

Management Plan for Antarctic Specially Protected Area (ASP) No. 106 CAPE HALLETT, NORTHERN VICTORIA LAND, ROSS SEA (170° 14' E, 72° 19' S)

Introduction

The Cape Hallett Antarctic Specially Protected Area is situated at the northern extremity of the Hallett Peninsula, northern Victoria Land at 170°13'25" E, 72°19'11" S. Approximate area: 0.53 km². The primary reason for designation of the Area is that it provides an outstanding example of biological diversity, in particular a rich and diverse terrestrial ecosystem. It includes a small area of particularly rich vegetation that represents a valuable scientific resource for monitoring of vegetation change in Antarctica. The Area contains the most diverse arthropod community known in the Ross Sea region, which is of scientific interest. Furthermore, the Area contains a substantial Adélie penguin (*Pygoscelis adeliae*) breeding colony comprising around 64 000 pairs in 2009-10, which is recolonizing the site of the former Hallett Station (NZ / US) and is therefore of particular scientific interest. Cape Hallett is the only protected area in northern Victoria Land designated on the grounds of its terrestrial ecosystem or which includes a substantial bird colony, providing an important representation of the ecosystem in this region of Antarctica. The Area was proposed by the United States of America and adopted through Recommendation IV-7 [1966, Specially Protected Area (SPA) No. 7]; boundaries were extended by Recommendation XIII-13 (1985); the Area was renamed and renumbered through Decision 1 (2002), and the boundaries were further extended through Measure 1 (2002) to include the Adélie penguin colony, increasing the size of the Area to 75 ha. A further adjustment of the boundary was made through Measure 5 (2010) to delete the Managed Zone and replace this with two sites outside of the protected area, to be managed by Antarctic Treaty Site Guidelines for Visitors. One of the sites identified for visitor access is on the northern / NW coast of Seabee Hook and the second is on the SE coast. An additional revision was made to the eastern boundary, making the size of the Area 53 ha. The boundaries of the Area have not been changed in the current management plan.

ASP No.106 was not classified under the Environmental Domains Analysis for Antarctica (EDA v.2.0) (Resolution 3 (2008)), although subsequent analysis has confirmed that the Area lies within 'Environment U – North Victoria Land Geologic'. Under the Antarctic Conservation Biogeographic Regions classification (Resolution 6 (2012)) the Area lies within ACBR8 – North Victoria Land.

1. Description of values to be protected

An area of approximately 12 ha at Cape Hallett was originally designated in Recommendation IV-7 (1966, SPA No. 7) after a proposal by the United States of America on the grounds that the Area provided an outstanding example of biological diversity, containing "a small patch of particularly rich and diverse vegetation which supports a variety of terrestrial fauna". The proposal gave special mention to the rich avifauna in the Area, which was noted as being of "outstanding scientific interest". The boundaries of the Area were enlarged in Recommendation XIII-13 (1985) to include extensive stands of vegetation to the south and north of the Area, increasing the Area to approximately 32 ha. The boundaries were further extended in Measure 1 (2002) to include scientific values related to the Adélie penguin (*Pygoscelis adeliae*) colony on Seabee Hook, increasing the size of the Area to 75 ha. Boundary and zoning revisions through Measure 5 (2010) reduced the size of the Area to 53 ha.

The eastern part of the Area contains a variety of habitats with plant communities that are considered important as they include most extensive, representative, and outstanding examples known near the northern extremity of the latitudinal gradient of Victoria Land and the Ross Sea. Vegetation surveys have recorded five species of moss in the Area, dominated by *Bryum subrotundifolium*, and 27 species of lichen. Although few algal species have been identified numerous species are expected to be present. The terrestrial habitats have been extensively studied, most recently as part of the international Latitudinal Gradient Project (LGP) (Italy, New Zealand, and United States). A vegetation plot in the eastern part of the Area is particularly valuable as a

scientific resource for monitoring vegetation change in Antarctica, and this is designated a Restricted Zone. This site was first surveyed in detail in 1961–62 and provides a valuable baseline against which vegetation changes can be measured at a fine scale.

Detailed information on the distribution and abundance of arthropod species in the Area is available, which also represents a valuable scientific resource. In terms of species richness, Cape Hallett represents the most diverse arthropod community known in the Ross Sea region, with eight species of mites (Acari) and three of springtails (Collembola) identified within the Area. Of these, two (*Coccorhagidia gressitti* and *Eupodes wisei*) have their type localities at Cape Hallett.

A large number of markers were placed during early scientific studies conducted within the Area to mark sites of plant and bird studies. Many of these markers remain *in situ* and now represent a highly valuable resource for scientific studies that may wish to make repeat measurements.

Hallett Station was established by New Zealand and the United States on Seabee Hook in 1956 as part of the International Geophysical Year (IGY), and operated continuously until it closed in 1973. Although all structures have been removed, the site continues to possess enduring historic and heritage values relating to its former human use. In recognition of these values, many of the structures and artefacts from the former station are now held at the Canterbury Museum, Christchurch. In 2015, the only known remaining item of potential historical value and/or scientific value is the well-preserved body of a husky that died in 1964, which is contained in an enclosed wooden box located in the eastern part of the Area.

Adélie penguins have started to recolonize the site where the station was previously located. The history of human impact on the Adélie penguin colony and the subsequent station closure, together with the availability of reliable and repetitive historical data on Adélie population changes, make this site unique and ideal for scientific study of impacts on, and recovery of, the colony following substantial ecosystem disturbance. As such, the site has high scientific value, and in order to maintain this value it is desirable that any further human presence be carefully controlled and monitored.

