fur seals or trampling by visitors (Poncet and Crosbie, 2005).

4.6.3 Invertebrates

Invertebrates are the most abundant terrestrial fauna on South Georgia, though they are less numerous than on other sub-Antarctic islands. These include beetles, flies, spiders, earthworms, mites and springtails. No specific study of invertebrates has been undertaken at Prion Island.

4.7 Visitors

Prion Island has been visited since the early 1970s. It is included on the cruise ship itineraries for South Georgia for most ships with less than 200 passengers. It is a convenient landing site as it has an accessible landing beach. With increased public awareness of the plight of the wandering albatross, visitor interest in seeing the birds at close range has grown.

Figure 13 shows the number of visitors to Prion Island over the past five seasons. Numbers have increased by a factor of 2.75 during this time. A large increase in numbers resulted from the closure of Albatross Island to visitors at the end of the 2003/04 season. Prion Island has become the focus for nearly all visits to view nesting and displaying wandering albatross.

Research has not yet shown any direct link between visitor impacts and decline in breeding bird success, and this is difficult to assess due to the impacts of fur seals and for wandering albatross, the impacts of long-line fishery (Poncet, 2003a). However, this does not mean that visitors are not causing impacts.

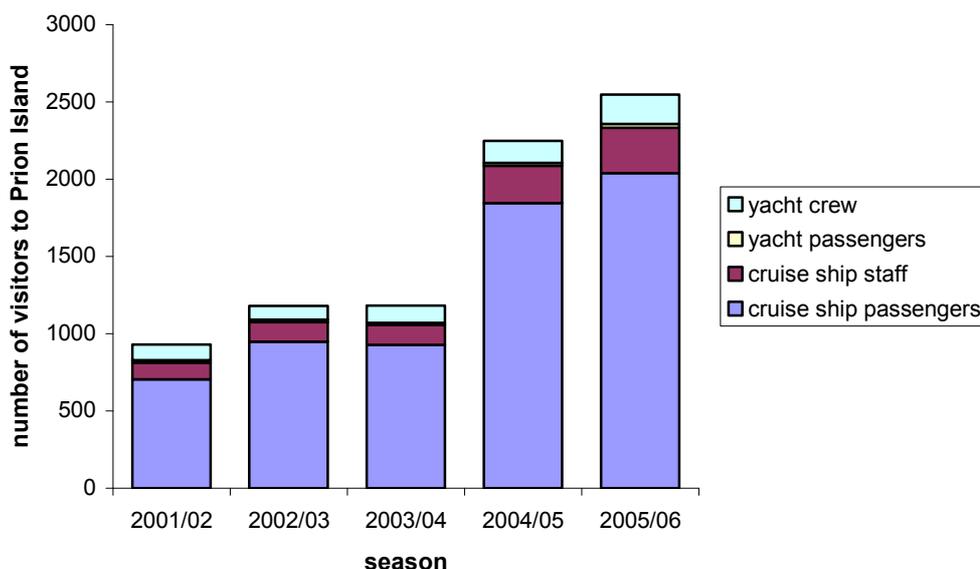


Figure 13. Number of visitors to Prion Island between 2001/02 and 2005/06

Visitor paths have formed in the short tussock and areas of tussock and *Deschampsia antarctica* on the upper sections of the main access gully are being trampled. This has resulted in some deep mud holes and subsidiary paths have formed around the damaged areas (Poncet, 2003b). Damage to vegetation has also occurred higher on the island due to visitors not staying on the path and within the viewing areas. Evidence of trampling of prion and petrel burrows has been noted.

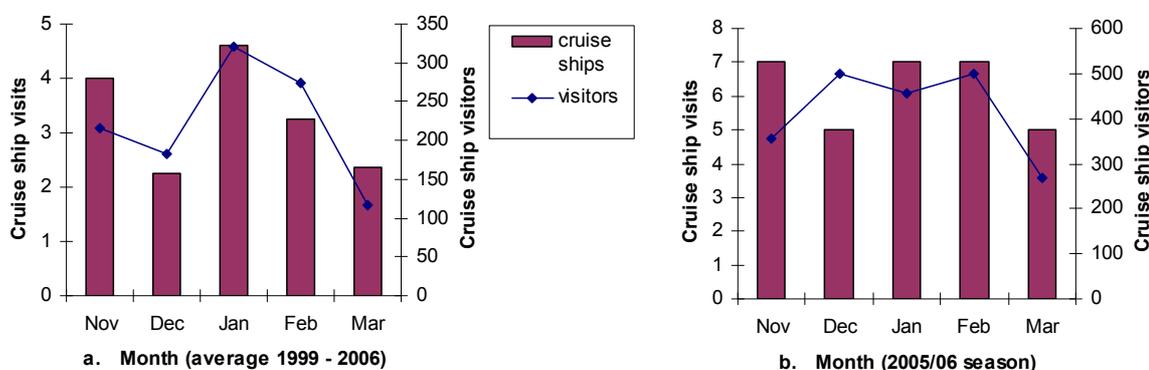


Figure 14. Average number of cruise ship visits to Prion Island by month

Figure 14a shows the number of cruise ship visits to Prion Island each month during the summer season (there are no cruise ship visits outside these months), based on average data from 1999 to 2006. The highest number of cruise ship and visitor visits is during January, with lower numbers during December and March. Figure 14b shows the number of visits for the 2005/06 season, showing a consistently high number of cruise ship visits (5-7 visits per month) and high number of visitors (300-500 visitors) for each month throughout the season.

4.8 Alien diseases and species

No introduced species have been recorded on Prion Island. However, due to high visitor numbers, introductions may have occurred that have not yet been detected.



4.9 Protected Areas and Historic Sites

Prion Island has been identified as having exceptional conservation value. It is a rat free island with high biodiversity and a unique assemblage of wildlife including vulnerable bird species. An on-going monitoring programme is located there. It has been designated as a Specially Protected Area (SPA) by the GSGSSI in their recent review of environmental management (Pasteur and Walton, 2006). Protected areas legislation is in preparation.

SPAs are intended to provide an additional level of protection. Entry into any SPA is prohibited unless a site-specific permit has been granted by the GSGSSI. Anchoring or cruising inshore and in bays close to SPAs is allowed.

There is one listed historic site on Prion Island: a large wooden spar or mast on the beach, which is thought to be from the vessel *Lovely Nancy* which was wrecked in 1820.

4.10 Monitoring

Bird Island has been the main focus for seabird research on South Georgia over the past 40 years, with boat-based surveys of the remainder of South Georgia taking place during the 1980s. The Albatross and Prion Islands Conservation Programme, which started in 1998/99, conducts annual surveys of wandering albatross, giant petrels, vegetation and visitors to the islands.

The South Georgia Albatross Survey 2003/04 carried out censuses of wandering, black-browed and grey-headed albatrosses throughout South Georgia using digital photography to determine conservation status and trends, and to establish baseline data for long-term monitoring of selected colonies (Poncet, 2004).

The current South Georgia ACAP Petrel Survey 2005-07 aims to assist the Government in achieving and maintaining favourable conservation status for southern and northern giant petrels and white-chinned petrels. Censuses are being carried out for each species and key breeding sites identified.

