

Management Plan for Antarctic Specially Protected Area No 135

NORTH-EAST BAILEY PENINSULA, BUDD COAST, WILKES LAND

Introduction

North-East Bailey Peninsula (66°16'59.9"S, 110°31'59.9"E) is located approximately 200m east of Australia's Casey station, in the Windmill Islands region of the Budd Coast, Wilkes Land, East Antarctica. It was designated as Site of Special Scientific Interest (SSSI) No 16 under Recommendation XIII-8 (1985), after a proposal by Australia. In accordance with Decision 1 (2002) the site was redesignated and renumbered as Antarctic Specially Protected Area (ASP) No 135. Revised management plans for the Area were adopted under Measure 2 (2003) and Measure 8 (2008). The ASPA is designated primarily as a scientific reference site which, since the early 1980s, has supported a range of studies into the diverse assemblage of vegetation found in the area. The close proximity of the Area to Casey station allows ease of access for field research but also creates the potential for disturbance of study areas.

1. Description of values to be protected

The North-east Bailey Peninsula Antarctic Specially Protected Area (the Area) is representative of a diverse assemblage of the Windmill Islands region flora. As such, the Area has intrinsic ecological value and scientific importance, particularly to botanists, microbiologists, soil scientists and glacial geomorphologists.

The Area contains three extensive and contrasting moss fields that have been the subject of taxonomic, ecological and physiological studies since the summer of 1982/83. Additional studies have included population ecology of invertebrates associated with the vegetation, and soil/water chemistry. Permanent lichen growth monitoring sites are established, as are sites monitoring annual growth increments in mosses (see Map E). Other floral studies have concentrated on the determination of biodiversity, physiological and biochemical attributes, component interactions, impact of anthropogenic pollutants, and potential effects of global climate change.

Global change studies have included a multi-year investigation into the impact of water and nutrients on various components of the vegetation, associated studies into the tolerance of mosses to both submergence and desiccation, and examination of the tolerance of three moss species to increased UV-B as a result of ozone depletion. Fine-scale analysis of genetic diversity of one cosmopolitan moss species *Ceratodon purpureus* has been compared for this location and others in the region. Dating of long cores of mosses has been achieved using ¹⁴C and stable carbon isotopes of moss shoots, which provide a signature for changes in site water availability.

The Area is included within the geographic coverage of an Australian Antarctic program State of the Environment Indicator 72 "Windmill Islands terrestrial vegetation dynamics", which involves quantitative analysis of a series of permanent transects across selected vegetation, with the aim of monitoring the effects of climate change on Antarctic cryptogamic communities. This indicator was updated in 2008 and 2012.

Moss and lichen communities are used as indicators of environmental impacts of Casey station. The Area provides baseline data with which to compare changes in similar plant communities in the immediate surroundings of Casey station. The Area also serves as a valuable comparative

site for similar plant communities in ASPA 136 Clark Peninsula, which are subject to less environmental stress and disturbance, due to lower human proximity.

2. Aims and objectives

Management of the Area aims to:

- avoid degradation of, or substantial risk to, the values of the Area by preventing unnecessary human disturbance and sampling in the Area;
- preserve a part of the natural ecosystem as a reference Area for the purpose of future comparative studies and to assess direct and indirect effects of Casey station;
- provide for compelling scientific research which cannot be served elsewhere;
- minimize, to the maximum extent practicable, the introduction of non-native plants, animals and microbes to the Area; and
- allow for the continued maintenance and operation of essential communications infrastructure including the transmitter building, towers, antennas, feed lines, storage rack and associated facilities without degradation of the Area's values.

3. Management activities

The following management activities shall be undertaken to protect the values of the Area:

- place signs illustrating the location and boundaries, with clear statements of entry restrictions at appropriate locations at the boundaries of the Area to help avoid inadvertent entry;
- display prominently information on the location of the Area (stating special restrictions that apply) and a copy of this Management Plan at Casey station and make copies of this information available to ships visiting the vicinity;
- secure and maintain in good condition markers, signs and structures erected within the Area for scientific or management purposes and remove them when no longer required;
- remove abandoned equipment or materials to the maximum extent possible provided this does not adversely impact on the values of the Area.
- detailed mapping of ongoing scientific experimental sites to ensure they are not disturbed;
- visit the Area as necessary (no less than once every five years) to assess whether the Area continues to serve the purposes for which it was designated and to ensure that management activities are adequate; and
- review the Management Plan at least every five years and update as required.

4. Period of designation

Designated for an indefinite period.

5. Maps

- Map A: Antarctic Specially Protected Areas, Windmill Islands, East Antarctica
- Map B: Antarctic Specially Protected Areas No 135, North-east Bailey Peninsula: Topography and Bird Distribution
- Map C: Antarctic Specially Protected Areas No 135, North-east Bailey Peninsula: Vegetation
- Map D: Antarctic Specially Protected Areas No 135, North-east Bailey Peninsula: Geology

- Map E: Antarctic Specially Protected Areas No 135, North-east Bailey Peninsula:
Long term scientific monitoring sites

Map specifications:

Projection: Lambert Conformal Conic (Map A)

Projection: UTM Zone 49 (Maps B, C D and E)

Horizontal Datum: WGS84 (All maps)

6. Description of the Area

6(i) Geographical co-ordinates, boundary markers and natural features

General description

The Area is located on Bailey Peninsula in the Windmill Islands region of Budd Coast, Wilkes Land, East Antarctica (Map A). Bailey Peninsula is an area of rock exposures and permanent snow and ice fields lying between Newcomb Bay and O'Brien Bay, two kilometres south of Clark Peninsula.

The Area is located in the north-east of Bailey Peninsula, approximately 200m east of Casey station (66°16'59.9"S, 110°31'59.9"E), and covers an area of approximately 0.28km². The boundary is irregular, extending in the north to within approximately 70m south of Brown Bay. Boundary coordinates for the Area are shown in Appendix 1.

Topographically, Bailey Peninsula comprises low lying, rounded ice-free rocky outcrops (maximum altitude approximately 40 m), which rise from the coast to the Løken Moraines (altitude approximately 130 m). Intervening valleys are filled with permanent snow or ice, or glacial moraine and exfoliated debris, and contain water catchment areas. The topography of Bailey Peninsula is shown at Map B.

Climate

The climate of the Windmill Islands region is frigid-Antarctic. Climate records from nearby Casey station (altitude 32 m) show mean temperatures for the warmest and coldest months of 2.2 and -11.4°C respectively, extreme temperatures ranging from 9.2 to -34°C, and mean annual maximum and minimum temperatures of -5.9°C and -12.5°C respectively. The climate is dry with a mean annual snowfall of 219 mm year (rainfall equivalent), precipitation as rain has been recorded in the summer and recently in July 2008 and July 2009.

There is an annual average wind speed of 25km per hour. Gale winds are predominantly from the east, off the polar ice cap. Blizzards may occur very suddenly and are a frequent occurrence especially during winter. Snowfall is common during the winter, but the extremely strong winds scour the snow off exposed areas of the Peninsula. On most hill crests on Bailey Peninsula snow gathers in the lee of rock outcrops and in depressions in the substratum. Further down the slopes snow forms deeper drifts.

Environmental domains analysis

Based on the Environmental Domains Analysis for Antarctica (Resolution 3 (2008)) North-east Bailey Peninsula is located within Environment D *East Antarctic coastal geologic*.

Antarctic Conservation Biogeographic Regions

Based on the Antarctic Conservation Biogeographic Regions (Resolution 6 (2012)) North-east Bailey Peninsula is located within Biogeographic Region 7 *East Antarctica*.

Geology and soils

WINDMILL ISLANDS REGION

The Windmill Islands region represents one of the eastern-most outcrops of a Mesoproterozoic low-pressure granulite facies terrain that extends west to the Bunger Hills and further to the Archaean complexes in Princess Elizabeth Land, to minor exposures in the east in the Dumont d'Urville area and in Commonwealth Bay. The total outcrop areas do not exceed more than a few square kilometres. The Mesoproterozoic outcrop of the Windmill Islands and the Archaean complexes of Princess Elizabeth Land are two of the few major areas in East Antarctica that can be directly correlated with an Australian equivalent in a Gondwana reconstruction. The Mesoproterozoic facies terrain comprises a series of migmatitic metapelites and metapsammites interlayered with mafic to ultramafic and felsic sequences with rare calc-silicates, large partial melt bodies (Windmill Island supacrustals), undeformed granite, charnockite, gabbro, pegmatite, aplites and cut by easterly-trending late dolerite dykes.

BAILEY PENINSULA

Bailey Peninsula is part of the northern gradation of a metamorphic grade transition which separates the northern part of the Windmill Islands region from the southern part. The metamorphic grade ranges from amphibolite facies, sillimanite-biotite-orthoclase in the north at Clark Peninsula, through biotite-cordierite-almandine granulite, to hornblende-orthopyroxene granulite at Browning Peninsula in the south. The Ardery Charnockite of the south is prone to deep weathering and crumbles readily because of its mineral assemblage, whereas the metamorphic sequences of the northerly parts of the region have a much more stable mineral assemblage and crystalline structure. This difference has a significant influence on the distribution of vegetation in the Windmill Islands region with the northern rock types providing a more suitable substrate for slow growing lichens.

The leucocratic granite gneiss, which constitutes the main outcrop on Bailey Peninsula, may be subdivided into leucogneiss and two different types of garnet-bearing gneiss. The outcrop on Bailey Peninsula is characterised as a garnet-bearing gneiss type 1 which is white, medium grained and foliated. The foliation is defined by the alignment of an early biotite generation that is tight to openly folded, with a garnet and a later biotite generation that overgrows the fabric. Unmetamorphosed and undeformed dolerite dykes occur over Bailey Peninsula such as at "Penguin Pass" (66°17'18"S, 110°33'16"E), to the south of the Area. Small outcrops of metapelite, metapsammite and leuco- gneisses occur on the Peninsula. Recent geochronology of the rocks of the Windmill Islands region suggest two major phases of metamorphism, the first at c. 1400-1310 Ma, an upper amphibolite facies event, followed by a granulite facies overprint c. 1210-1180 Ma. The geology of Bailey Peninsula is shown at Map D.