In addition to the ecological and scientific values described, the Area possesses outstanding aesthetic values, with its combination of prolific biological resources and the impressive surrounding scenery of Edisto Inlet and Mt. Herschel (3335 m). Seabee Hook is one of only a few such sites that are relatively accessible in the northern Ross Sea. The site also has high educational value as an example of a station that was decommissioned and removed, with the site now showing evidence of recovery.

2. Aims and objectives

Management at Cape Hallett aims to:

- avoid degradation of, or substantial risk to, the values of the Area by preventing unnecessary human disturbance to the Area;
- allow scientific research, in particular on terrestrial and seabird ecology and on environmental recovery, while preventing unnecessary sampling and human disturbance in the Area;
- allow other scientific research provided it will not jeopardize the values of the Area;
- prevent the removal of, or disturbance to, markers used in previous scientific research that could be valuable for future comparative studies;
- allow environmental clean-up and remediation activities associated with the decommissioning and removal of the former Hallett Station as required and appropriate, provided the impacts of these activities are not greater than those arising from leaving material *in situ*;
- take into account the potential historic and heritage values of any artifacts before their removal and/or disposal, while allowing for appropriate clean-up and remediation;
- minimize the possibility of introduction of alien plants, animals and microbes into the Area; and
- allow visits for management purposes in support of the aims of the Management Plan.

3. Management activities

- Markers should be installed to identify areas requiring specific management activities, such as scientific monitoring sites;
- Markers, signs or structures erected within the Area for scientific or management purposes shall be secured and maintained in good condition, and removed when no longer necessary;
- National Antarctic programs operating in the Area should maintain a record of all new markers, signs and structures erected within the Area;
- National programs shall ensure the boundaries of the Area and the restrictions that apply within are marked on relevant maps and charts for which they are responsible;
- To the extent practicable, efforts shall be made to remove any small waste debris still present within the Area following the removal of Hallett Station, although this shall be undertaken in consultation with an appropriate authority to ensure that potentially important historic or heritage values of any artifacts are not lost;
- Visits shall be made as necessary (preferably at least once every five years) to assess whether the Area continues to serve the purposes for which it was designated and to ensure that management and maintenance measures are adequate;
- National Antarctic programs operating in the region shall consult together for the purpose of ensuring that the above provisions are implemented.

4. Period of designation

Designated for an indefinite period.

5. Maps

Map 1: Cape Hallett Antarctic Specially Protected Area No. 106: Regional map.

Map specifications: Projection: Lambert Conformal Conic; Standard parallels: 1st 72° 20' S; 2nd 72° 30' S; Central Meridian: 170° 00'E; Latitude of Origin: 72° 00'S; Spheroid and horizontal datum: WGS84; Contour interval 200 m.

Map 2: Cape Hallett Antarctic Specially Protected Area No. 106: Air access guidance.

Map specifications: Projection: Lambert Conformal Conic; Standard parallels: 1st 72° 19' S; 2nd 72° 19' 30" S; Central Meridian: 170° 13' 30" E; Latitude of Origin: 72° 00' S; Spheroid: WGS84; Datum: USGS 'Fisher' geodetic station 1989-90: ITRF93 Coordinates 170° 12' 39.916" E, 72° 19' 06.7521" S;

Map 3: Cape Hallett Antarctic Specially Protected Area No. 106: Topographic map.

Specifications for Map 3 are the same as for Map 2. Contour interval 5 m: contours derived from a digital elevation model used to generate an orthophotograph at 1:2500 with a positional accuracy of ±1 m (horizontal) and ±2 m (vertical) with an on-ground pixel resolution of 0.25 m.

Map 4: Cape Hallett Antarctic Specially Protected Area No. 106: Former Hallett Station area.

Specifications for Map 4 are the same as for Map 2.

6. Description of the Area

6(i) Geographical coordinates, boundary markers and natural features

Boundaries and coordinates

Cape Hallett is located at the southern end of Moubray Bay, Northern Victoria Land, in the western Ross Sea (Map 1). The protected area occupies most of the ice-free ground of a cusped spit of low elevation known as Seabee Hook and includes the adjacent western slopes of the northern extremity of Hallett Peninsula, extending east of Willett Cove to the margin of the permanent glaciers (Maps 1 – 3).

The northern boundary of the Area extends along the northern coast of Seabee Hook from 170° 14' 25.5" E, 72° 19' 05.0" S to the eastern limit of the Adélie colony at 170° 14' 19.3" E, 72° 19' 04.9" S (Map 3). The boundary then follows the edge of the nesting area of the Adélie colony (as defined in 2009), maintaining a distance of at least 5 m from the colony, extending to the coordinate 170° 12' 25.3" E, 72° 19' 07.9" S (Map 4).

From 170° 12' 25.3" E, 72° 19' 07.9" S the boundary extends 33 m due west to the coast at 170° 12' 21.8" E, 72° 19' 07.9" S (Map 4). From this coastal position, the boundary of the Area continues southward to follow the western and southern coastline of Seabee Hook to the position 170° 12' 54.3" E, 72° 19' 19.1" S, which is near the southeastern extremity of the spit (Map 3). From this location the boundary extends northward, following around the edge of the nesting area, maintaining a distance of at least 5 m from the colony, in the southeastern part of Seabee Hook to the position 170° 12' 58.7" E, 72° 19' 15.3" S (Map 3). From this coastal position, the boundary of the Area continues northward to follow the low water shoreline along the eastern coast of Seabee Hook, and then follows the low water coastline around Willett Cove to the southern boundary at 170° 13' 24.9" E, 72° 19' 28.0" S (Map 3).