The northern part of Prion Island, representing around 25% of the island, has been designated as a research (control) area (see Figure 1). No visitors are permitted to enter this area. An annual census of wanderer fledglings and nests has been conducted in the Research Area and Visitor Area on Prion Island since 2000. Vegetation surveys are undertaken every three years to record the impact of fur seals on plant communities. Annual monitoring using post-visit reports assesses numbers of visitors and their spatial distribution during each tourist visit which can be used in relation to bird breeding success and condition of vegetation (Poncet, 2003a).

4.11 Future environmental reference state in the absence of the proposed activity

It is likely that without additional visitor management controls, visitor numbers will continue to increase. In the absence of the proposed boardwalk, further erosion may be caused in the gully area and higher on the plateau and spreading of paths and damage to vegetation is likely to result from increased use with consequent effects on the aesthetic and wilderness values of the island. Visitors will continue to disturb fur seals breeding on the beach in order to access the island.

The risk of disturbing breeding wandering albatross, giant petrels and burrowing petrels, as well as other breeding bird species will also likely increase due to the combined effect of visitors and fur seals. Irrespective of the proposed activity, the impact of fur seals on the



wildlife and vegetation at Prion Island is likely to continue to increase if the fur seal population continues to rise.

The population of wandering albatross is likely to continue to decrease due to the effects of the fisheries outside the South Georgia Maritime Zone, unless illegal and unregulated (IUU) longline fishing throughout the wandering albatross feeding areas can be significantly reduced in the near future.



5. ASSESSMENT, MINIMISATION AND MITIGATION OF LIKELY IMPACTS

The following section assesses the likely impacts on the environment of the proposed installation of a boardwalk on Prion Island.

Minimisation and mitigation measures to reduce these impacts are described. The impact matrix table in section 5.11 summarises these impacts and mitigating measures.

5.1 Wilderness and aesthetic values

The construction of a boardwalk will change the wilderness and aesthetic character of the site significantly. The boardwalk will have a high visual impact during the approach to the island as it will be a man-made structure, some well above ground level, made from materials which do not exist naturally at the site.

The proposed boardwalk will introduce very visible infrastructure to an island with no previous infrastructure of any kind.

There are no records of any previous overnight camping on Prion Island and the construction camp represents a significant change from this baseline.

Minimisation and Mitigation

It is not possible to mitigate the visual impact of the proposed jetty and boardwalk structure across the beach and these will be visible from a considerable distance. Minimisation and mitigation could be achieved by:

- Modify design so that boardwalk is not a continuous structure. For example a natural stone path in the lower section of the gully and some of the path on the plateau. Boardwalk could be to cross the beach and where there are areas of fragile vegetation and bird burrows
- Keep boardwalk as low as possible and close to vegetation to shield visual impact
- No handrails on the structure, apart from the beach section

5.2 Physical disturbance

The proposed activity will create physical disturbance during landing and unloading of cargo, establishing and using the construction camp, construction of the boardwalk and during annual inspection and maintenance works. The areas affected will be the campsite, beach and route of the proposed boardwalk, and breeding species in close proximity to these areas.

If there are any cruise ship or yacht visitors during the construction period, there may be additional impacts if visitors are not able to use the usual route to the viewing sites.

The breeding season for elephant seals and fur seals will have finished before the project starts and although some seals will be hauled out on the beach for moulting, the beach will not be densely packed. However, there will be significant disturbance on the beach due to the site of the construction camp and also the works which will be undertaken to build the jetty and boardwalk over the beach. Disturbance to seals may result in a temporary increase in metabolic rate and consequent energy expenditure. Research at Bird Island shows that breeding success of fur seals is not affected by raised boardwalks and the seals continue to breed below the structure provided that they can move freely beneath it (K. Reid, personal communication).

There is no previous record of visitors spending nights ashore at Prion Island as visits have primarily been yacht and ship-based. A shore-based camp and two-month construction



program therefore represent a significant increase in activity compared to the past. of the boardwalk will necessitate the presence of people on the island and Noise or physical disturbance to breeding birds may result in loss of eggs or chicks through abandonment of nests or due to raiding by skuas, northern giant petrels and gulls.

Concrete preparation in the beach area may produce dust. However, this will not take place in the vicinity of sensitive vegetation and will be rapidly dispersed. Sawdust will be generated by drilling and sawing of timbers for the boardwalk. This should be kept to a minimum by the prefabrication of the structure, as most of the bulk sawing work will have been undertaken elsewhere.

Construction activities will take place during daylight hours. Lighting at the camp during dark evenings may cause disturbance to birds.

It should be noted that regular monitoring activities also contribute to visitor pressure. However, impacts have been minimised and all previous monitoring activities at Prion Island have been yacht-based, without requiring researchers to camp on the island.

Physical disturbance is assessed as being of high probability and medium to high importance.

Minimisation and mitigation

- Scheduling of construction and maintenance outside the main breeding period
- Prior to the commencement of works, the precise locations of nesting birds and other wildlife should be established. The locations should be marked on a map and all operatives briefed so that disturbance can be avoided where possible
- Briefing by Government Officer and adhering to Prion Island Code of Conduct
- Limiting the size of the camp and construction areas to the minimum required
- Not mixing concrete, sawing or drilling wood during windy conditions
- Minimise use of lighting and angle any outside lights below horizontal
- Plans will be made in advance if any cruise ships or yachts are due to visit Prion Island during the construction period, so that impacts are kept to a minimum.

5.2.1 Noise

Noise will be generated by small boats coming ashore with the construction team and cargo. The use of generators and power tools and the presence of people will also create noise.

Breeding birds and seals may be disturbed by noise.

Minimisation and Mitigation

- Small boat landings will be kept to a minimum
- Activities will be conducted in such a way as to minimise noise
- Particular care will be taken in the vicinity of breeding birds

5.3 Introduction of alien species and translocation of diseases

South Georgia has been highlighted as the most threatened area in the sub-Antarctic for potential alien species introductions due to climate warming and the increasing number of visitors (Frenot et al., 2005).



The installation of a boardwalk on Prion Island presents a moderately high risk of introduction of alien species or diseases. Considerable amounts of imported materials will be taken to the island, including camping equipment, food, concrete and aggregate, tools, prefabricated boardwalk and personnel. These materials may be contaminated with microbes (including fungi), invertebrates, seeds and spores alien to South Georgia that may rapidly establish on the island. Significant introductions have occurred elsewhere on South Georgia in recent years.

The timber for the boardwalk has already been purchased in Chile and has been transported via the Falkland Islands to King Edward Point (KEP). The wood has not been treated with pesticides or fungicides, but it has been kiln dried. The boardwalk has been prefabricated and stored at KEP where there are several known introduced species.

Whilst the use of chemicals to treat wood may have a local effect on adjacent vegetation and water, the risk of the introduction of alien species is high and may have significant second order effects. Introduced species may influence the way that the foodweb works (Frenot et al., 2005).