GLACIATION

The Windmill Islands region was glaciated during the Late Pleistocene. The southern region of the Windmill Islands was deglaciated by 8000 corr. yr B.P., and the northern region, including Bailey Peninsula deglaciated by 5500 corr. yr B.P. Isostatic uplift has occurred at a rate of between 0.5 and 0.6 m/100 yr, with the upper mean marine limit, featured as ice-pushed ridges, being observed on Bailey Peninsula at approximately 30m where they extend in continuous rows from the present sea- level.

SOILS

Soils on Bailey Peninsula are derived from weathered gneiss, moraine deposits and outwash gravels stemming from glacial episodes. Seabirds have a large impact on soil formation in the entire landscape. Soils are frozen much of the year during summer, the upper 30-60 cm thaws with the few top centimetres, refreezing at night. Soils are mainly formed by cryoturbation and cryoclastic weathering. In the vicinity of Casey station most soils are classified by Blume, Kuhn and Bølter (2002) as cryosols with lithic, leptic, skeletal, turbic and stagnic subunits. Other soils in the Area are gelic subunits of histosols, podzols, and regosols, boulder and rock outcrops with ecto- and endolithic flora are classified as Lithosols. ASPA 135 was the site of an

abandoned penguin colony, isolated due to isostatic uplift between 3-8000 years ago, that provides a rich ancient guano nutrient source for the current vegetation.

Lakes

Cold monomictic lakes and ponds occur throughout the Windmill Islands region in bedrock depressions and are usually ice-free during January and February. Nutrient rich lakes are found near the coast, in close proximity to penguin colonies or abandoned colonies, sterile lakes are located further inland and are fed by meltwater and local precipitation. A number of these lakes and ponds occur across Bailey Peninsula with two large lakes located 500m to the west of the Area. Two ponds occur within the protected Area, the largest being approximately 75m by 50m and the smaller soak approximately 25m diameter. The distribution of lakes and ponds on Bailey Peninsula is shown at Map B.

Vegetation and microbial communities

WINDMILL ISLANDS REGION

The Windmill Islands region supports some of the most extensive and best-developed plant communities in eastern Antarctica. The region is floristically diverse with rich associations of macrolichens and bryophytes that occupy very specific ecological niches. The flora of the Windmill Islands region comprises at least 36 species of lichen, 4 bryophytes (3 mosses and 1 liverwort), 150 non-marine algae and at least 120 fungal taxa. An ascomycete mycorrhizal fungus has been shown in the liverwort *Cephaloziella varians*.

Lichens constitute the largest part of the Windmill Islands region flora, with bryophytes being dominant in moister areas. At least 11 cryptogamic community types have been identified. These vegetation groupings exist within a continuum of ecological variation along environmental gradients influenced by soil moisture, soil chemistry, and microclimate. On the peninsulas in the region, the major community types are distinguished by the dominance of three bipolar lichens, *Usnea sphacelata*, *Pseudephebe minuscula* and *Umbilicaria decussata*. Vegetation communities on the islands are dominated by algal species such as *Prasiola crispa*, with bryophyte and lichen being considerably poorer developed than on the peninsulas. Mosses and lichens are all but absent in eutrophic sites near bird colonies with a prevalence of *Prasiola crispa*, *Prasiococcus calcareus* and *Desmococcus olivaceus* chlorophyte algae occurring.

The vegetation of Bailey Peninsula is exceptionally well developed and diverse and the Area represents one of the most important botanical sites on continental Antarctica. Within the relatively complex plant communities and contrasting habitats found on Bailey Peninsula, are found at least 23 lichens, three mosses, and a liverwort. There are expansive dense stands of macrolichens and in the more moist and sheltered areas bryophytes form closed stands of 25-50 m² with turf up to 30 cm in depth. Together with the lichens *Umbilicaria decussata*, *Pseudephebe minuscula* and *Usnea sphacelata* mixed bryophytes dominate the vegetation cover of most of the ice-free areas. This is particularly so on the north-east and centre of the Peninsula where there are dense communities similar to those found on Clark Peninsula. The most complex bryophyte communities are restricted to small locally moist hollows adjacent to melt pools and streams in the central north-east and central parts of the Peninsula. Vegetation is absent or poorly developed on the ice-free areas of the Peninsula's southern coast. Appendix 2 provides a list of bryophytes and lichens identified in the Area. In many areas mosses appear to be becoming increasingly moribund and are being out-competed or overgrown by lichens. Stable isotopes analysis of moss shoots has shown that growth rates have slowed since the 1980s associated with drying of the moss beds.

Two principal cryptogamic subformations are recognised; a lichen-dominated association occupying a variety of windswept substrata ranging from bedrock to gravel, and, a short cushion and turf moss subformation comprising four moss dominated groupings. The vegetation of Bailey Peninsula is shown at Maps C and E.

At least 150 taxa of non-marine algae and cyanobacteria have been isolated; these include 50 cyanobacteria, 70 chlorophytes and 23 chromophytes. The taxa have been found in snow and ice, soil, rocks, ephemeral ponds, tarns and lakes; 24 cyanobacterial and algal species occur in the snow. Snow algae are abundant and widespread in the icy corridors between the rocky outcrops and in semi-permanent snow drifts. A list of cyanobacterial and algal species from the Area, Bailey Peninsula, and the Windmill Islands region is shown in Appendix 3.

The vegetated soils of Bailey Peninsula contain fungal hyphae, yeasts, fungal propagules, an assortment of algae, cyanobacteria, protozoa, and provide a significant habitat for soil microfauna such as nematodes, mites, rotifers and tardigrades. There is relatively low fungal diversity in the Windmill Islands region, with 35 taxa representing 22 genera of fungi being isolated from soils, mosses, algae and lichens. Thirty fungal taxa have been detected in soils in the vicinity of Casey station with 12 of these taxa restricted to anthropogenically influenced soils around the station suggesting that there may be a non-native element in this flora, *Penicillium* species dominate in these sites. Within the Windmill Islands region, 21 fungal taxa have been isolated the mosses, with 12 taxa isolated from algae and 6 from lichens. A number of fungi have also been found associated with animals of the region. Appendix 4 provides detail of the taxa and their source.

Genomic analysis of soil microbial flora is currently under investigation. There have been some genomic analyses of mosses, especially *C. purpureus*.

Birds

Four species of birds are known to nest in the vicinity of Bailey Peninsula. These include Adélie penguin *Pygoscelis adeliae*, the most abundant bird species in the Area. The nearest breeding colony is on Shirley Island about 1.5km west of Casey station. Snow petrels *Pagodroma nivea* are seen all year round and breed throughout the Windmill Islands region including Reeve Hill about 750m west of the Area and Budnick Hill, 600m to the north-west. Wilson's storm petrels *Oceanites oceanicus* breed throughout the Windmill Islands region and nest in the Area. The Antarctic skua *Catharacta maccormicki* breeds throughout the Windmill Islands region at widely dispersed nests, mostly near Adélie penguin colonies. Skuas use the lake in the ASPA for bathing.

Other birds that breed in the Windmill Islands region but not in the immediate vicinity of Bailey Peninsula include southern giant petrel *Macronectes giganteus*, cape petrel *Daption capense*, southern fulmar *Fulmarus glacialisoides* and Antarctic petrel *Thalassoica antarctica*. The emperor penguin *Aptenodytes forsteri* is a common visitor to the Windmill Islands region and a breeding colony of approximately 2000 pairs is established in the area of Peterson Bank, 65km north-west of Casey station.

Terrestrial invertebrates and microbial communities

The Antarctic flea *Glaciopsyllus antarcticus* has been found in the nests of southern fulmars. The anopluran louse *Antarctophthirus ogmorhini* is found on the Weddell seal *Leptonychotes weddellii*. A number of species of mallophagan lice have also been found on birds.

The free-living mite *Nanorchestes antarcticus* has been found on Bailey Peninsula at sites characterised as having sandy or gravelly soils, free of extensive moss or lichen cover, and moist but not water-logged.

Five species of tardigrades have been collected on Bailey Peninsula: *Pseudechiniscus suillus*, *Macrobiotus* sp., *Hypsibius antarcticus*, *Ramajendas frigidus* and *Diphascion chilense*. Significant positive associations between bryophytes and the most common species of tardigrades *P. suillus*, *H. antarcticus* and *D. chilense*, have been found, and strong negative associations between those species and algae and lichens have been established. No systematic or ecological accounts of nematodes have yet been published for the Windmill Islands region.

Protozoa have been studied at a number of sites on Bailey Peninsula and in the Area ciliates and testate amoebae are active. Twenty seven ciliate species and six testacean species have been found (see Appendix 5).

6(ii) Access to the Area

The north-west boundary of the Area is located approximately 200m east of Casey station, and the Area is easily accessible by foot. Vehicle access to and within the Area is covered under section 7(ii) of this plan.

6(iii) Location of structures within and adjacent to the Area

Casey station (Australia) is located approximately 200m west of the Area. Prior to the designation of the Area in 1986 an array of radio transmitters had been progressively established at the site since 1964. During the 2001/2002 and 2007/2008 summers redundant aerials and some other infrastructure were removed. A number of structures remain within the Area, including a small storage rack holding antenna spares in the north-west, the transmitter building (which can also be used as an emergency refuge), a 45m high tandem delta antenna mast and a non-directional beacon antenna located in the south-east (Map E). Another 35m high mast is located approximately 100m south of the Area. These form the basis of the Casey High Frequency (HF) Transmit installation.

6(iv) Location of other Protected Areas in the vicinity

Other protected areas in the vicinity include (see Map A):

- ASPA No 136, Clark Peninsula, is located 2.5km to the north-east, across Newcomb Bay.
- ASPA No 103, Ardery and Odbert Islands, is located approximately 11km to the south, west of Robinson Ridge.
- ASPA No 160, Frazier Islands, is located in the eastern part of Vincennes Bay approximately 16km to the west-north-west.

6(v) Special zones within the Area

There are no special zones within the Area.

7. Terms and conditions for entry permits

7(i) General permit conditions

Entry to the Area is prohibited except in accordance with a Permit issued by an appropriate national authority. Conditions for issuing a Permit to enter the Area are that:

- it is issued for compelling scientific research, maintenance of the communications installation and associated facilities, removal of obsolete structures/materials, or for essential management purposes consistent with the Management Plan's objectives and provisions;
- the actions permitted are in accordance with this Management Plan;
- the activities permitted will give due consideration via the environmental impact assessment process to the continued protection of the ecological or scientific values of the Area or interfere with existing scientific studies;
- the Permit shall be issued for a finite period; and
- the Permit shall be carried when in the Area.