From 170° 13' 24.9" E, 72° 19' 28.0" S the boundary extends eastward to the Bornmann Glacier, following a seasonal stream which descends from the glacier. The eastern boundary of the Area then follows the glacier and permanent ice margin northward at elevations approximately between 120 – 150 m, crossing the steep western slopes of Hallett Peninsula and following the upper outcrops of a series of rocky ridges dissecting the slope. The boundary then descends to join the northern coastline of Seabee Hook at the base of a rock buttress at 170° 14' 25.5" E, 72° 19' 05.0" S (Map 3).

Climate

Seabee Hook is surrounded by sea ice for approximately eight months of the year. Sea ice usually breaks out annually, beginning in late December to early January, and re-forms in early March. Summer temperatures range from 4°C to -8°C, with a mean annual temperature of -15.3°C, and winds are predominantly from the south. Precipitation in the form of snow is common during the summer, with annual precipitation approximately 18.3 cm of water equivalent.

Geology, geomorphology, soils and freshwater environment

The topography of the Area comprises the large flat area of the spit and adjoining steep scree forming part of the western slopes of northern Hallett Peninsula. Seabee Hook is composed of coarse volcanic material deposited in a series of beach ridges, with gently undulating terrain of hummocks and depressions and a number of level areas. Many of the depressions contain melt water in the summer, and are colonized by dense mats of algae. In the northeastern part of the Area a small meltwater stream flows from the western slopes of the Hallett Peninsula down to Willett Cove. There is higher moisture availability in soils at Cape Hallett compared to sites in Southern Victoria Land. Sub-surface soils are typically saturated after snowfall, with groundwater at between 8 and 80 cm below the soil surface during summer. Permafrost underlies soils on Seabee Hook at a depth of ~1 m (Hofstee *et al.* 2006). Soils in areas occupied by, or affected by water runoff from, penguin colonies are ornithogenic in character and were classified as Typic Haplorthels over mounds

and Typic Aquorthels between mounds by Hofstee *et al.* (2006). Beyond areas influenced by the presence of penguins, these authors classified soils as Typic Haplothels, with one example of Typic Haploturbels in an area of patterned ground.

Vegetation

In wetter parts of the Area, the algal component is comprised mainly of the sheet-like green alga *Prasiola crispa* and *Protococcus* sp., with associated filamentous and blue-green forms (*Ulothrix* sp.) and cyanobacteria (e.g. *Nostoc*). It is expected that a number of other algal species may be present, but few have been identified.

The vegetation within the Area, with the exception of algae such as *Prasiola*, is largely confined to the ice-free ground not occupied by breeding Adélie penguins, which is to the east of Willett Cove and south of 72° 19' 10" S. This area includes a 100-200 m strip of relatively level ground adjacent to Willett Cove and steeper slopes up to the crest of the Hallett Peninsula ridge. The strip of flat ground comprises a number of dry, gravel hummocks up to 1.5 m high, many of which are occupied by nesting skuas, and in the northern part old guano deposits indicate former occupation by Adélie penguins. Small patches of moss and algae may be found at the base of these hummocks but the upper parts are devoid of vegetation. Substantial beds of moss colonize stable gravel flats in the north part of the flat ground where there is a high water table, while scattered patches of moss, algae and lichen occur on coarser, more angular, loose rocks in the south. The moss becomes more sparse as the ground slopes upwards, with the notable exception of a particularly dense and extensive patch covering approximately 3900 m² with almost complete coverage of the substratum occupying a shallow valley on a scree slope in the south of the Area (Map 3). Only the most prolific areas are illustrated on Map 3.

Five moss species have been identified within the Area (Table 1). *Bryum subrotundifolium* is the dominant moss within the Area. The presence of *Bryum subrotundifolium* in such a bird enriched area makes the Area an excellent example of a bird affected vegetation site. Also, the presence of almost mono-specific stands of *Bryum pseudotriquetrum* at the site is unusual for the region.

The steep scree slope adjoining the largely flat area is dissected by shallow gullies and small ridges, with a number of prominent rock outcrops. These rock outcrops, particularly in the north of the Area, support large stands of lichens and scattered moss, with cover of 70 – 100% in many places. Twenty-seven lichen species have been recorded in the Area (Table 1). Nitrogen-tolerant lichen species such as *Xanthomendoza borealis* and species of *Caloplaca*, *Candelariella*, *Physcia* and *Xanthoria* may be observed in the immediate vicinity of the penguin breeding area (Crittenden *et al.* 2015).

Eight species of mites and three species of springtails have been recorded from within the Area (Table 1) (Sinclair *et al.* 2006). *F. grisea* occurs mainly on the scree slopes and adjacent level areas, *C. cisantarcticus* was reported to be associated with moss, occurring plentifully on level ground, while *D. klovstadi* was abundant under stones on the slopes. Four species of nematodes have been found in the Cape Hallett area (Table 1), the most abundant, and in general the most dominant, species of which is *Panagrolaimus davidi* Timm (Raymond *et al.* 2013).