The International Plant Protection Convention for minimising the spread of plant pests and diseases give the approved measures for timber fumigation as a heat treatment (including kiln-drying) or methyl bromide (banned under EU legislation as it damages the ozone layer). Construction timber used by the British Antarctic Survey on South Georgia and in Antarctica is usually kiln-dried, but is not treated with pesticides or fungicides. The timber for the boardwalk has been kiln dried.

By the time the project starts, the wood will have been at KEP for over a year, and so any alien species might well be fairly obvious from a visual inspection. Some smaller arthropods such as mites could be transferred on the timber, but this risk is likely to be no greater than the risk of transfer in other cargo such as aggregates and sand (P. Bridge, personal communication).

Food will be brought ashore during the camp and construction phases increasing the risk of introducing disease (such as morbillivirus, Newcastle disease, infectious bursal disease and zoonotic diseases) to the bird population on Prion Island.

With the vigilant implementation of all minimisation and mitigation measures, the probability of introduction of alien species during the construction of the boardwalk is assessed as being low.

Minimisation and mitigation

- All materials and clothing will be inspected carefully for alien plant or animal species (particularly rats), prior to being transported to Prion Island
- Further checks will be made after loading on the FPV and before unloading from the sea trucks
- The 'Guidelines for prevention of introduction and translocation of alien species' (see Appendix 2) will be followed for all equipment and personnel taken to Prion Island
- No poultry products should be taken ashore. Foodstuffs and waste will be carefully controlled in order to avoid scavenging (see section 5.5)
- Careful sourcing and packaging of materials brought on site

5.4 Atmospheric emissions

Atmospheric emissions during the installation of the boardwalk will come primarily from:



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- Ship transport to Prion Island for personnel and equipment (fuel oil)
 - Cooking stoves (liquid petroleum gas, LPG)
 - Generator use (unleaded petrol)
 - Fuel spills and fuel vapour emissions during refuelling activities
 - Small amount of lubricants

Use of fossil fuels will generate carbon dioxide, carbon monoxide, hydrocarbons, nitrogen oxides, sulphur dioxides and particulates. Refuelling activities and fuel spills will cause some emissions to the atmosphere as much of the fuel may evaporate. The vapours will include hydrocarbons and carbon dioxide, which are greenhouse gases and contribute to climate change.

LPG is composed of a mixture of propane and butane gases under pressure. It is clean burning when properly mixed with air and produced virtually no soot and very little carbon monoxide, hydrocarbons or nitrogen oxides. The transportation and storage of LPG in cylinders means that it is closed to the atmosphere preventing any evaporative emissions. In the event of a leak LPG will rapidly vaporise and mix in the atmosphere and will not cause any ground level contamination.

Emissions will be at or close to the sea in an area where wind speeds are generally high. They will therefore be rapidly dispersed and are unlikely to have any significant impact of wildlife, marine or air quality. Heavy particulates, such as carbon may deposit a short distance down-wind and may be detectable in soil and marine sediments.

The atmospheric emissions caused by the proposed activity will be low and will not result in significant environmental impacts. However, atmospheric emissions are cumulative and certain gases emitted may contribute the local burden of pollutants caused by past and current activities in the area and to regional atmospheric pollution.

Minimisation and Mitigation

- The project will use shipping already operating in the area for the transfer of cargo and personnel; this will reduce the impact of atmospheric emissions compared to having a dedicated vessel
- Use of low sulphur fuel
- Fuel use will be kept as low as possible
- Checks will be made to ensure clean-running engines and no oil leaks
- Choice of generator and cooking stove will be based on fuel efficiency and environmental performance; minimise use of generator
- Maintain equipment to high standard and service regularly

5.5 Solid waste

Site waste disposal is discussed in section 2.6. All solid waste will be removed from South Georgia for recycling or safe disposal.

If not correctly managed, some waste may be scattered by winds. Wastes could be scavenged by the local avian population or contaminate soil and vegetation if not contained.

The main component of non-hazardous waste will be off-cuts of wood. Limited quantities of hazardous waste, such as adhesives, batteries, solvents, oily wastes and paints will also be generated.



The disposal of waste will depend on how it is shipped out of Prion Island is likely to be with a licensed waste contractor in the Falkland Islands.

Minimisation and Mitigation

- Minimisation by reduction of packaging where practicable
- Hazardous materials brought to site will be kept to an absolute minimum and all hazardous material will be removed from South Georgia
- No prohibited products (listed in Environmental Management Plan for South Georgia, 2000) will be brought to South Georgia
- Waste items will be re-used and recycled as much as possible
- A record of all waste produced and how it is removed from the island will be maintained throughout the project
- All food wastes will be stored in secure containers to prevent scavenging
- All waste will be sorted, labelled and securely contained at the camp, to prevent wind dispersal or scavenging. Waste will be removed from the island on a regular basis
- The Project Manager will assign one of the team responsibility for waste procedures
- Regular litter collection will be conducted

5.6 Impacts on soil, vegetation and hydrology

Water for domestic use will be brought to the site.

5.6.1 Fuel and Oil Spills

Information on fuel storage and handling is given in section 2.4.4. Fuel and oil spills may occur during fuelling of the generator or by leakage from the drums. Most spills are likely to be less than 5 litre and the maximum risk is the loss of a fuel drum (205 litres).

Fuel is relatively volatile and spills will rapidly evaporate but a waxy residue may remain. Larger fuel spills may lead to biological effects on vegetation and contamination of soil layers. If washed into the sea, fuel will be rapidly dispersed. Fuel spills in vegetated areas will cause physiological and physical damage to plants and animals.

Minimisation and Mitigation

- Standard procedures for transport, handling, transfer and use of fuels will be followed
- Correct equipment will be used, and handling and transfer of fuels will be minimised
- Secondary containment drum stands will be used for fuel transfers. Delivery pipework and trigger guns will be kept within the stands
- Fuelling points will have suitable absorbent mats, drip trays and clean-up equipment
- Any spills will noted and included in the Post-visit report form

5.6.2 Sewage and domestic waste water (grey water)

Grey water will be filtered and discharged to the ground away from any freshwater sources, or to the sea. Solid filtrate will be removed from the Island.

It has been proposed that a lime pit toilet be used for sewage. This would be dug near to the or within the tussac area above the beach and is therefore likely to cause some damage to the



tussac. There is a small risk that insects may fall into the pit, or potentially even seals. The use of a lime will add to the contamination of the local area around the pit. Because anaerobic waste breakdown in a pit is slow, pathogens may remain viable for years. If material is not sufficiently well buried, it may come to the surface in future years if, for example, more erosion is caused by fur seals.

Direct disposal of sewage waste to the sea is the standard method used on South Georgia for parties operating close to the sea. A simple port-a-loo bucket method could be used, whereby all faeces and urine is placed in a container, which is emptied daily into the sea. Any solid paper material should be put into a separate container and removed as waste. The amount of waste being produced during the construction is relatively small.

The direct effect of any sewage and grey water disposal to the sea will be a temporary increase in the contamination of the water around the southern end of Prion Island. However, material will be rapidly dispersed in the sea. Effluent will add nutrients, including bacteria, yeasts and viruses that are not native to South Georgia, as well as heavy metals and organic pollutants. In summer, human derived fecal coliform cells in the marine environment are likely to be killed off by the biologically damaging effects of solar radiation (Hughes, 2003).