Additional conditions, consistent with the Management Plan's objectives and provisions, may be included by the issuing authority.

7(ii) Access to, and movement within or over, the Area

Helicopters are prohibited from landing within the Area.

Vehicles are prohibited from entering the Area, except for the purpose of conducting ongoing maintenance of the transmitter building, associated buildings and antennas, or for the removal of structures/materials. Access to the transmitter building near the south-east end of the Area should be via the over-snow access route to Law Dome, several kilometres to the south. Within the Area, vehicles should follow the most direct practicable route between the Area boundary and the communications facilities, avoiding vegetation and cables. Vehicle use in the Area shall be kept to a minimum and only use the route specified in the permit.

The north-west boundary of the Area is located approximately 200m east of Casey station, and the Area is easily accessible by foot. Visitors should avoid walking on visible vegetation. Care should be exercised when walking in areas of moist ground, where foot traffic can easily damage sensitive soils, plant or algae communities, and degrade water quality. Pedestrian traffic should be kept to the minimum necessary to undertake permitted activities and every reasonable effort should be made to walk around such areas, keeping to ice-covered areas or bare rock where it is practicable and safe to do so.

7(iii) Activities which may be conducted in the Area

Activities which may be conducted within the Area include:

- Compelling scientific research which cannot be undertaken elsewhere and which will not jeopardise the ecosystem of the Area.
- Essential management activities, including monitoring, erection of signs and removal of structures/materials.
- Sampling, but this should be the minimum required for the approved research programs.
- Operation, maintenance and other essential activities associated with the communications installation including the transmitter building, towers, antennas, feed lines, storage rack and associated facilities.

7(iv) Installation, modification or removal of structures

- Any structures erected or installed within the Area are to be specified in a Permit. Scientific markers and equipment must be secured and maintained in good condition, clearly identifying the permitting country, name of principal investigator and year of installation. All such items should be made of materials that pose minimum risk of contamination of the Area. Markers or equipment should not be made of material that may impact on the surrounding environment.
- Installation (including site selection), maintenance, modification or removal of structures and equipment shall be undertaken in a manner that minimises disturbance to the values of the Area.
- Equipment associated with scientific research, shall be removed before the Permit (or authorisation) for that research expires, as a condition of the Permit (or authorisation). Details of markers and equipment left in situ should be reported to the permitting Authority. Such details should include a description, expected "use by date", and accurate GPS location with longitude and latitude in decimal degrees to 6 decimal places (where practicable, details should also be given regarding the horizontal datum used, model of GPS, base station details, and horizontal and vertical accuracies).
- Removal of specific structures or equipment shall be a condition of the Permit for when the Permit expires.
- Permanent structures or installations are prohibited with the exception of permanent survey markers.

- All such items should be free of organisms, propagules (e.g. seeds, eggs) and non-sterile soil, and be made of materials that can withstand the environmental conditions and pose minimal risk of contamination of the Area.
- All temporary structures and installations must be removed when they are no longer required, or on the expiry of the permit, whichever is the earlier, to the extent that this does not cause more damage than benefit to the vegetation/values of the area.

7(v) Location of field camps

Camping is prohibited within the Area.

7(vi) Restrictions on materials and organisms which may be brought into the Area

- No living animals, plant material or microorganisms shall be deliberately introduced into the Area. To help maintain the ecological and scientific values of the plant communities found in the Area, persons entering the Area shall take special precautions against unintentional introductions. Of particular concern are microbial or vegetation introductions sourced from soils at other Antarctic sites, including stations, or from regions outside Antarctica. To minimise the risk of introductions footwear and any equipment – including carry cases, sampling equipment and markers – to be used in the Area shall be thoroughly cleaned before entering the Area.
- No herbicides or pesticides shall be brought into the Area unless assessed necessary to control or eradicate an alien species. Chemicals may be introduced for scientific or management purposes specified in a Permit and shall be removed from the Area at or before the conclusion of the permitted activity.
- Permanent fuel depots are prohibited. Fuel may be temporarily stored in the Area for essential purposes connected with an activity for which a Permit has been granted. Such fuel shall be stored in sealed and banded containers.
- Any materials introduced for a stated period shall be removed at or before the conclusion of the stated period, and shall be stored and handled so that the risk of dispersal into the environment is minimised.

7(vii) Taking of, or harmful interference with native flora and fauna

Taking of or harmful interference with native flora and fauna is prohibited, except in accordance with a Permit. Where taking of or harmful interference with animals is involved this should, as a minimum standard, be in accordance with the *SCAR Code of Conduct for the Use of Animals for Scientific Purposes in Antarctica*.

7(viii) The collection or removal of material not brought into the Area by the permit holder

Material may only be collected or removed from the Area in accordance with a Permit and should be limited to the minimum necessary to meet scientific or management needs.

Material of human origin likely to compromise the values of the Area, and which was not brought into the Area by the Permit Holder or otherwise authorised, may be removed unless the impact of the removal is likely to be greater than leaving the material *in situ*. In such cases the appropriate national authority must be notified and approval obtained.

7(ix) Disposal of waste

All wastes, including all human wastes, shall be removed from the Area.

7(x) Measures that may be necessary to continue to meet the aims of the Management Plan

Permits may be granted to enter the Area to carry out the following measures, provided they do not adversely impact on the values of the Area:

- biological monitoring and Area inspection and management activities, which may involve the collection of small samples for analysis or review;
- erect or maintain signposts;
- maintenance or removal of the storage rack, buildings, antenna masts and associated supplies located in the north-west of the Area; and
- other protective measures as required.

7(xi) Requirements for reports

The principal Permit Holder for each Permit issued shall submit to the appropriate national authority a report describing the activities undertaken. Such reports should include, as appropriate, the information identified in the Visit Report form contained in the *Guide to the Preparation of Management Plans for Antarctic Specially Protected Areas*. Parties should maintain a record of such activities and, in the Annual Exchange of Information, should provide summary descriptions of activities conducted by persons subject to their jurisdiction, which should be in sufficient detail to allow evaluation of the effectiveness of the Management Plan. Parties should, wherever possible, deposit originals or copies of such original reports in a publicly accessible archive to maintain a record of usage; to be used both in any review of the Management Plan and in organising the scientific use of the Area.

8. Supporting documentation

Adamson, E., and Seppelt, R. D. (1990) A comparison of airborne alkaline pollution damage in selected lichens and mosses at Casey Station, Wilkes Land, Antarctica. In: Kerry, K. R. and Hempel, G. (eds.) *Antarctic Ecosystems: Ecological Change and Conservation* Springer-Verlag, Berlin, pp. 347-353.

Azmi, O. R., and Seppelt, R. D. (1997) Fungi in the Windmill Islands, continental Antarctica. Effect of temperature, pH and culture media on the growth of selected microfungi. *Polar Biology* **18**: 128-134.

Azmi, O. R., and Seppelt, R. D. (1998) The broad scale distribution of microfungi in the Windmill Islands region, continental Antarctica. *Polar Biology* **19**: 92-100.

Bednarek-Ochyra, H., Váða, J., Ochyra, R., Lewis Smith, R. I. (2000) *The Liverwort Flora of Antarctica*. Polish Academy of Sciences, Institute of Botany, Cracow.

Bergstrom D. and Robinson, S (2010) Casey: the Daintree of Antarctica.

<http://www.antarctica.gov.au/about-antarctica/fact-files/plants/casey-the-daintree-of-antarctica>

Beyer, L., (2002) Properties, Formation and Geography of Soils in a Coastal Terrestrial Ecosystem of East Antarctica (Casey Station, Wilkes Land) [cited 26 November 2012]. Available from internet: [http://books.google.com.au/books?hl=en&lr=&id=m-MB7TZrwwg0C&oi=fnd&pg=PA3&dq=Beyer,+L.,+\(2002\)+Properties,+Formation+and+Geography+of+Soils+in+a+Coastal+Terrestrial+Ecosystem+of+East+Antarctica&ots=snaw67pzBU&ig=xU4CR0XzXafitWuROLhm1nR1FT0#v=onepage&q&f=false](http://books.google.com.au/books?hl=en&lr=&id=m-MB7TZrwwg0C&oi=fnd&pg=PA3&dq=Beyer,+L.,+(2002)+Properties,+Formation+and+Geography+of+Soils+in+a+Coastal+Terrestrial+Ecosystem+of+East+Antarctica&ots=snaw67pzBU&ig=xU4CR0XzXafitWuROLhm1nR1FT0#v=onepage&q&f=false)

Beyer, L., Pingpank, K., Bölter, M. and Seppelt, R. D. (1998) Small-distance variation of carbon and nitrogen storage in mineral Antarctic cryosols near Casey Station (Wilkes Land). *Zeitschrift für Pflanzenahrung Bodendunde* **161**: 211-220.

Beyer, Lothar, Kristina Pingpank, Manfred Bölter and Rod D. Seppelt (2002): Soil organic matter storage on soil profile and on landscape level in permafrost affected soils in the coastal region of East Antarctica (Casey Station, Wilkes Land). In: Tarnocai et al. (Eds.). *Cryosols - Permafrost-Affected Soils*. Lewis Publishers, Boca Raton (in press).