Table 1: Moss, lichen and invertebrate species recorded within ASPA No. 106, Cape Hallett

Mosses a	Lichens a, b, c, d	Invertebrates
<i>Bryum subrotundifolium</i>	<i>Acarospora gwynnii</i>	Mites e
<i>Bryum pseudotriquetrum</i>	<i>Amandinea petermannii</i>	<i>Coccorhagidia gressittii</i>
<i>Ceratodon purpureus</i>	<i>Amandinea coniops</i>	<i>Eupodes wisei</i>
<i>Grimmia</i> sp	<i>Buellia frigida</i>	<i>Maudheimia petronia</i>
<i>Sarconeurum glaciale</i>	<i>Caloplaca athallina</i>	<i>Nanorchestes</i> sp.,
	<i>Caloplaca citrina</i>	<i>Stereotydeus belli</i>
	<i>Caloplaca saxicola</i>	<i>S. punctatus</i>
	<i>Candelaria murrayi</i>	<i>Tydeus setsukoae</i>
	<i>Candelariella flava</i>	<i>T. wadei</i>
	<i>Lecanora chrysoleuca</i>	Springtails e
	<i>Lecanora expectans</i>	<i>Cryptopygus cisantarcticus</i>
	<i>Lecanora mons-nivis</i>	<i>Friesea grisea</i>
	<i>Lecanora physciella</i>	<i>Desoria klovstadi</i>
	<i>Lecidea cancriformis</i>	Nematodes f
	<i>Lecidella greenii</i>	<i>Eudorylaimus antarcticus</i> (Steiner) Yeates
	<i>L. siplei</i>	<i>Panagrolaimus davidi</i> Timm
	<i>Physcia caesia</i>	<i>Plectus</i> sp.
	<i>Pleopsidium chlorophanum</i>	<i>Scottinema lindsayae</i> Timm
	<i>Rhizocarpon geographicum</i>	
	<i>Rhizoplaca chrysoleuca</i>	
	<i>Rhizoplaca macleanii</i>	
	<i>Rhizoplaca melanophthalma</i>	
	<i>Umbilicaria decussata</i>	
	<i>Usnea sphacelata</i>	
	<i>Xanthomendoza borealis</i>	
	<i>Xanthoria elegans</i>	
	<i>Xanthoria mawsonii</i>	

Sources:

a T.G.A. Green, University of Waikato, New Zealand and R. Seppelt, Australian Antarctic Division, 2002; b Smykla *et al.* 2011; c Ruprecht *et al.* 2012; d Crittenden *et al.* 2015; e Sinclair *et al.* 2006; f Raymond *et al.* 2013.

Birds

Seabee Hook is the site of one of the largest Adélie penguin colonies in the Ross Sea region, with a mean of 42 628 breeding pairs of Adélie penguins (*Pygoscelis adeliae*) reported over 14 seasons sampled between 1981 and 2012 (Lyver *et al.* 2014). Approximately 63 971 breeding pairs were present in 2009-10 (combined total of direct nest, oblique aerial and ground photo counts made 26 November – 3 December 2009; unpublished data ERA 2010). Seabee Hook is also the site of the former Hallett Station, a joint United States and New Zealand station that was open from 1956-73. During operation the station and associated infrastructure occupied an area of 4.6 ha on land that had formerly been occupied by breeding Adélie penguins. Establishment of Hallett Station in 1956 required eviction of 7580 penguins, including 3318 chicks, in order to clear the 0.83 ha required for bulldozing and erection of buildings. The colony was subjected to substantial impacts from the establishment and operation of Hallett Station, and declined from 62 900 pairs in 1959 to a low of 37 000 pairs in 1968, although increased again to 50 156 by 1972. Fluctuations in populations may have been exacerbated by changes in sea ice cover documented for the entire region. By 1987, after the closure of the station in 1973, the colony had increased to near its 1959 population; however, few areas modified by humans had by that time been fully recolonized. The area formerly occupied by the station has now been partly recolonized, although numbers were estimated at 39 014 breeding pairs in 1998-99, and an aerial census in 2006-07 (conducted as part of a long-term program) recorded only 19 744 breeding pairs (Lyver and Barton 2008, unpublished data). The count of 63 971 breeding pairs of Adélie penguins made in late 2009 (unpublished data ERA 2010) is comparable to numbers recorded on Seabee Hook around the time Hallett Station was built.

South Polar skuas (*Catharacta maccormicki*) breed within the Area. The population declined from 181 breeding pairs in 1960-61 to 98 breeding birds recorded in both 1968-69 and 1971-72. In January 1983 there was a population of 247 birds (84 breeding pairs and 79 non-breeding birds). A survey conducted between 27 November – 02 December 2009 recorded 14 breeding pairs and 66 individuals on Seabee Hook. An additional 23 breeding pairs and 92 individuals were counted in the area east of Willett Cove, giving a total of 37 breeding pairs and 158 individuals, and a grand total of 232 birds in 2009-10. Approximately 250 skua nest sites are marked and numbered within the Area; markers should not be disturbed or removed.

Emperor penguins (*Aptenodytes forsteri*) have been recorded in the vicinity in late December, and solitary Chinstrap penguins (*Pygoscelis antarctica*) have been recorded in late January and February. Wilson's Storm petrels (*Oceanites oceanicus*) and Snow petrels (*Pagodroma nivea*) breed close to Cape Hallett across Edisto Inlet; numerous Snow petrels were observed around the cliffs of Cape Hallett in December 2009, suggesting they may breed in this area. Southern Giant petrels (*Macronectes giganteus*) have been sighted frequently in the vicinity of the Area, although numbers have dropped in recent years, possibly due to declining populations further to the north. Weddell seals (*Leptonychotes weddellii*) are commonly seen; these seals breed in Edisto Inlet, and have been recorded ashore on Seabee Hook. Other mammals commonly seen offshore include Leopard seals (*Leptonyx hydrurga*) and Minke whales (*Balaenoptera acutorostrata*).

Human activities and impact

Hallett Station was established by New Zealand and the United States on Seabee Hook in December 1956 as part of the IGY. The base operated continuously until its closure in February 1973 and supported a range of activities including the 1967-68 Mt. Herschel expedition led by Sir Edmund Hilary. Station construction had significant impacts on the environment, with almost 8000 Adélie penguins removed from the site. Beginning in 1984, the station was progressively cleaned up, and a joint NZ / US multi-year remediation plan for the station and surrounding area was formulated in 2001. Remediation continued in 2003-04 and 2004-05, when most remaining structures were demolished and removed, and the last remaining substantial items were removed at the end of January 2010. Many of the buildings and artefacts from the former Hallett Station are now held at the Canterbury Museum, Christchurch.