Minimisation and Mitigation

- Care will be taken that no sewage and grey water discharges are made directly in the vicinity of wildlife
- Sewage and grey water should be disposed of to the sea, where it will be rapidly dispersed and can break down more quickly.

5.6.3 Erosion and vegetation damage

One of the aims of the boardwalk construction is to reduce erosion and vegetation damage caused by visitor trampling. The boardwalk has been designed so that visitors will always be on the boardwalk and this will be reinforced by visitor briefings.

During the construction of the boardwalk there will be considerable trampling around the area of the gully and to the side of the gully and up on the plateau. Workers will be carrying heavy loads (boardwalk sections), which means that their impact will be greater.

Direct damage to vegetation may be caused by any levelling work and by the installation of the boardwalk posts. Also, any vegetation underneath the boardwalk will receive greatly reduced amount of light, which may mean that it will not survive.

The boardwalk and viewing platforms should be carefully positioned to maximise their effectiveness. If a viewing platform falls just short of a high point with a good view, then visitors may be tempted to step off the platform, causing erosion and damage to burrows.

Minimisation and Mitigation

- A route should be marked out for use during the construction phase so that there is a minimum amount of trampling of vegetation or damage to burrows. Short cuts should not be taken
- Moving large loads and working in erosion sensitive areas should be avoided during wet conditions
- A route will be marked out for any visitors during the construction period
- Design boardwalk to minimise potential for visitors stepping off it



5.6.4 *Chemical leaching from boardwalk*

It is proposed that galvanised chicken wire is stapled to the boardwalk to provide a non-slip walking surface. Bolts and other ironmongery will also be galvanised to prevent rusting. There may be damage to sensitive vegetation caused by leaching of zinc from the galvanising.

5.7 Possible impacts of boardwalk on fauna

5.7.1 *Trapping of fur seals on beach section of boardwalk and possible injuries to seals*

The boardwalk will be gated at the jetty and at the end of the beach section to prevent seals gaining access to the jetty and the high section over the beach. If the seals accessed these areas, they may be injured by falling from the high structure.

A potential problem with having a gated boardwalk is that seals may somehow gain access to the gated area and then become trapped. Fur seals will go to great lengths to gain a good position and an elevated boardwalk is likely to be a favoured position on a crowded beach.

Fur seals may also become injured if using other sections of the boardwalk – for example, where the boardwalk is covered in chicken wire, sharp bits of wire may become loose and cut into the fur seals as they move along the surface.

Minimisation and Mitigation

- Design and maintenance of jetty and beach boardwalk sections to avoid any possibility of trapping fur seals
- Examine boardwalk carefully after construction and during annual maintenance to ensure that there are no protruding wires or other sharp objects which could damage seals (or people)

5.7.2 *Use of boardwalk by seals*

Seals often sit on areas of boardwalk, for example at Bird Island (K. Reid, personal communication) and are likely to access any available boardwalk surfaces. At Bird Island, seals have become habituated to the presence of people and readily move off the boardwalks. However, at Prion Island they will be less accustomed to the presence of people and will need to be cleared off by visitors. This may cause some disturbance to the seals.

Above the area of steps, fur seals may use the boardwalk to gain access to the plateau area on Prion Island. The fur seals are already encroaching on the bird nesting areas at the top of the island, but the presence of the boardwalk may encourage them, by giving them an easy route up the island. Also, if the seals sit on the boardwalks and viewing areas on the plateau, when visitors come to the island, they will clear the seals off these areas and may force them closer to nesting birds, causing disturbance to the birds.

Minimisation and Mitigation

- If the boardwalk is not continuous, then this problem may be reduced. For example, boardwalk could be used for the upper part of the gulley, but then a path from the top of the gulley to the viewing area

5.7.3 *Bird strike due to use of handrails*

In the New Zealand sub-Antarctic islands, handrails are not allowed as they are considered to be a real risk to the Royal albatross (P. McClelland, personal communication). Records of low flying birds hitting the wooden track marker pegs on Campbell Island indicate that the use of handrails could cause bird strikes.



On Prion Island, handrails will be used for the section of boardwalk which crosses the beach for safety reasons as this will be some distance above the ground. If bird strike was to occur here, it would occur regardless of the presence of handrails, though handrails could increase the frequency of collisions.

The section of boardwalk leading up from the back of the beach up the side of the gully to the plateau will go through areas of tussac, which will shield the boardwalk partially from view. There are no breeding birds in the immediate area. However, partially visible handrails may cause an obstruction to flying birds.

Minimisation and Mitigation

- No use of handrails except on the beach section of the boardwalk
- Monitor to assess if any impacts
- Remove structure if evidence of bird strike

5.7.4 Birds nesting too close to the boardwalk

In future seasons, birds may chose to nest closer to the boardwalk structure than during construction. This has happened on Campbell Island, where a pair of royal albatross nested within 1m of the boardwalk. Tourists were diverted off the boardwalk to reduce disturbance, but thereby damaging vegetation (P. McClelland, personal communication).

The effect of birds nesting close to the structure is assessed as having a low impact. Wandering albatross build their nests during November, when there will already be regular visits by cruise ships and yachts (see section 4.7). If birds start to nest close to the boardwalk then it is therefore likely that the nesting pair will be habituated to an extent to the presence of visitors.

Minimisation and Mitigation

- Appropriate management procedures should be developed as part of the site management plan and Code of Conduct to cover the event that birds nest closer to the boardwalk than the minimum of 10m. Measures may include a requirement for groups to pass the nest individually and spaced out at a set distance so that the area does not become crowded or noisy
- Monitoring should take place if birds nests closer than the minimum of 10m, to see if they are affected by the presence of visitors. If such monitoring indicates disturbance, then visitors should be diverted off the boardwalk
- The boardwalk has been designed as a movable structure so it could be moved away from the nesting birds. However, depending on how close the nesting site was to the boardwalk, it may not be advisable to move the boardwalk as it could disturb the birds
- If the nesting site was too close to one of the viewing areas and the birds appeared to be agitated by the presence of visitors, then the viewing area may have to be closed

These issues should be investigated as part of the site management plan, which will include a maintenance plan for the boardwalk.

5.8 Impacts due to maintenance activities or removal

The jetty and boardwalk will require routine inspection and maintenance. This could bring additional impacts resulting from bringing of more materials to the island (concrete, aggregate, replacement boardwalk sections) as well as possible impact of overnight camping and many of the impacts discussed in section 5.2–5.6 relating to construction work.



Minimisation and Mitigation

- Refer to minimisation and mitigation in sections 5.2–5.6
- Use ship or yacht-based facilities rather than camping if visit requires overnight accommodation
- Keep number of visits to a minimum and link inspection to a normal tour visit

5.9 Adjacent and Associated Ecosystems

The features of the proposed activities which are most likely to impact associated ecosystems are

- Atmospheric emissions (see section 5.4) as these contribute to regional air pollution burdens; and
- Removal of waste (see section 5.5) resulting in increased landfill, probably in the Falkland Islands. This has the indirect effect of contamination of soil and groundwater.