- Blight, D. F. (1975) The Metamorphic Geology of the Windmill Islands Antarctica, Volume 1 and 2, PhD thesis, University of Adelaide.
- Blight, D. F. and Oliver, R. L. (1982) Aspects of the Geological history of the Windmill Islands, Antarctica. In: Craddock, C. (Ed.) *Antarctic Geoscience*, University of Wisconsin Press, Madison, WI, pp. 445-454.
- Blight, D. F. and Oliver, R. L. (1997) The metamorphic geology of the Windmill Islands Antarctica: a preliminary account. *Journal of the Geological Society of Australia*. **24** (5): 239-262.
- Block, W. (1992) *An Annotated Bibliography of Antarctic Invertebrates (Terrestrial and Freshwater)*. British Antarctic Survey, Natural Environmental Research Council, Cambridge.
- Block, W. (2002) A dataset of Antarctic and sub-Antarctic invertebrates. [www site], [cited 26 November 2012]. Available from internet: http://gcmd.nasa.gov/KeywordSearch/Metadata.do?Portal=amd_au&KeywordPath=Parameters%7C%28%5BFreetext%3D%27invertebrates%27%5D+AND+%5BFreetext%3D%27sub-antarctic%27%5D%29&OrigMetadataNode=AADC&EntryId=block_invertebrates&MetadataView=Full&MetadataType=0&1bnode=mdl5
- Blume, H-P., Kuhn, D. and Bölter, M. (2002) Soils and landscapes. In: Beyer, L. and Bölter, M. (eds.) *Geoecology of Antarctic Ice-Free Coastal Landscapes*. Springer-Verlag, Berlin, pp. 94-98, 105-108.
- Bramley-Alves, J. *King, DH, Miller, RE & Robinson SA. (2013) Dominating the Antarctic Environment: bryophytes in a time of change. In Photosynthesis of Bryophytes and Seedless Vascular Plants. Eds Hanson DT & Rice SK. Volume in series Advances in Photosynthesis and Respiration. Springer (in press).
- Bureau of Meteorology (2004) Climate and History, Climate of Casey [www site], [cited 22 June 2004] Available from internet: <http://www.bom.gov.au/weather/ant/casey/climate.shtml>
- Clarke, L.J., Robinson, S.A., Ayre, D.J. (2008) Somatic mutation and the Antarctic ozone hole *Journal of Ecology* 96 378-385. Editor's choice article for March 2008.
- Clarke, L.J., Robinson, S.A. Cell wall-bound UV-screening pigments explain the high UV tolerance of the Antarctic moss, *Ceratodon purpureus* (revised submission to *New Phytologist* Feb 2008)
- Clarke, L.J., Robinson, S.A., Ayre, D.J. Genetic structure of Antarctic populations of the moss *Ceratodon purpureus*. *Antarctic Science* 21 51-58
- Clarke, L.J., Robinson, S.A., Hua, Q., Ayre D.J. & Fink, D. (2012) Radiocarbon bomb spike reveals biological effects of Antarctic climate change. *Global Change Biology*, **18** 301-310 plus front cover.
- Cowan, A. N. (1979) Giant petrels at Casey, Antarctica. *Australian Bird Watcher*. **8** (2): 66-67.
- Cowan, A. N. (1981). Size variation in the Snow petrel (*Pagodroma nivea*). *Notornis* **28**: 169-188.
- Dunn, J. (2000) Seasonal variation in the pigment content of three species of Antarctic bryophytes Honours thesis University of Wollongong .; [Ref:10167]; AAS Projects [941](#), [1310](#)
- Dunn, J.L., Robinson, S.A. (2006) Ultraviolet B screening potential is higher in two cosmopolitan moss species than in a co-occurring Antarctic endemic moss: implications of continuing ozone depletion. *Global Change Biology* 12. 2282-2296; [Ref:12830]; AAS Projects [1310](#), [2542](#)
- Dunn, J.L., Robinson, S.A. (2006) UV-B screening potential is higher in two cosmopolitan moss species than in a co-occurring Antarctic endemic moss - implications of continuing ozone depletion *Global Change Biology* 12 (12). 42pp; [Ref:12867]; AAS Projects [1310](#), [2542](#)

- Dunn, J.L., *Turnbull, J.D. & Robinson, S.A. (2004) Comparison of solvent regimes for the extraction of photosynthetic pigments from leaves of higher plants. *Functional Plant Biology* 31: 195-202.
- Giese, M. (1998) Guidelines for people approaching breeding groups of Adélie penguins (*Pygoscelis adeliae*). *Polar Record*. **34** (191): 287-292.
- Goodwin, I. D. (1993) Holocene deglaciation, sea-level change, and the emergence of the Windmill Islands, Budd Coast, Antarctica. *Quaternary Research*. **40**: 70-80.
- Hallingbäck, Tomas and Hodgetts, Nick. (Compilers) (2000) *Mosses, Liverworts, and Hornworts: Status Survey and Conservation Action Plan for Bryophytes*. IUCN/SSC Bryophyte Specialist Group.
- Heatwole, H., Saenger, P., Spain, A., Kerry, E. and Donelan, J. (1989) Biotic and chemical characteristics of some soils from Wilkes Land Antarctica. *Antarctic Science*. **1**(3): 225-234.
- Hogg ID, Stevens MI (2002) Soil Fauna of Antarctic Coastal Landscapes. In: Beyer L and Bölter M (eds). *Geoecology of Antarctic Ice-Free Coastal Landscapes*. Ecological Studies Volume 154, pp 265-282. Springer-Verlag, Berlin
- Hovenden, M. J. and Seppelt, R. D. (1995) Exposure and nutrients as delimiters of lichen communities in continental Antarctica. *Lichenologist* **27**(6): 505-516.
- Leslie, S. (2003) The Combined Effects of Desiccation and UV-B Radiation on the Accumulation of DNA Damage, Pigment Composition and Photosynthetic Efficiency in three species of Antarctic moss. Thesis. Bachelor of Biotechnology (Honours) Degree, University of Wollongong. 1-87; [Ref:11456]; AAS Project [1310](#)
- Ling, H. U. (1996) Snow algae of the Windmill Islands region, Antarctica. *Hydrobiologia* 336: 99-106. Ling, H. U. (2001) Snow Algae of the Windmill Islands, Continental Antarctica: *Desmotetraaureospora*, sp. nov. and *D. antarctica*, comb. nov. (Chlorophyta). *Journal of Phycology* **37**: 160-174.
- Ling, H. U. and Seppelt, R.D. (1990) Snow algae of the Windmill Islands, continental Antarctica. *esotaenium berggrenii* (Zygnematales, Chlorophyta) the alga of grey snow. *Antarctic Science* 2(2): 143-148
- Ling, H. U. and Seppelt, R.D. (1993) Snow algae of the Windmill Islands, continental Antarctica. 2. *Chloromonas rubroleosa* sp. nov. (Volvocales, Chlorophyta), an alga of red snow. *European Journal of Phycology* : 77-84.
- Ling, H. U. and Seppelt, R.D. (1998) Non-marine algae and cyanobacteria of the Windmill Islands region, Antarctica, with descriptions of two new species. *Archiv für Hydrobiologie Supplement 124, Algological Studies* 89: 49-62.
- Ling, H. U. and Seppelt, R.D. (1998) Snow Algae of the Windmill Islands, continental Antarctica 3. *Chloromonas polyptera* (Volvocales, Chlorophyta) *Polar Biology* 20: 320-324.
- Ling, H. U. and Seppelt, R.D. (2000) Snow Algae of the Windmill Islands Region, Adaptations to the Antarctic Environment. Davison, W., Howard-Williams, C., Broady, P. (eds.) *Antarctic Ecosystems: Models for Wider Ecological Understanding*. pp. 171-174.
- Longton, R. E. (1988) *Biology of polar bryophytes and lichens*. Cambridge University Press, Cambridge. 307-309.
- Lovelock, C.E., Robinson, S.A. (2002) Surface reflectance properties of Antarctic moss and their relationship to plant species, pigment composition and photosynthetic function. *Plant, Cell and Environment*. **25**. 1239-1250; [Ref:10869]; AAS Projects [941](#), [1310](#)
- Lucieer, A, Robinson, S and Bergstrom D. (2010) Aerial 'OktoKopter' to map Antarctic moss *Australian Antarctic Magazine*, Issue 19. pp. 1-3 <http://www.antarctica.gov.au/about-antarctica/australian-antarctic-magazine/issue-19-2010/aerial-oktokopter-to-map-antarctic-moss>.

- Melick, D. R., Hovenden, M. J., and Seppelt, R. D. (1994) Phytogeography of bryophyte and lichen vegetation in the Windmill Islands, Wilkes land, Continental Antarctica. *Vegetatio* 111: 71-87.
- Melick, D. R., and Seppelt, R. D. (1990) Vegetation patterns in Relation to climatic and endogenous changes in Wilkes Land, continental Antarctica. *Journal of Ecology* 85: 43-56.
- Miller, W. R., Miller, J. D. and Heatwole, H. (1996) Tardigrades of the Australian Antarctic Territories: the Windmill Islands, East Antarctica. *Zoological Journal of the Linnean Society* 116: 175-184.
- Murray, M. D., and Luders, D. J. (1990) Faunistic studies at the Windmill Islands, Wilkes Land, East Antarctica, 1959-80. *ANARE Research Notes* 73, Antarctic Division, Kingston.
- Orton, M. N. (1963) A Brief Survey of the fauna of the Windmill Islands, Wilkes Land, Antarctica. *The Emu* 63 (1): 14-22.
- Øvstedal, D. O. and Lewis Smith, R. I. (2001) Lichens of Antarctica and South Georgia: A Guide to their Identification and Ecology. Cambridge University Press, Cambridge.
- Paul, E., Stüwe, K., Teasdale, J. and Worley, B. (1995) Structural and metamorphic geology of the Windmill Islands, East Antarctica: field evidence for repeated tectonothermal activity. *Australian Journal of Earth Sciences* 42: 453-469.
- Petz, P. (1997) Ecology of the active microfauna (Protozoa, Metazoa) of Wilkes Land, East Antarctica. *Polar Biology* 18: 33-44.
- Petz, P. and Foissner, W. (1997) Morphology and infraciliature of some ciliates (Protozoa, Ciliophora) from continental Antarctica, with notes on the morphogenesis of *Sterkiella histriomuscorum*. *Polar Record* 33(187): 307-326.
- Robinson, S.A., Wasley, J., Popp, M., Lovelock, C.E. (2000) Desiccation tolerance of three moss species from continental Antarctica. *Australian Journal of Plant Physiology* 27. 379-388; [Ref:9083]; AAS Projects 941, 1087, 1313
- Robinson, S.A., Dunn, J., Turnbull, D., Clarke, L. (2006) UV-B screening potential is higher in two cosmopolitan moss species than in a co-occurring Antarctic endemic ? implications of continuing ozone depletion. Abstracts of the Combio 2006 Conference, Brisbane Sept 24-28th 2006. p. 101; [Ref:12837]; AAS Projects 1310, 2542
- Robinson, SA, *Turnbull, JD & Lovelock, C.E. (2005) Impact of changes in natural UV radiation on pigment composition, surface reflectance and photosynthetic function of the Antarctic moss, *Grimmia antarctici*. *Global Change Biology* 11: 476-489.
- Robinson SA. & *Waterman M. (2013) Sunsafe bryophytes: photoprotection from excess and damaging solar radiation. In *Photosynthesis of Bryophytes and Seedless Vascular Plants*. Eds Hanson DT & Rice SK. Volume X in series *Advances in Photosynthesis and Respiration*. Springer (in press).
- Robinson, SA, *Wasley, J & Tobin, AK (2003) Living on the edge-plants and global change in continental and maritime Antarctica. *Global Change Biology* 9 1681-1717. *Invited review*.
- Roser, D. J., Melick, D. R., Ling, H. U. and Seppelt, R. D. (1992) Polyol and sugar content of terrestrial plants from continental Antarctica. *Antarctic Science* 4 (4): 413-420.
- Roser, D. J., Melick, D. R. and Seppelt, R. D. (1992) Reductions in the polyhydric alcohol content of lichens as an indicator of environmental pollution. *Antarctic Science* 4 (4): 185-189.
- Roser, D. J., Seppelt, R. D. and Nordstrom (1994) Soluble carbohydrate and organic content of soils and associated microbiota from the Windmill Islands, Budd Coast, Antarctica. *Antarctic Science* 6(1): 53-59.