Some material associated with the former station still remains dispersed throughout the Area, including small pieces of wood and metal, wire, and metal drums, much of which is firmly embedded in the ground. In addition, the well-preserved body of a husky that died in 1964 remains contained within an enclosed wooden box covered by rocks in the east of the Area (Map 3).

As part of the clean up operation, mounds were constructed within the old station footprint to encourage Adélie penguin recolonization, and substantial parts of these areas have now been occupied (Map 4). The history of human impact on the Adélie colony and its subsequent recovery make the site of high scientific value for research into the impacts on and recovery of the colony following significant ecosystem disturbance.

6(ii) Access to the Area

Access to the Area may be made by air, from the sea or by pedestrians over sea ice. Break out of sea ice at Cape Hallett usually begins between late December and early January and sea ice generally reforms in early March. Areas of sea ice that are potentially more stable and better suited to aircraft landing may be found at sites southwest of Seabee Hook in the enclosure of Edisto Inlet. However, sea ice within Edisto Inlet can break out rapidly, even early in the season, so care is needed.

The breeding season for Adélie penguins and skuas within the Area is between October and March. During this period and when suitable sea ice is present, fixed wing aircraft may land at any site outside of the 1/2 nautical mile (~930 m) guideline distance described in Section 7(i) and shown on Map 2. When landings beyond 1/2 nautical mile are unsafe or impractical, fixed wing landings may be made at any site beyond 1/4 nautical mile (~460m) of the Adélie colony on Seabee Hook. Access to the Area from fixed wing landing locations may be by helicopter or on foot over sea ice.

Helicopters may land at any site outside of the 1/2 nautical mile (~930m) guideline distance, except when such landings are unsafe or impractical, in which case the designated helicopter landing site within the Area in Willett Cove at 170° 13.579' E, 72° 19.228' S may be used. Helicopter access to the designated landing site should be from the south and follow the eastern coastline of Willett Cove (Map 2). Occasionally the designated helicopter landing site at Willett Cove may be susceptible to inundation by high tides.

When access to the Area is made from the sea, small boats may land anywhere within the Area, although small boat landings with the purpose of camping should be made to Willett Cove. Strong currents and eddies have been reported on the seaward margins of Seabee Hook, which may prove difficult for small boat landings. Ocean conditions are generally calmer in Willett Cove and in the lee of Seabee Hook.

Access to the Area on foot may be made over sea ice.

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

Hallett Station was established on Seabee Hook in December 1956 and closed in February 1973. By 1960 the buildings of Hallett Station occupied 1.8 ha and the associated roads, refuse dumps, fuel caches and radio aerials a further 2.8 ha. The station was occupied year-round until 1964, from when summer-only operation continued until closure. The station was progressively dismantled after 1984 and in 1996 only six structures, including a large 378,500 liter (100,000 gallon) fuel tank remained. Liquid fuel remaining in the large fuel tank was removed in February 1996. Further clean-up work was undertaken in 2003-04 and 2004-05, to remove all remaining structures including the fuel tank, and to remove contaminated soil from the area. All remaining substantial items were removed from the Area on 30-31 January 2010.

Two Automatic Weather Stations (AWS) operated by the United States (McMurdo Dry Valleys Long Term Ecological Research) and New Zealand (National Institute of Water and Atmospheric Research) are located 10 m apart approximately 50 m north of the designated campsite (Map 3). New Zealand maintains a banded fuel cache of several drums approximately 50 m south of the designated campsite. An enclosed box containing the remains of a husky dog that died in 1964 is located near a large rock in the eastern part of the Area, covered by loose rocks (Map 3).

The USGS geodetic station 'FISHER' (Maps 3 & 4) consists of a standard USGS Antarctic brass tablet stamped with "FISHER 1989-90" and is set flush on the top of a large concrete block (2x1x1 m) at an elevation of 2.15 m. The benchmark is located approximately 80 m south of the emergency cache and 140 m inland from the NW coast of Seabee Hook. Following recolonization of the old station area, the benchmark now lies within a small Adélie subcolony, and is therefore likely to be surrounded by breeding birds during the summer. An emergency cache, comprising a large box (~1.5 m square and 1 m in height) painted bright red on top with smaller box alongside, is located on the site of the former station (Map 4).

Markers from a number of scientific studies are present within the Area, including those delineating the vegetation monitoring plot within the Restricted Zone. It should be noted that not all historical markers have been documented.

6(iv) Location of other protected areas within close proximity of the Area

The nearest protected areas to Cape Hallett are Cape Adare (ASPA No.159) 115 km to the north, Mount Rittman (ASPA No.175) ~200 km to the south, and Mount Melbourne (ASPA No.175) and Edmonson Point (ASPA No.165) which are both approximately 290 km to the south.

6(v) Special zones within the Area

Restricted Zone

A small zone directly below the scree slopes in the northeast of the Area is designated a Restricted Zone in order to preserve part of the Area as a reference site for future comparative vegetation studies. Access to the Restricted Zone is allowed only for compelling reasons that cannot be served elsewhere in the Area. The remainder of the Area is more generally available for research programs and sample collection.