Purchasing of materials for the project may also cause impact on other ecosystems, for example, the purchasing of non-sustainable timber.

5.10 Indirect and cumulative impacts

An indirect impact of the construction of a boardwalk on Prion Island may be to influence the development of tourist infrastructure in other parts of the sub-Antarctic and Antarctic. If a boardwalk is deemed acceptable for a pristine site such as Prion Island, then it may be considered for other sites.

Cumulative impacts of the boardwalk include emissions to air, fuel spills and local discharge of grey water during the construction phase of the project. These cumulative impacts may affect the biota in the region and reduce the scientific value of the area.

5.11 Impact matrix

An impact matrix (Table 3) has been prepared to summarise the likely environmental impacts of the proposed installation of a boardwalk on Prion Island. Activities that will have an impact are identified and the duration and output (potential results of the activity that may cause the impact) are stated.

The following columns predict the probability of the impact occurring as L = Low (<25% probability); M = Medium (25–75%) and H = High (>75%) and the importance of the impact (L, M, H). The final two columns in the impact matrix describe the predicted impacts and indicate the measures that will be put in place to mitigate or prevent them from occurring.

The table has two sections. The first deals with the impacts of the proposed construction of a boardwalk on Prion Island. The second deals with the possible adverse impacts of the boardwalk once it has been completed. The positive environmental impacts of the boardwalk are discussed in section 2.2.1 and are not included in the table.



Table 3. Impact matrix, showing preventative or mitigating measures

<i>Activity</i>	<i>Output</i>	<i>Probability</i>	<i>Importance</i>	<i>Predicted Impacts</i>	<i>Mitigation</i>
CONSTRUCTION OF PROPOSED BOARDWALK					
Shipping and cargo handling	Atmospheric emissions	H	L	Cumulative contribution to regional and global air pollution	<ul style="list-style-type: none"> • Minimise ship and small boat movements • Use of ship already operating in the area • Use of low sulphur fuel • Fuel use will be kept as low as possible • Checks will be made to ensure clean-running engines and no oil leaks
	Noise / physical disturbance of wildlife	H	L	Disturbance of seals on beach	<ul style="list-style-type: none"> • Team briefed on minimising disturbance of fauna • Activities will be conducted in such a way as to minimise noise • Equipment to be routinely serviced to minimise noise output • Keep small boat landings to a minimum • Ensure that operatives drive small boats in considerate manner
	Introduction of alien species	L	H	Spread of alien diseases; loss of biodiversity	<ul style="list-style-type: none"> • All materials and clothing will be cleaned and inspected carefully for alien plant or animal species prior to loading • Further checks will be made after loading and before unloading from the sea trucks • Careful control of foodstuffs to prevent scavenging • No poultry will be taken to island • ‘Guidelines for prevention of introduction and translocation of alien species’ (see Appendix 2) will be followed • Careful sourcing and packaging of materials brought on site
Running generators	Atmospheric emissions	H	L	Cumulative contribution to regional contamination of local ecosystems	<ul style="list-style-type: none"> • Maintain equipment to high standard and service regularly • Minimal use of generators • Choice of stove and generator based on fuel efficiency and environmental performance
	Noise	H	L-M	Cumulative if repeated. Disturbance of wildlife;	<ul style="list-style-type: none"> • Use acoustic protection on generator • Generator use and use of power tools in vicinity of wildlife will be avoided • Particular care will be taken in the vicinity of breeding birds



<i>Activity</i>	<i>Output</i>	<i>Probability</i>	<i>Importance</i>	<i>Predicted Impacts</i>	<i>Mitigation</i>
Fuelling and handling of oil and fuel	Fuel spill: <200 litre. Oil: <5 litre	L	H	Cumulative contamination of soil, water, fauna and flora; reduction in scientific value	<ul style="list-style-type: none"> • Standard procedures for transport, handling, transfer and use of fuels • Minimise handling and transfer of fuels; use of correct equipment • Secondary containment drum stands used for fuel transfers. Delivery pipework and trigger guns will be kept within the stands • Absorbent mats, drip trays and clean-up equipment at fuelling points • Appropriate training of operatives; spill response exercises • Reporting of spills in post visit report form • Clean running engines on landing craft so that no light oil spills on seawater
Construction of boardwalk	Damage to vegetation	H	M	Permanent loss of vegetation and habitat Visual impact	<ul style="list-style-type: none"> • A path will be marked out for use during the construction phase so that there is a minimum amount of trampling of vegetation or damage to burrows • Moving large loads and working in erosion sensitive areas will be avoided during wet conditions • A path will be marked out for any visitors during the construction period • Design of boardwalk to minimise the potential for visitors to step off it
	Erosion	H	M	Loss of surface soil; changes in drainage; Damage to vegetation; visual impacts	<ul style="list-style-type: none"> • As above
	Noise/ physical disturbance	H	M	Disturbance to wildlife; chick mortality; reduction in breeding bird population	<ul style="list-style-type: none"> • Timing of boardwalk construction outside main breeding period • Prior to start of project, verify locations of nesting birds in operational area and map out their locations so that they can be avoided as much as possible • Briefing by Government Officer and adhering to Prion Island Code of Conduct • Size of camp and construction areas to be kept to minimum required • No mixing of concrete and sawing and drilling wood in windy conditions • Make plan to organise work site if cruise ship or yacht expected during construction work to ensure minimum impacts
Waste generation	Discharge of grey water and sewage to sea	H	L	Contamination of local marine habitat; loss of scientific value	<ul style="list-style-type: none"> • No sewage and grey water discharges to be made in the direct vicinity of wildlife



<i>Activity</i>	<i>Output</i>	<i>Probability</i>	<i>Importance</i>	<i>Predicted Impacts</i>	<i>Mitigation</i>
	Removal of hazardous and non-hazardous waste	H	L	Contamination of soil, water, fauna and flora if not stored securely. Indirect effect of waste disposal outside South Georgia;	<ul style="list-style-type: none"> • Minimisation by reduction of packaging where practicable • Waste items will be re-used and recycled as much as possible • Minimise hazardous materials brought to site; all hazardous materials to be removed from South Georgia • No prohibited products to be brought to South Georgia • Waste will be sorted, labelled and securely contained • Team all briefed on waste management procedures; one of team will be responsible for waste management • Regular litter collection around the site • A record of all waste produced and how it is removed from the island will be maintained throughout the project
Light pollution	Disturbance of birds	L	L	Disturbance and disorientation of birds; decrease in number of breeding birds	<ul style="list-style-type: none"> • Minimise use of lights • Outside lights to be angled below the horizontal
POSSIBLE ADVERSE IMPACTS OF PROPOSED BOARDWALK					
Introduction of infrastructure	Visual impact	H	H	Destroys wilderness value of island. Ugly.	<ul style="list-style-type: none"> • Keep boardwalk low and close to vegetation to shield visual impact • No use of handrails except on beach section
	Aesthetic impact	H	M	Island no longer "pristine". Evidence of human activity	
Use of jetty and boardwalk by seals	Trapping seals in gated area; seals falling from jetty or boardwalk	L	H	Injury or death to seals	<ul style="list-style-type: none"> • Monitoring • Modification of design or removal if any indication of injury or death to seals
	Need to clear boardwalk before visitors can use it	H	M	Disturbance to seals Indirect disturbance to nesting birds	<ul style="list-style-type: none"> • Avoid clearing seals towards areas where there are nesting birds