- Selkirk, P. M. and Skotnicki, M. L. (2007) *Measurement of moss growth in continental Antarctica*, *Polar Biology* 30(4): pp. 407-413; Springer-Verlag, Berlin, illus. incl. 2 tables; 21 refs.
- Seppelt, R. D. (2002) Plant Communities at Wilkes Land. In: Beyer, L. and Bölter, M. (eds.) *Geocology of Antarctic Ice-Free Coastal Landscapes* Springer-Verlag, Berlin, 233-242.
- Seppelt, R. D. (2002) Wilkes Land (Casey Station). In: Beyer, L. and Bölter, M. (eds.) *Geocology of Antarctic Ice-Free Coastal Landscapes*. Springer-Verlag, Berlin, pp. 41-46.
- Seppelt, R. D. (2008) Dr R. Seppelt, Senior Research Scientist, Australian Antarctic Division. Personal communication.
- Smith, R. I. L. (1980) *Plant community dynamics in Wilkes Land, Antarctica*, Proceedings NIPR Symposium of polar biology **3**: 229-224.
- Smith, R. I. L. (1986) Plant ecological studies in the fellfield ecosystem near Casey Station, Australian Antarctic Territory, 1985-86. *British Antarctic Survey Bulletin*. **72**: 81-91.
- Terauds A., Chown, S.L., Morgan, F., Peat, H.J., Watts, D., Keys, H., Convey, P. and Bergstrom, D.M. (2012) Conservation biogeography of the Antarctic. *Diversity and Distributions*, **18**, 726–741
- Turnbull, J.D., Leslie, S.J. & Robinson, S.A. (2009) Desiccation protects two Antarctic mosses from ultraviolet-B induced DNA damage. *Functional Plant Biology* **36** 214-221.
- Turnbull, J.D., Robinson, S.A. Susceptibility to Ultraviolet Radiation Induced DNA Damage In Three Antarctic Mosses (submitted to *Global Change Biology*)
- Turnbull, J.D. & Robinson, S.A. (2009) Accumulation of DNA damage in Antarctic mosses: correlations with ultraviolet-B radiation, temperature and turf water content vary among species. *Global Change Biology* **15** 319-329.
- Turnbull, J.D., Robinson, S.A., Leslie, S.J., Nikaido, O. (2008) Desiccation confers protection from UV – B radiation but an endemic Antarctic moss is more susceptible to DNA damage than co-occurring cosmopolitan species. (in prep)
- Turner, D., Lucieer, A. and Watson, C. (2012) An Automated Technique for Generating Georectified Mosaics from Ultra-High Resolution Unmanned Aerial Vehicle (UAV) Imagery, Based on Structure from Motion (SfM) Point Clouds. *Remote Sens.* **4**, 1392-1410
- Wasley, J., Robinson, S.A., Lovelock, C.E., Popp, M. (2006) Climate change manipulations show Antarctic flora is more strongly affected by elevated nutrients than water. *Global Change Biology* **12**. 1800-1812; [Ref: [12682](#)]; AAS Project [1087](#)
- Wasley, J., Robinson, S.A., Lovelock, C.E., Popp, M. (2006) Some like it wet — biological characteristics underpinning tolerance of extreme water stress events in Antarctic bryophytes. *Functional Plant Biology* **33**. 443-455; [Ref: [12318](#)]; AAS Project [1087](#)
- Wasley, J., Robinson, S.A., *Turnbull, J.D., *King D.H., Wanek, W. Popp, M. (2012) Bryophyte species composition over moisture gradients in the Windmill Islands, East Antarctica: development of a baseline for monitoring climate change impacts. *Biodiversity* DOI:10.1080/14888386.2012.712636.
- Woehler, E. J., Penney, S. M., Creet, S. M. and Burton, H. R. (1994) Impacts of human visitors on breeding success and long-term population trends in Adélie penguins at Casey, Antarctica. *Polar Biology* **14**: 269-274.
- Woehler, E. J., Slip, D. J., Robertson, L. M., Fullagar, P. J. and Burton, H. R. (1991) The distribution, abundance and status of Adélie penguins *Pygoscelis adeliae* at the Windmill Islands, Wilkes Land, Antarctica. *Marine Ornithology* **19**(1): 1-18.

Appendix 1: North-east Bailey Peninsula, Antarctic Specially Protected Area

No 135, boundary coordinates

Boundary	Longitude	Latitude	Boundary	Longitude	Latitude
1	110°32'56"	66°17'11"	15	110°32'16"	66°16'52"
2	110°32'50"	66°17'11"	16	110°32'19"	66°16'53"
3	110°32'41"	66°17'10"	17	110°32'19"	66°16'55"
4	110°32'22"	66°17'7"	18	110°32'24"	66°16'55"
5	110°32'20"	66°17'6"	19	110°32'25"	66°16'53"
6	110°32'18"	66°17'2"	20	110°32'29"	66°16'53"
7	110°32'18"	66°17'0"	21	110°32'44"	66°16'54"
8	110°32'14"	66°17'0"	22	110°33'9"	66°17'5"
9	110°32'9"	66°16'56"	23	110°33'11"	66°17'6"
10	110°32'8"	66°16'54"	24	110°33'10"	66°17'9"
11	110°32'5"	66°16'54"	25	110°33'2"	66°17'11"
12	110°32'7"	66°16'52"			
13	110°32'7"	66°16'52"			
14	110°32'12"	66°16'51"			

Appendix 2: Mosses, liverworts and lichens identified from North-east Bailey Peninsula Antarctic Specially Protected Area No 135, (from Melick 1994, Seppelt pers. comm.)

Mosses
<i>Bryum pseudotriquetrum</i> (Hedw.) Gaertn., Meyer et Scherb.
<i>Ceratodon purpureus</i> (Hedw.) Brid.
<i>Schistidium antarctici</i> Card.
Liverworts
<i>Cephaloziella varians</i> Steph.
Lichens
<i>Acarospora gwynii</i> Dodge & Rudolph
<i>Amandinea petermannii</i> (Hue) Matzer, H. Mayrhofer & Scheid.
<i>Buellia cf. cladocarpiza</i> Lamb?
<i>Buellia frigida</i> Darb.
<i>Buellia grimmiae</i> Filson
<i>Buellia cf. lignoides</i> Filson
<i>Buellia papillata</i> Tuck.
<i>Buellia pycnogonoides</i> Darb.
<i>Buellia soledians</i> Filson
<i>Caloplaca athallina</i> Darb.
<i>Caloplaca citrina</i> (Hoffm.) Th. Fr.
<i>Candelariella flava</i> (C.W. Dodge & Baker) Castello & Nimis
<i>Lecanora expectans</i> Darb.
<i>Lecidea</i> spp.
<i>Lecidea cancriformis</i> Dodge & Baker (= <i>Lecidea phillipsiana</i> Filson)
<i>Lecidea andersonii</i> Filson
<i>Lepraria</i> sp.
<i>Pleopsidium chlorophanum</i> (Wahlenb.) Zopf
<i>Rhizocarpon geographicum</i>
<i>Rhizoplaca melanophthalma</i> (Ram.) Leuck. & Poelt
<i>Rinodina olivaceobrunnea</i> Dodge & Baker
<i>Physcia caesia</i> (Hoffm.) Hampe
<i>Umbilicaria aprina</i> Nyl.
<i>Umbilicaria decussata</i> (Vill.) Zahlbr.
<i>Umbilicaria cf. propagulifera</i> (Vainio) Llano
<i>Xanthoria elegans</i> (Link) Th. Fr.
<i>Xanthoria mawsonii</i> Dodge.
<i>Pseudophebe minuscula</i> (Nyl ex Arnold) Brodo & Hawksw.
<i>Usnea antarctica</i> Du Rietz
<i>Usnea sphacelata</i> R. Br.

Appendix 3: Fungi isolated from soils, mosses, lichens and algae from ASPA No 135 and from species of wider distribution in the Windmill Islands region (from Azmi 1998 and Seppelt pers. comm. 2008)

Note: This is only a partial list of the taxa isolated from the Windmill Islands

	ASPA No 135	Bailey Peninsula	Bryum pseudotriquetrum	Ceratodon purpureum	Grimmia antarctici	Algae	Lichens*
<i>Acremonium</i> sp.					9		
<i>Acremonium crocotingenum</i> (Schol-Schwarz) W. Gams		9					9
<i>Alternaria alternata</i> (Fr.) Keissl.		9					
<i>Arthrobotrys</i>			9	9			
<i>Aspergillus nidulans</i> (Eidam) G. Winter		9					
<i>Aspergillus</i> sp.						9	
<i>Botrytis cinerea</i> Pers.		9					
<i>Chrysosporium</i> sp	9		9	9	9		
<i>Chrysosporium pannorum</i> (Link.) S. Hughes	9	9	9	9	9	9	9
<i>Cladosporium</i> sp.		9					
<i>Diplodia</i> sp.		9					
<i>Fusarium oxysporum</i> E.F. Sm., & Swingle		9					
<i>Geomyces</i> sp.		9	9	9		9	9
<i>Geotrichum</i> sp.							
<i>Mortierella</i> sp.		9	9		9	9	9
<i>Mortierella gamsii</i> Milko		9	9				
<i>Mucor pyriformis</i> Scop.		9	9		9		
<i>Mycelia sterilia</i> 1**	9		9	9	9	9	9
<i>Mycelia sterilia</i> 2**	9		9	9	9	9	
<i>Mycelia sterilia</i> 3**	9		9	9	9		
<i>Mycelia sterilia</i> 4**		9					
<i>Nectria peziza</i> Berk.		9	9		9		
<i>Penicillium chrysogenum</i> Thom	9		9		9	9	
<i>P. commune</i> Thom		9					
<i>P. corylophilum</i> Dierckx		9					
<i>P. expansum</i> Link		9	9	9		9	
<i>P. hirsutum</i> Dierckx		9					
<i>P. palitans</i> Westling		9	9	9	9		
<i>P. roqueforti</i> Thom		9					
<i>Penicillium</i> sp.			9	9	9	9	
<i>Penicillium</i> sp. 1							
<i>Penicillium</i> sp. 2							