A vegetation study plot of approximately 28 m by 120 m was mapped in detail by Rudolph (1963), which was relocated and re-mapped by Brabyn *et al.* (2006) to provide a quantification of vegetation change at the site over a 42-year period. This site established by Rudolph represents an extremely valuable resource for monitoring vegetation change. Markers used in both studies remain *in situ* and define the extent of the vegetation monitoring plot. The NE corner of the monitoring plot is indicated by a large boulder with a cairn built on top, located at 170°14'2.55" E 72°19'11.37" S. Detailed descriptions of the plot are given in Rudolph (1963) and Brabyn *et al.* (2006). Rudolph also photographed stones colonized by lichens, which Brabyn *et al.* (2006) re-photographed to measure lichen growth rates. One of these sites (shown on Map 3) is within the Restricted Zone and should not be disturbed.

The Restricted Zone provides a buffer around the monitoring plot of 20 m on the NW side and 10 m on the other three sides, making a rectangle of 58 m in width and 140 m in length. The corner coordinates of the Restricted Zone are defined in Table 2. A series of cairns has been constructed (on existing rocks where possible) to indicate the extent of the Restricted Zone (Map 3).

Table 2. Restricted Zone corner coordinates

Corner	Longitude (E)	Latitude (S)
Northeast	170°14'4.012"	72°19'11.219"
Northwest	170°13'58.341"	72°19'10.43"
Southwest	170°13'51.901"	72°19'14.479"
Southeast	170°13'57.338"	72°19'15.299"

7. Terms and conditions for entry permits

7(i) General permit conditions

Entry into 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 only for scientific purposes, or for educational purposes that cannot be served elsewhere, or for reasons essential to the management of the Area;
- the actions permitted are in accordance with the Management Plan;
- The activities permitted will give due consideration via the environmental impact assessment process to the continued protection of the environmental, scientific, educational, historic, and aesthetic values of the Area;
- The Permit shall be issued for a finite period;
- the Permit, or a copy, shall be carried when in the Area.

7(ii) Access to and movement within the Area

- Access into the Area shall be by small boat, helicopter, or on foot.
- Vehicles are prohibited within the Area.

- Restrictions on aircraft operations apply during the period between 01 October and 31 March, when aircraft shall operate and land within the Area according to strict observance of the following conditions:
 - Overflight of the Area below 2000 feet (~610 m) is prohibited, unless authorized by permit for purposes allowed for by the Management Plan;
 - Overflight and landings within ½ nautical mile (~930 m) of the Adélie colony on Seabee Hook for tourism is strongly discouraged;
 - Landings within ½ nautical mile (~930 m) of the Adélie colony on Seabee Hook should be avoided wherever possible;
 - Landings beyond ½ nautical mile (~930 m) of the Adélie colony may select landing sites according to visit needs and local conditions;
 - The Primary Landing Site (170° 11.460' E, 72° 19.686' S) shown on Map 2 represents the location where access to the designated camping site is shortest by traverse over sea ice. Landings at this site may be made as local conditions allow; and
 - When landings beyond ½ nautical mile (~930 m) of the Adélie colony are considered unsafe or impractical (e.g. because sea ice is absent or poor, if weather conditions are unfavorable, or because there is an important logistic need such as to move heavy equipment), the following conditions apply:

FIXED WING

- Fixed wing aircraft may land beyond ¼ nautical mile (~460 m) of the Adélie colony;
- Fixed wing aircraft landings should not be made in Willett Cove.

HELICOPTERS

- Helicopters shall land at the designated site at Willett Cove (170° 13.579' E, 72° 19.228' S) (Map 2), either on land or on sea ice adjacent to the campsite;
- On occasions the landing site is susceptible to inundation by high tides: if this occurs landings may be made on nearby dry ground, avoiding vegetated sites and preferably remaining on beach gravels south of the designated landing site, keeping as close to the shore as possible. Landings closer to the Adélie penguin colony shall be avoided;
- Helicopters should follow the designated approach route to the maximum extent practicable. The preferred helicopter approach route is from the south and extends from the primary landing site to the designated landing site following a route along the southern and eastern coastline of Willett Cove (Map 2).

- There are no special restrictions on where access can be gained to the Area by small boat, although small boat landings with the purpose of camping should be made to Willett Cove in order to avoid the need to haul camp equipment through the Adélie colony.
- Access to the Restricted Zone is allowed only for compelling reasons that cannot be served elsewhere in the Area.
- It is important that all visitors are careful to restrict their movements around the campsite, keeping to the area along the shoreline to avoid trampling inland areas that are seasonally moist and richly colonized by a variety of plants and invertebrates, which are the subject of on-going research.
- Within the Adélie colony, visitors should not enter sub-groups of nesting penguins unless required for research or management purposes: visitors should walk around the coastal strip of Seabee Hook when possible, and/or around or between sub-groups. Traces of the old station road extend from the NW corner of Willett Cove through to the former station site, and remains a comparatively wide corridor where pedestrians can maintain a reasonable distance from nesting birds.
- Visitors should avoid walking on the scree slopes in the eastern part of the Area unless necessary for essential scientific or management purposes; screes are a sensitive and easily damaged habitat for a diverse community of flora and fauna.

- All pedestrian traffic should be kept to the minimum necessary consistent with the objectives of any permitted activities and every reasonable effort should be made to minimize effects. Visitors should avoid walking on visible vegetation. Care should be exercised when walking in areas of moist ground and on screes, where foot traffic can easily damage sensitive soils and plant communities.

7(iii) Activities that may be conducted within the Area

- Scientific research that will not jeopardize the values of the Area;
- Essential management activities, including assessment or remediation of impacts, and monitoring;
- Activities with educational aims (such as documentary reporting (photographic, audio or written), the production of educational resources or services, or educating program personnel about clean-up methods) that cannot be served elsewhere. Educational aims do not include tourism; and
- Activities with the aim of preserving or protecting historic resources within the Area.