<i>Activity</i>	<i>Output</i>	<i>Probability</i>	<i>Importance</i>	<i>Predicted Impacts</i>	<i>Mitigation</i>
	Possible loose wire or other sharp objects on boardwalk	L	M	Injury to seals	<ul style="list-style-type: none"> • Examine boardwalk carefully after construction and during maintenance to ensure that there are no protruding wires or sharp objects; repair as necessary • Regular checking of boardwalk by Expedition Leaders and repairs as necessary
	Increase in seal numbers inland due to boardwalk	M	H	Increased disturbance to nesting birds Increased vegetation erosion; loss of habitat	<ul style="list-style-type: none"> • Reassess design. Non-continuous boardwalk may reduce this potential problem
Collision of birds with jetty/boardwalk	Bird strike	L	H	Death or injury to birds	<ul style="list-style-type: none"> • Do not use handrails • Monitor to assess impacts • Remove if any evidence of bird strike
Nesting birds relocating too close to boardwalk	Need for monitoring and possible modified visitor code	L	L	Disturbance to nesting birds Damage to vegetation if visitors required to step off boardwalk	<ul style="list-style-type: none"> • Develop management procedures to reduce potential visitor impacts. Eg. Pass nest individually and keep noise to absolute minimum • Monitoring to assess visitor impacts on birds • Diversion or closure of area if birds are agitated by visitor presence
Nesting birds relocating too far away from boardwalk	Possible need to move boardwalk sections	L	M	Damage to vegetation Disturbance to nesting/burrowing birds Construction impacts	<ul style="list-style-type: none"> • Refer to minimisation and mitigation for construction • Use ship or yacht-based facilities rather than camping if visit requires overnight accommodation
Maintenance activities or removal of boardwalk	Many of impacts of construction	H	M		<ul style="list-style-type: none"> • Refer to minimisation and mitigation for construction • Use ship or yacht-based facilities rather than camping if visit requires overnight accommodation • Keep number of visits to a minimum and link inspection to a normal tour visit



6. MONITORING AND VERIFICATION

The initial environmental reference state of Prion Island is described in section 4. This information can be used as a baseline when assessing impacts on the environment resulting from the proposed project. Past and current monitoring activities are described in section 4.10. Prion Island has already been identified as a key monitoring site for ACAP. Monitoring activities should also include assessment of human impacts, vegetation damage and monitoring of specific impacts associated with any boardwalk infrastructure.

During the project, records will be kept of any environmental incidents. These will be reported to the GSGSSI.

A review will be undertaken when the boardwalk is complete, to include an assessment of whether the predictions contained in this IEE were correct and that the recommended mitigation measures were used and were effective.

Future monitoring of the impacts of visitors on Prion Island should include specific reference to the impacts of the proposed boardwalk.

7. GAPS IN KNOWLEDGE AND UNCERTAINTIES

The following gaps in knowledge and areas of uncertainty exist:

- Locations of bird nesting sites, sensitive vegetation and substrate
- Topographical survey and exact location of the route
- Precise logistics for movement of cargo and personnel
- Likely continuing decline in wandering albatross breeding numbers
- How visitors will behave on the boardwalk, and if they will stay on the boardwalk at all times
- Effect of visitation on bird breeding success
- Effect of boardwalk on fur seal access to plateau area
- Potential for bird strike on boardwalk structure

8. ENVIRONMENTAL MANAGEMENT OF PRION ISLAND

GSGSSI policy states that site specific management plans will be prepared for all Specially Protected Areas (Pasteur and Walton, 2006).

A management plan will therefore be prepared for Prion Island, which is likely to include:

- site boundary; research and visitor areas
- reasons for designation
- guidelines for visitors (revision of Code of Conduct for Prion Island)
- activities which are prohibited, restricted or managed
- maintenance plan for boardwalk
- monitoring of impact of boardwalk
- other monitoring and research activities

In order to meet with some of the mitigation measures outlined in section 5, a site specific management plan for Prion Island, including revisions to the Prion Island Code of Conduct, should be prepared before the completion of the boardwalk.



9. CONCLUSIONS

The Government of South Georgia propose a boardwalk on Prion Island because they feel it solves many management and conservation issues such as restricting visitors to a set path, reducing erosion and vegetation damage and providing a route across a beach that can be full of fur seals. The boardwalk has been designed as a temporary structure and could be removed in the future.

Possible alternatives to a boardwalk have been suggested. A combination of path improvements with management controls such as restrictions to visitor access during the fur seal breeding season, a cap on visitor numbers and the use of observers offer viable environmental management alternatives to the construction of a boardwalk, which may result in a lower level of environmental impacts. Most of the alternatives suggested involve placing restrictions on visitor access to Prion Island and may result in increased impacts at other locations.

The proposed activity is assessed to generate the impacts as described in section 5. Due to the small scale of the operation, many of the impacts, such as atmospheric emissions, light pollution and waste disposal are assessed as being low. However, these impacts should be mitigated as much as possible.

The most significant temporary impacts of the proposed boardwalk are physical disturbance to sensitive wildlife and damage to vegetation and erosion during construction. The vegetation will largely recover, apart from beneath the boardwalk sections whilst they are in place, and vegetation damage due to visitors should be eliminated by the presence of the boardwalk. Possible injuries to seals may occur due to the boardwalk, but these would be addressed should they occur.

The most significant long-term impacts are:

- Loss of wilderness and aesthetic value to Prion Island
- Visual impact of the boardwalk
- Possible introduction of alien species
- Possible increase in access of fur seals to plateau area of island and consequent increased disturbance of breeding birds

Every care should be taken to minimise the possible introduction of alien species as this represents a serious risk. Monitoring to check for possible impacts such as increasing disturbance of albatross by fur seals and any bird injuries due to collisions with the structure should be undertaken and remedial action taken if necessary.

The current design is a significant structure and removal would be costly and difficult. Also, in practice, once infrastructure has been introduced it would be difficult to remove it without leaving traces of its previous presence. However, if the construction and operation were well executed and then removal was effected, then the overall impact could be considered as no more than minor or transitory.



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Cover photograph by Sally Poncet.

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12. ABBREVIATIONS AND ACRONYMS

Acronym	Meaning
BAS	British Antarctic Survey
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
GSGSSI	Government of South Georgia and South Sandwich Islands
IEE	Initial Environmental Evaluation, as defined by the Protocol to the Antarctic Treaty (1992)
KEP	King Edward Point
SPA	Specially Protected Area

13. APPENDICES

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Appendix 1: Management Plan Questionnaire survey responses

Should boardwalks be used at sites with high visitor numbers to protect fragile vegetation and burrowing birds from trampling, provide a route through fur seals and provide viewing platforms for observation of nesting birds (at an appropriate distance)?