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	ASPA No 135	Bailey Peninsula	Bryum pseudotri- quetrum	Ceratodo n purpureu	Grimmia antarctici	Algae	Lichens*
<i>Phialophora malorum</i> (Kidd & Beaumont) McColloch		9	9	9	9	9	
<i>Phoma herbarum</i> Westend		9	9	9	9		
<i>Phoma</i> sp.	9						
<i>Phoma</i> sp. 1			9	9	9		
<i>Phoma</i> sp. 2				9	9		
<i>Rhizopus stolonifer</i> (Ehrenb.) Vuill.		9				9	
<i>Sclerotinia sclerotiorum</i> (Lib.) de Bary		9					
<i>Thelebolus microsporus</i> (Berk. & Broome) Kimbr.	9	9	9	9	9	9	9
<i>Trichoderma harzianum</i> Rifai		9					
<i>T. pseudokoningi</i> Rifai		9					

*Lichens are *Xanthoria mawsonni*, *Umbilicaria decussata* and *Usnea sphacelata*.

** Mycelia sterilia is a general term for sterile mycelia. Approximately 45% of all the isolates obtained from the Windmill Islands have not been identified because they remained sterile in culture.

Appendix 4: Cyanobacterial and algal species identified from the Windmill Islands region

The taxa are listed in alphabetical order under each phylum together with their habitats and whether they are maintained in culture. A = Aquatic, T = Terrestrial (from soil),

S = Snow or ice and C = Culture. (from Ling 1998 and Seppelt pers. comm. 2008).

Cyanobacteria	
<i>Aphanothece castagnei</i> (Breb.) Rabenh.	A
<i>Aphanocapsa elachista</i> var. <i>irregularis</i> Boye-Pet.	A
<i>Aphanocapsa muscicola</i> (Menegh.) Wille	A
<i>Aphanothece saxicola</i> Nageli	A
<i>Aphanothece</i> sp.	A
<i>Calothrix parietina</i> Thur.	A
<i>Chamaesiphon subglobosus</i> ((Ros-Taf) Lemmerm.	A
<i>Chroococcus dispersus</i> (Keissl.) Lemmerm.	A
<i>Chroococcus minutus</i> (Kutz.) Nageli	A
<i>Chroococcus turgidus</i> (Kutz.) Nageli	A
<i>Dactylococcopsis antarctica</i> F E. Fritsch	A
<i>Dactylococcopsis smithii</i> R. et E.Chodat (= <i>Rhabdogloea smithii</i> (R. et E.Chodat)	A
<i>Eucapsis</i> sp.	T
<i>Gloeocapsa dermochroa</i> Nageli	A
<i>G. kuetzingiana</i> Nageli	A
<i>Hammatoidea</i> sp.	A
<i>Homoeothrix</i> sp.	A
<i>Isocystis pallida</i> Woron.	AT
<i>Katagnymene accurata</i> Geitler	AT
<i>Lyngbya attenuata</i> Fritsch	A
<i>Lyngbya martensiana</i> Menegh.	A
<i>Merismopedia tenuissima</i> Lemmerm.	AT
<i>Myxosarcina concinna</i> Printz	A
<i>Nodularia harveyana</i> var. <i>sphaerocarpa</i> (Born. et Flah.) Elenkin	A
<i>Nostoc commune</i> Vaucher	ATC
<i>Nostoc</i> sp.	T
<i>Oscillatoria annae</i> Van Gook	A
<i>Oscillatoria fracta</i> Carlson	A
<i>Oscillatoria irrigua</i> Kutz	A
<i>Oscillatoria lemmermannii</i> Wolosz.	A
<i>Oscillatoria proteus</i> Skuja	A
<i>Oscillatoria</i> sp. (Broady 1979a, <i>Oscillatoria</i> cf. <i>limosa</i> Agardh)	A
<i>Oscillatoria</i> sp. (BROADY 1979a, <i>Oscillatoria</i> sp. C)	T
<i>Phormidium autumnale</i> (Agardh) Gomont	T
<i>Phormidium foveolarum</i> Gomont	A
<i>Phormidium frigidum</i> F.E. Fritsch	A
<i>Phormidium subproboscideum</i> (W et G. S. West) Anagnost et Komarek	A
<i>Phormidium</i> sp.	A
<i>Plectonema battersii</i> Gomont	A
<i>Plectonema nostocorum</i> Bornet	A
<i>Pseudanabaena mucicola</i> (Hub.-Pest. et Naum.) Bour.	A
<i>Schizothrix antarctica</i> F E. Fritsch	A
<i>Stigonema mesentericum</i> Geitler f.	T
<i>Stigonema minutum</i> (AGARDH) Hassall	T
<i>Stigonema</i> sp.	T
<i>Synechococcus aeruginosus</i> Nageli	T
<i>Synechococcus maior</i> Schroeter	AT
<i>Tolypothrix byssoidea</i> (Berk.) Kirchner f	A
<i>Tolypothrix distorta</i> var. <i>penicillata</i> (Agardh)Lemmerm.(= <i>Tolypothrix penicillata</i> Thuret)	A
Chlorophyta	
<i>Actinotaenium cucurbita</i> (Breb.) Teiling	AC
<i>Apodochloris irregularis</i> Ling et Seppelt	AC
<i>Asterococcus superbus</i> (Cienk.) Scherff.	AC
<i>Binuclearia tatrana</i> Wittr.	AC
<i>Binuclearia tectorum</i> (KÜTZ.) Beger	AC
<i>Chlamydomonas pseudopulsatilla</i> Gerloff	S
<i>Chlamydomonas sphagnicola</i> (F.E. Fritsch) F.E. Fritsch et Takeda	TC
<i>Chlamydomonas subcaudata</i> Wille	A
<i>Chlamydomonas</i> sp. 1	A

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<i>Chlamydomonas</i> sp. 2	A
<i>Chlorella vulgaris</i> Beij.	AT
<i>Chloromonas brevispina</i> Hoham, Roemer et Mullet	S
<i>Chloromonas polyptera</i> (F.E. Fritsch) Hoham, Mullet et Roemer	SC
<i>Chloromonas rubroleosa</i> Ling et Seppelt	SC
<i>Chloromonas</i> sp. 1	SC
<i>Chloromonas</i> sp. 2	A
<i>Coenochloris</i> sp.	T
<i>Desmococcus olivaceus</i> (Pers. ex Ach.) Laundon	ATC
<i>Desmotetra</i> sp. 1	SC
<i>Desmotetra</i> sp. 2	SC
<i>Dictyosphaerium dichotomum</i> Ling et Seppelt	T
<i>Fernandinella alpina</i> Chodat	AC
<i>Geminella terricola</i> Boye-Pet.	T
<i>Gloeocystis polydermatica</i> (Kutz.) Hindak	T
<i>Gloeocystis vesiculosa</i> Nageli	T
<i>Gongrosira terricola</i> Bristol	AC
<i>Gonium sociale</i> (Dujard.) Warm.	AC
<i>Hormotila</i> sp.	SC
<i>Kentrosphaera bristolae</i> G.M.Smith	A
<i>Klebsormidium dissectum</i> var. 1(Broady 1979a, <i>Chlorhormidium dissectum</i> var. A)	T
<i>Klebsormidium subtilissimum</i> (Rabenh.) Silva, Mattox et Blackwell	A
<i>Klebsormidium</i> sp. (BROADY 1981, <i>Klebsormidium</i> sp. A)	SC
<i>Lobococcus</i> sp.?	T
<i>Lobosphaera tirolensis</i> Reisigl	TC
<i>Macrochloris multinucleate</i> (Reisigl) Ettl et Gartner	ATC
<i>Mesotaenium berggrenii</i> (Wittr.) Lagerh. f.	S
<i>Monoraphidium contortum</i> (Thur.) Komark.-Legn.	A
<i>Monoraphidium</i> sp.	S
<i>Myrmecia bisecta</i> Reisigl	T
<i>Palmella</i> sp. 1	TC
<i>Palmella</i> sp. 2	A
<i>Palmellopsis</i> sp.	SC
<i>Prasiococcus calcarius</i> (Boye-Pet.) Vischer	ATSC
<i>Prasiola calophylla</i> (Carmich.) Menegh.	TC
<i>Prasiola crispa</i> (Lightf.) Menegh.	ATSC
<i>Prasiola</i> sp.?	A
<i>Pseudochlorella subsphaerica</i> Reisigl	T
<i>Pseudococcomyxa simplex</i> (Mainx) Fott	T
<i>Pyramimonas gelidicola</i> McFadden, Moestrup et Wetherbee	A
<i>Pyramimonas</i> sp.	A
<i>Raphidonema helvetica</i> Kol	S
<i>Raphidonema nivale</i> Lagerh.	S
<i>Raphidonema sempervirens</i> Chodat	TC
<i>Raphidonema tatrae</i> Kol	S
<i>Schizogonium murale</i> Kutz.	ATC
<i>Schizogonium</i> sp.	AT
<i>Staurastrum</i> sp.	A
<i>Stichococcus bacillaris</i> Nageli	TSC
<i>Stichococcus fragilis</i> (A. Braun) Gay	A
<i>Stichococcus minutus</i> Grintzesco et Peterfi	S
<i>Tetracystis</i> sp. 1	TC
<i>Tetracystis</i> sp. 2	TC
<i>Trebouxia</i> sp.	TC
<i>Trichosarcina mucosa</i> (B Broady) Chappell et O'Kelly	TC
<i>Trochiscia</i> sp. (Broady 1979x,	A
<i>Trochiscia</i> sp. A)	
<i>Ulothrix implexa</i> (Kutz.) Kutz. A	
<i>Ulothrix zonata</i> (Weber et Mohr) Kutz	
<i>Ulothrix</i> sp. 1	A
<i>Ulothrix</i> sp. 2	S
<i>Uronema</i> sp.	S
Xanthophyta	
<i>Botrydiopsis</i> sp.	TC
<i>Bumilleriopsis</i> sp.	TC
<i>Ellipsoidion</i> sp.?	S
<i>Fremya</i> sp.	ATC
<i>Gloeobotrys</i> sp.	A
<i>Heterococcus filiformis</i> Pitschm.	TC
<i>Heterococcus</i> sp.	TC
<i>Heterothrix debilis</i> Vischer	TC
<i>Tribonema microchloron</i> Ettl	A