7(iv) Installation, modification or removal of structures

- No structures are to be erected within the Area except as specified in a permit;
- All structures and scientific equipment installed in the Area must be authorized by permit and clearly identified by country, name of the principal investigator and year of installation. All such items should be made of materials that pose minimal risk of contamination of the Area;
- Installation (including site selection), maintenance, modification or removal of structures shall be undertaken in a manner that minimizes disturbance to flora and fauna;
- The emergency cache should only be used in genuine emergency, and any such use should be reported to an appropriate authority so the cache can be restocked; and
- Removal of specific equipment for which the permit has expired shall be the responsibility of the authority which granted the original Permit, and shall be a condition of the permit.

7(v) Location of field camps

Permanent field camps are prohibited within the Area. When conditions allow, temporary camping should preferably be located on sea ice in Willett Cove, which is outside of the Area. When this is not practical, temporary camping is permitted at a designated site on the eastern shore and 100 m south of the head of Willett Cove (72° 19' 13" S, 170° 13' 34" E). This site comprises unconsolidated beach gravels, is not colonized by birds or significant plant communities (although these are present nearby) and lies on the site of a former station road (Map 3). Stakes have been driven into the hard, stony ground at the campsite for tent guys; these should be used wherever possible.

The campsite is located immediately adjacent to areas rich in terrestrial fauna and flora and visitors should restrict their movements around the campsite to the area along the shoreline unless required for research purposes. On occasions the site is susceptible to inundation by high tides: if this occurs the camp may be moved to dry ground, avoiding vegetated sites to the maximum extent practicable and preferably remaining on beach gravels south of the designated campsite, keeping as close to the shore as possible.

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

In addition to the requirements of the Protocol on Environmental Protection to the Antarctic Treaty, restrictions on materials and organisms which may be brought into the Area are:

- Deliberate introduction of animals, plant material, micro-organisms and non-sterile soil into the Area is prohibited. Precautions shall be taken to prevent the accidental introduction of animals, plant material, micro-organisms and non-sterile soil from other biologically distinct regions (within or beyond the Antarctic Treaty area);
- Visitors shall ensure that sampling equipment and markers brought into the Area are clean. To the maximum extent practicable, footwear and other equipment used or brought into the area (including

backpacks, carry-bags and tents) shall be thoroughly cleaned before entering the Area. Visitors should also consult and follow as appropriate recommendations contained in the Committee for Environmental Protection Non-native Species Manual (CEP 2011), and in the Environmental Code of Conduct for Terrestrial Scientific Field Research in Antarctica (SCAR 2009);

- In view of the presence of breeding bird colonies at Cape Hallett, no poultry products, including products containing uncooked dried eggs, and wastes from such products, shall be released into the Area;
- No pesticides shall be brought into the Area;
- Fuel, food, chemicals and other materials shall not be stored in the Area, unless specifically authorized by permit, or are contained within an emergency cache authorized by an appropriate authority, and shall be stored and handled in a way that minimizes the risk of their accidental introduction into the environment;
- All materials introduced shall be for a stated period only, and shall be removed at or before the conclusion of that stated period; and
- If release occurs which is likely to compromise the values of the Area, removal is encouraged only where the impact of removal is not likely to be greater than that of leaving the material *in situ*.

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

Taking of, or harmful interference with, native flora and fauna is prohibited, except in accordance with a permit issued under Article 3 of Annex II to the Protocol on Environmental Protection to the Antarctic Treaty. Where animal taking or harmful interference 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) Collection or removal of materials not brought into the Area by the Permit holder.

- Material may be collected or removed from the Area only in accordance with a permit and should be limited to the minimum necessary to meet scientific or management needs. Permits shall not be granted if there is a reasonable concern that the sampling proposed would take, remove or damage such quantities of soil, native flora or fauna that their distribution or abundance within the Area would be significantly affected.
- Removal of, or disturbance to, markers left by previous scientific work within the Area is prohibited unless specifically authorized by permit.
- Other than scientific markers as noted above, material of human origin likely to compromise the values of the Area, which was not brought into the Area by the Permit holder, and is clearly of no historic value or otherwise authorized, may be removed from the Area unless the environmental impact of the removal is likely to be greater than leaving the material *in situ*: if this is the case the appropriate authority must be notified and approval obtained.
- Material found that is likely to possess important historic or heritage values should not be disturbed, damaged, removed or destroyed. Any such artifacts should be recorded and referred to the appropriate authority for a decision on conservation or removal. Relocation or removal of artifacts for the purposes of preservation, protection, or to re-establish historical accuracy is allowable by permit.
- The well-preserved body of a husky is contained in an enclosed wooden box located in the eastern part of the Area and should not be disturbed while options for its future management remain under consideration.

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 meet the aims of the Management Plan

Permits may be granted to enter the Area to:

- carry out monitoring and Area inspection activities, which may involve the collection of a small number of samples or data for analysis or review;

- erect or maintain signposts, structures or scientific equipment (specific sites of long-term monitoring should be appropriately marked);
- carry out protective measures.