Yes, at a very limited number of popular sites from which seals or birds can be viewed.
Yes, of course, subject to considerations in 11 above and taking account of visitor perceptions.
yes but only if access to the place e.g. Prion Island was not limited to the boardwalk. That is, if the board walk provided access through fur seals and up onto the island but we could still wander beyond the end of the board walk
yes
This would be a good idea at frequently visited and sensitive sites.
Yes
Yes, cf. Macquarie I., Marion I., Cape Horn, etc.
Yes, proven in many parts of the world, plus high enough for movement underneath
Boardwalks are an effective tourist management tool. The RSPB has developed recycled plastic boardwalks which have proved effective at their sites, which would be worth looking into.
The short answer is yes. But limiting visitor numbers or closing off areas on a rolling basis - i.e. closed for a year or two and then opened for a number of years. If there are a reasonable number of areas then there would always be enough, with a variety of wildlife/scenery to satisfy a (controlled) number of visitors.
yes or strictly monitored pathways
Yes in moderation. I don't know what the effect of construction of boardwalks would have
yes
If the fur seals have not already ruined the areas, board walks could be an idea providing they can be constructed at a reasonable cost and can withstand the environment and seals
Viewing platforms (such as ones at Schleiپر Bay), boardwalks (such as at Macquarie Island and Campbell Island) could be practicable. If safe and secure, with a good landing place, I believe visitors would enjoy seal viewing platforms
yes
Yes, Prion Island is a particular case
yes
Yes, but only if visitors can not be controlled any other way. There are always some that seem not to show respect.
yes
Boardwalks provide a hardy all season route without causing damage to land - recommended where there are high numbers of visitors
Yes, boardwalks would be worthwhile
yes
yes, in a few sites
Yes, in certain areas
yes, if really necessary
yes, as a priority
yes
yes



Yes, if the visitor access is acceptable generally but liable to cause localised damage/disturbance of consequence to habitat/species
Yes
Unfortunately, yes.
Similar to that at Macquarie Island and Campbell Island
YES but only if doesn't cause addition damage or endanger the animals beginning viewed.
If it is well made: yes
with care and consideration
yes, while I know people do not like to see boardwalks in wilderness - the reality is people will come, people need to see, smell, learn from experience - they are easier to control
yes
yes - this works well in Malaysia
Boardwalks are a good idea but would detract from the wilderness experience that most people visit SG for.
Firstly, need to prove that visitors are significantly trampling burrowing birds and killing fragile vegetation. Fur seals may also be contributing to this. Visitors tend to use rock creeks and non vegetative routes.
Best to protect the nesting birds rather than build a large boardwalk that might interfere with bird movements, displaying and breeding. Humans are temporary - boardwalk is permanent.
If there are significant impacts (and these are only likely to get worse), and assuming visitor pressure is likely to increase then boardwalks etc are definitely an asset - but they need to be well planned out e.g. at the end of the boardwalk you often get a mud area unless thought is put into planning it. These facilities can then be used to justify focusing future visitor pressure in these sites and leave others alone - refer NZ subant management.
Yes, provided the impact from the construction of the boardwalks was minimised and did not involve large plant machinery to put them in place, and a management plan to maintain the boardwalks annually was implemented.
A perfectly reasonable option, but see answer to 11
Broadwalks might be a good compromise, if the science proves their non-intrusiveness.
Perhaps through the fur seals at Prion Island. But no other boardwalks should be put in place.
I think a boardwalk, as part of visitor management on Prion or Albatross Island, is a good idea. I would not make a statement that boardwalks should be used at other sites with high visitor numbers, which would imply there should be the same at Gold Harbour, Cooper bay, St Andrews etc etc
Only where considered essential. EIA necessary. The wilderness experience must be taken into account.
Sounds desirable but should first obtain expert assessment of environmental costs (as well as financial costs) of implementing and maintaining them.
High maintenance costs may make such an approach too costly. Sticking to well known routes may be just as effective. Fur seals are unlikely to avoid the boardwalks in most cases anyway.
cost?
only after a cost-benefit analysis
The decision to install such infrastructure should take into account the impact of the structure, whether it can be removed in the future should it prove to be inappropriate, the costs of maintenance (and the potential cost of non-maintenance), how important it is to afford access. A boardwalk would be more removable than a hardened path.
There is no clearcut case. Both pros and cons need further careful consideration, and have



been presented in the LVMR. See LVMR Section 13.7 and Rec 59.

Possibly, at a limited number of sites and depending on the seriousness of the problem. It will clearly detract from the wilderness experience but may provide desirable protection and control at some popular sites. The scale of costs of creating and maintaining or removing such infrastructure needs considering.

Within IAATO, members have debated whether to endorse the boardwalk proposal for Albatross and/or Prion Island now for years. There is still no clear consensus. If a boardwalk is built, we must realize that it is a precedent for the western hemisphere Antarctic/sub-antarctic region. It would really be a horrible change to the relatively pristine nature and wilderness feel of the Antarctic if each and every site that gets increasing tourism use ended up with some kind of visitor infrastructure. That said, if use is to continue at the current level something certainly must be done, because with all use being focused on Prion Island and with increasing numbers of vessels, the beautiful mosses of the islands are taking a beating and there is no real way of knowing if all groups are behaving as instructed. If we take the example of Campbell Island, New Zealand, they have been very pro-active with management. They have built an extended boardwalk to reduce the impact of visitors going up to the Royal Albatross colony, but once passengers are up in the colony, they are free to wander. This would NOT be appropriate for Prion or Albatross Island because these sites are just too small and receive too much traffic. The system on Campbell only works because very few ships visit; permits are limited to 500/year, and even if they were not, demand is just not the same as South Georgia.

I believe that there are really very few options. Either: 1. close the islands completely; 2. build a boardwalk that is a loop or something like this, extending a walkway through the colony that visitors are not allowed to depart from, or; 3. reduce visitation via a permit system. This might be combined with a boardwalk into the higher part of the island to reduce impact on the vegetation. /I, and Cheesemans' Ecology Safaris, support the third option, because while it is ideal for everybody to have the incredible experience of sitting with a Wandering Albatross, the small island may suffer at the hands of so many visits. If a boardwalk is to be built as a complete experience that visitors are not allowed to leave, there is no way to assure that birds are either close enough to have a good experience or far enough to assure that people have little impact. However, given the frequency with which Bird Island albatross are approached and handled and how they habituate, we could assume that any birds nesting very close to the trail will either already be or become habituated.

Currently time limits are imposed on tourist visits, which by my impression is counter-productive. It is in the interest of both birds and visitors to have a very relaxed, unpressured visit where people do not feel pressure to get views and pictures within their time limit, and people are able to sit back in a relaxed manner to watch natural albatross behaviour unfold. Only the very few keenly interested visitors and most avid photographers want to stay longer than the current two hour limit, and these are the people who will be the most respectful – they are there because they love the birds – if they are allowed to have exactly this, a long relaxed time to be with the birds. Obviously they must continue to be monitored in no less a stringent way than when the bulk of visitors are on the island.

Further, while we debate how visitors can be most respectful and least harmful while visiting the Wandering Albatross, the birds are obviously dying not at the hands of visitors but on the lines of pirate fishing interests. GSGSSI has done well to get its own house in order. However, it is the responsibility of GSGSSI to use whatever political clout it may bring to bear on the governments that are not controlling their own fishing interests. Maybe very little can be done, maybe only a statement by the governor to the various countries whose vessels are responsible for the fishing, but if this is all that can be done it should be done.