Chrysophyta	
<i>Chrysococcus</i> sp.	S
<i>Chroomonas lacustris</i> Pascher et Ruttner	A
Dinophyta	
<i>Gymnodinium</i> sp.	A
Bacillariophyta	
* <i>Achnanthes coarctata</i> var. <i>elliptica</i> Krasske	S
<i>Amphora veneta</i> Kutz.	A
* <i>Cocconeis imperatrix</i> A. Schmidt	S
* <i>Diploneis subcineta</i> (A. Schmidt) Cleve	S
* <i>Eucampia balaustium</i> Castray	S
<i>Fragilaria</i> sp.	A
<i>Fragilariopsis antarctica</i> (Castray) Hust.	A
<i>Hantzschia amphioxys</i> (Ehrenb.) Grun.	A
<i>Navicula atomus</i> (Nag.) Grun.	A
<i>Navicula murrayi</i> W. et G. S. West	A
<i>Navicula muticopsis</i> Van Heurck	AT
<i>Navicula</i> sp.	A
<i>Nitzschia palea</i> (Kutz.) W. S M.	AT
<i>Pinnularia borealis</i> Ehrenb.	AT
<i>Torpedoes laevissima</i> W et G. S. West	A

*Believed to be marine diatoms from wind-borne sea spray.

Appendix 5: Ciliates and testate amoebae active in the vicinity of Casey

Station on Bailey Peninsula

(Modified from Petz and Foissner 1997)

Ciliates
<i>Bryometopus</i> sp
<i>Bryophyllum</i> cf. <i>loxophylliforme</i>
<i>Colpoda cucullus</i> (Mueller, 1773)
<i>Colpoda inflata</i> (Stokes, 1884)
<i>Colpoda maupasi</i> Enriques, 1908
<i>Cyclidium muscicola</i> Kahl, 1931
<i>Cyrtolophosis elongata</i> (Schewiakoff, 1892)
<i>Euplotes</i> sp.
<i>Fuscheria terricola</i> Berger and others, 1983
<i>Gastronauta derouxi</i> Blatterer and Foissner, 1992
<i>Halteria grandinella</i> (Mueller, 1773)
<i>Holosticha sigmoidea</i> Foissner, 1982
<i>Leptopharynx costatus</i> Mermod, 1914
<i>Odontochlamys wisconsinensis</i> (Kahl, 1931)
<i>Oxytricha opisthomuscorum</i> Foissner and others, 1991
<i>Parafurgasonia</i> sp.
<i>Paraholosticha muscicola</i> (Kahl, 1932)
<i>Platyophrya vorax</i> Kahl, 1926
<i>Pseudocohnilembus</i> sp.
<i>Pseudoplatyophrya nana</i> (Kahl, 1926)
<i>Pseudoplatyophrya</i> cf. <i>saltans</i>
<i>Sathrophilus muscorum</i> (Kahl, 1931)
<i>Sterkiella histriomuscorum</i> (Foissner and others, 1991)
<i>Sterkiella thompsoni</i> Foissner, 1996
<i>Trithigmostoma</i> sp.
<i>Vorticella astyliformis</i> Foissner, 1981
<i>Vorticella infusionum</i> Dujardin, 1841
Testate amoebae
<i>Assulina muscorum</i> Greeff, 1888
<i>Corythion dubium</i> Taranek, 1881
<i>Euglypha rotunda</i> Wailes and Penard, 1911
<i>Pseudodifflugia gracilis</i> var. <i>terricola</i> Bonnet and Thomas, 1960
<i>Schoenbornia viscicula</i> Schoenborn, 1964
<i>Trachelocorythion pulchellum</i> (Penard, 1890)

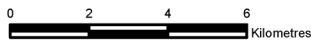


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Map A: Antarctic Specially Protected Areas, Windmill Islands, East Antarctica

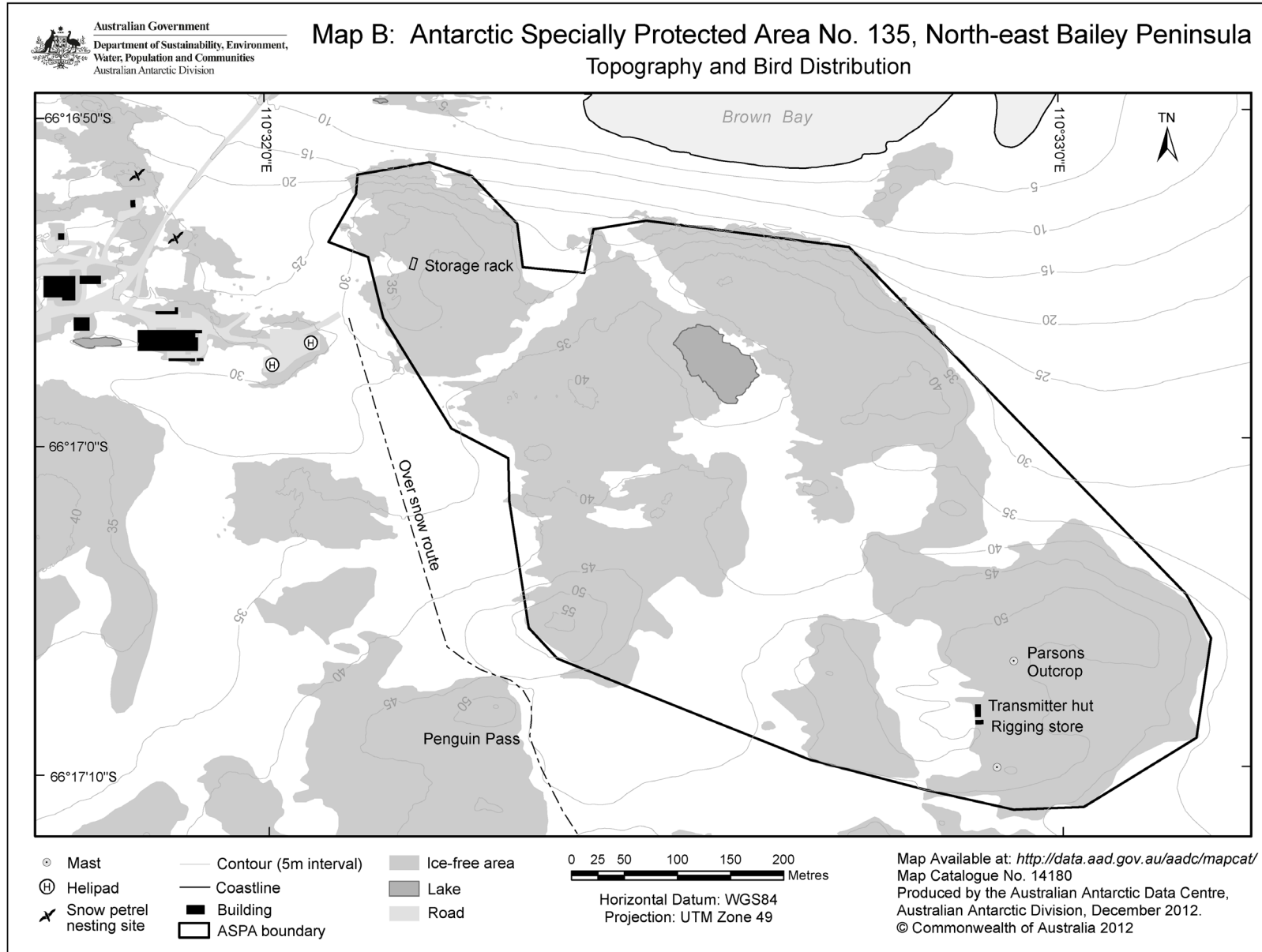


- Station ▲ Refuge
- Contour (50 metre interval)
- ▭ ASPA boundary
- ▭ NE Bailey Peninsula ASPA No. 135

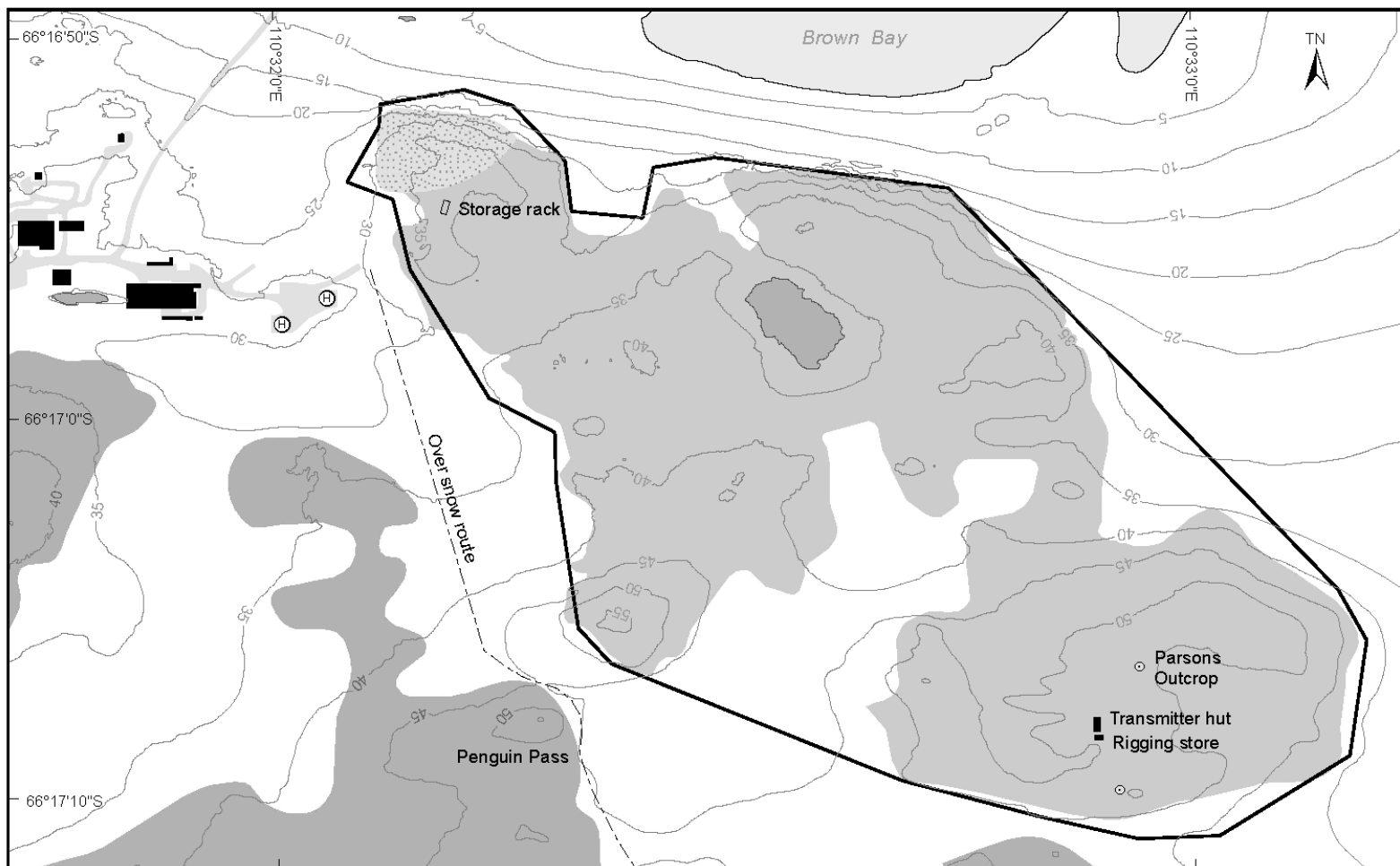


Horizontal Datum: WGS84
 Projection: UTM Zone 49

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Map C: Antarctic Specially Protected Area No. 135, North-east Bailey Peninsula Vegetation



**Vegetation association
 (Dominant species)**

- Bryophytes
- Buellia frigida*
- Umbilicaria decussata*

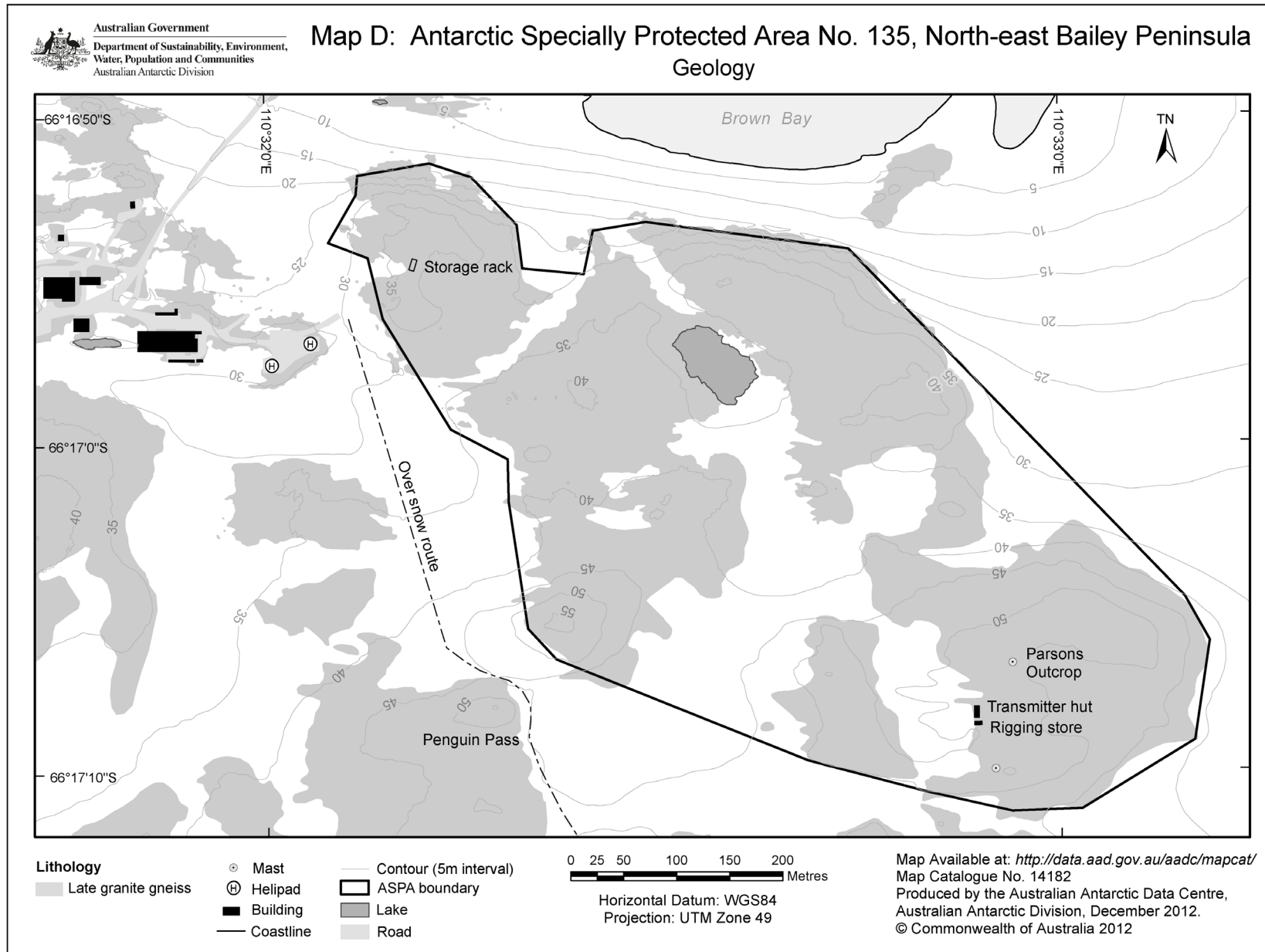
- Mast
- H Helipad
- Building
- Coastline

- Contour (5m interval)
- ASPA boundary
- Lake
- Road

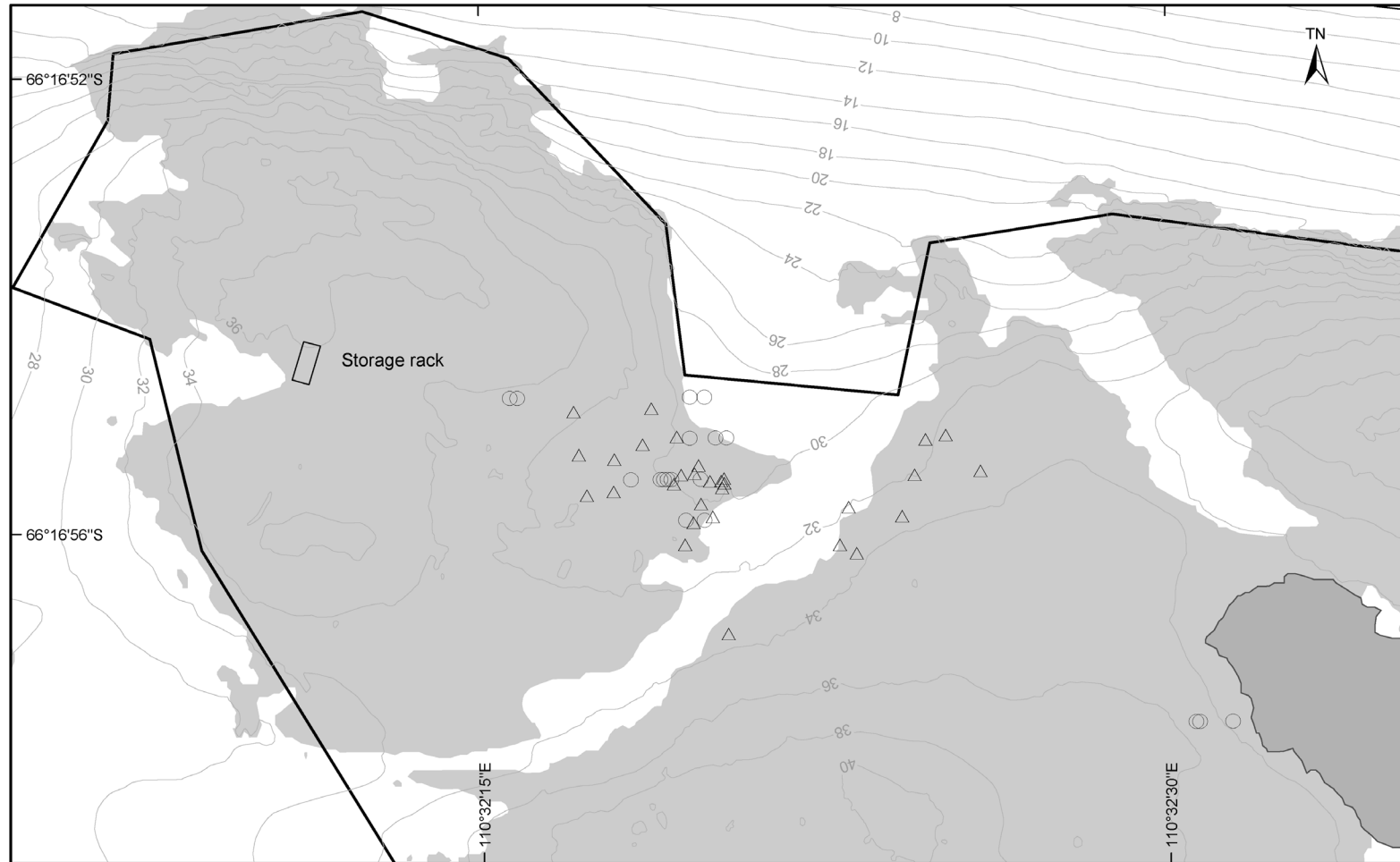


Horizontal Datum: WGS84
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Map E: Antarctic Specially Protected Area No. 135, North-east Bailey Peninsula Long term scientific monitoring sites



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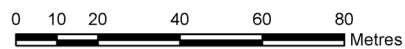
- △ Robinson
- Skotnicki

— Contour (2m interval)

▭ ASPA boundary

■ Lake

■ Ice-free area



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