No – too intrusive, requiring high maintenance and intrusive presence to achieve the build and



the maintenance, government liable to litigation from decaying or slippery boardwalks. Natural stream bed on Prion is sufficient with perhaps a dedicated team to fill in holes in the stream bed (out of season) with natural stone. This would make a natural pathway encouraging people to walk on the safe ground away from burrows etc. Seriously consider reducing visitor numbers rather than catering for increasing ones. Birds have moved because of impact so the boardwalk may always need extending as the nest sites go further from the visitors with a never-ending problem having been started up. A suggestion of a “bridge” across the beach at the Prion landing site has some merit as this would keep the fur seals from being disturbed and territorial fights ensuing. But this would be unnecessary if visit during the fur seal season were stopped – see later responses.

Boardwalks may be the best option for particular sites. Marked and prepared “tracks” may be another. Any of these type of management tools should only be undertaken after a thorough EIA process and discussion with stakeholders, as required in the Environment Charter. Boardwalks will have a long-term impact and should attract some of the highest level EIA analysis.

Boardwalks: There is value for a boardwalk at for example Prion Island where the zodiac embarkation/disembarkation takes place as long as its done in such a way that the fur seals can’t actually get on to the boardwalk or wouldn’t get caught underneath it. It’s always a challenge to clear the fur seals if one is to do a landing there. However there should be a cost analysis perhaps to see what it would cost to build, maintain and also if it goes up the hill towards the Wandering Albatross, how would it take into account the possibility of nests being not used or moved. So, a boardwalk around the fur seals might make the most sense and then a gravel path up the hill. If there is a boardwalk it should be erected with the possibility of removing it easily or changing its location if need be. This sort of thing is done successfully in Africa for example at the bush camps with the concessionaire permits. We understand that there has been approval for boardwalks already.

Boardwalks are one option. Naturally hardened paths are another. The latter is the most environmentally suitable option, and one which should be given every consideration. By not giving respondents to this questionnaire the opportunity to consider it as an option indicates that naturally hardened pathways are less likely to be considered as a management tool than are boardwalks, and it certainly doesn’t inform respondents that there are other options available. That it wasn’t included in this questionnaire indicates a significant bias.

Boardwalks, like naturally hardened paths, may possibly be justifiable if used to prevent damage to vegetation AND to ensure that visitors stick to a single track – the justification for a boardwalk/path comes from the need to prevent damage to substrate, to burrowing petrel burrows and to stop people getting too close to threatened species e.g. wanderers. Putting a boardwalk in to provide a route through fur seals is dodgy – if you consider it necessary for one site, then its got to be necessary at many others too if the justification is passenger protection and guaranteed site access.

Installation of boardwalks etc at rat-free sites would need a thorough environmental impact assessment and evaluation of the potential long-term impacts caused by annual maintenance activities - these activities may present more impact risks than those associated with tourists. See L&V Report for more details on boardwalks etc.

I feel that boardwalks would detract from the wildness of the place and probably not be adhered to anyway. The visitors and guides are generally very conscious and respectful of the environment, and I believe briefings, guidelines and a strict code of conduct for the guides (who are generally conscientious and experienced) would be more effective.

No



No, it would become an unnatural requirement
No. If visitor numbers are causing this damage, then they should be reduced.
No, but keep under review
not keen but it is difficult to control mixed fitness groups when visiting albatross on Albatross and Prion Islands - perhaps justified for these. No need to put boards up for fur seals - usually can find alternative route

Appendix 2: Guidelines for prevention of introduction and translocation of alien species

The South Georgia Government requires the following procedures be observed by all visitors to protect South Georgia from further introduction or translocation of alien species and disease.

Before departure from port

1. All boots and clothing must be cleaned.
2. Other equipment such as cargo boxes, scientific and filming equipment, tripod stands, walking sticks, backpacks and any items which come into contact with the ground or vegetation must also be checked.
3. The contents of pockets must be emptied and any Velcro cleaned, both with vacuum cleaner process to ensure seeds or other material do not adhere to the cloth.
4. Large items of equipment such as plant and machinery must be checked and, if necessary, steam-cleaned.

Landings at South Georgia

1. Visitors must check again that all boots, clothing and equipment are clean prior to making any landings.
2. Where possible, cleaning facilities should be provided on deck, such as brushes for clothing, boot washing stations (buckets of disinfectant, stiff brushes, running water etc.).
3. Boots, clothing and equipment must be cleaned as well as possible before re-entering the landing craft or helicopter to return to the ship/yacht. Where possible, brushes should be provided to facilitate this.
4. On returning to the ship, boots and clothing must be cleaned thoroughly at the boot washing station.
5. Boots and clothing should be dried completely between landings if possible.

Prevention of introduction and transfer of rats

1. All vessels over 100 tonnes must have a current de-ratting certificate
2. Bait stations or traps must be maintained on board all vessels and food wastes must be correctly disposed of
3. All vessels berthing anywhere on the island must use rat guards and raise the gangway at night, and ensure that no foodstuffs are left on deck and that hatches are secure
4. Precautions must be taken when packing cargo in areas where rats may be present.
5. Food must be packed in rat-proof containers
6. Regular inspections for the presence of rats must be made when packing, loading, unloading and unpacking





Appendix 3 Visitor's Code for Prion Island

CODE OF CONDUCT FOR VISITORS TO PRION ISLAND

GSGSSI 2001

Note that Albatross Island is closed to visitors

1. No landings other than on the designated landing beach on the E coast of Prion Island, as indicated on Site Map
2. Research areas at the N end of Prion Island (as indicated on Site Map) are not to be visited
3. Avoid walking on fragile vegetation and burrowing petrel areas
4. No more than 1 vessel visit a day
5. Prior to cruise ship passengers landing, the Expedition Leader and staff set up a flagged route from beach to main viewing stations, avoiding fragile vegetation, moss banks and burrowing petrel areas, and respecting the minimum distances from wildlife
6. Minimum viewing distance from wanderers and giant petrels is 10m for birds on nests, 25m from displaying wanderers
7. Visitors to remain in groups of maximum 11 passengers guided at all times by an experienced staff member
8. Maximum of 12 people, including a guide, at a wanderer nest or display site at any one time
9. Maximum of 65 people ashore at any one time
10. Maximum visit duration 4 hours



Appendix 4. SGSSI Post-visit report: Part 3



SGSSI POST-VISIT REPORT: PART 3

Environmentally Sensitive Area Visit Record

On the map below, shade the areas visited including the landing beach, access routes and areas walked. Provide the following details:

Expedition Leader's name:	Vessel name:
Date of landing:	Total number of guided groups landed:
Any beach debris, litter, net-entangled wildlife observed:	
Any other comments:	

PRION ISLAND

- selected wandering albatross viewing areas X
- gully access route (fur seals permitting) - - - -
- designated landing site →
- stream, seepage gully ~~~~~
- pond, lake ●●
- beach ::::