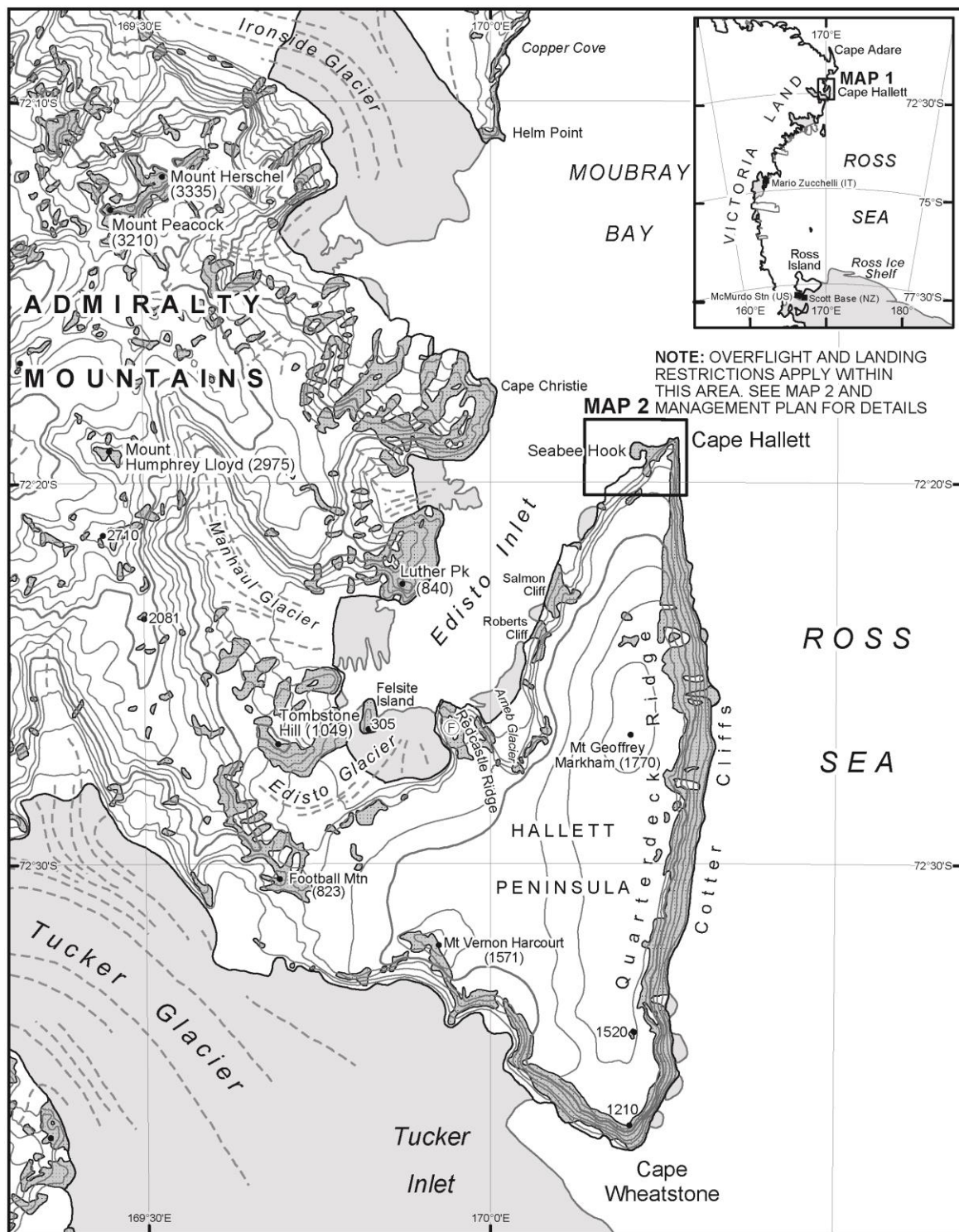
7(xi) *Requirements for reports*

- The principal permit holder for each visit to the Area shall submit a report to the appropriate national authority as soon as practicable, and where possible should do so within six months after the visit has been completed.
- Such reports should include, as appropriate, the information identified in the Visit Report form contained in Appendix 2 of the Guide to the Preparation of Management Plans for Antarctic Specially Protected Areas (Resolution 2 (2011)). If appropriate, the national authority should also forward a copy of the visit report to the Party that proposed the Management Plan, to assist in managing the Area and reviewing 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 organizing the scientific use of the Area.
- The appropriate authority should be notified of any activities / measures undertaken, anything removed, and / or of any materials released and not removed, that were not included in the authorized permit.

8. Supporting documentation

- Brabyn, L., Beard, C., Seppelt, R.D., Rudolph, E.D., Türk, R. & Green, T.G.A. 2006. Quantified vegetation change over 42 years at Cape Hallett, East Antarctica. *Antarctic Science* **18**(4): 561–72.
- Brabyn, L., Green, T.G.A., Beard, C. & Seppelt, R.D. 2005. GIS goes nano: Vegetation studies in Victoria Land, Antarctica. *New Zealand Geographer* **61**: 139–47.
- Crittenden, P.D., Scrimgeour, C.M., Minnullina, G., Sutton, M.A., Tang, Y.S. & Theobald, M.R. 2015. Lichen response to ammonia deposition defines the footprint of a penguin rookery. *Biogeochemistry* **122**: 295–311. doi:10.1007/s10533-014-0042-7
- Hofstee, E. H., Balks, M. R., Petchey, F., & Campbell, D. I. (2006). Soils of Seabee Hook, Cape Hallett, northern Victoria Land, Antarctica. *Antarctic Science* **18**(4): 473-486. doi:10.1017/S0954102006000526
- Lyver, P.O'B., Barron, M., Barton, K.J., Ainley, D.G., Pollard, A., Gordon, S., McNeill, S., Ballard G. & Wilson, P.R. 2014. Trends in the breeding population of Adélie penguins in the Ross Sea, 1981–2012: a coincidence of climate and resource extraction effects. *PLoS ONE* **9**(3): e91188. doi:10.1371/journal.pone.0091188
- Raymond, M.R., Wharton, D.A. & Marshall, C.J. 2013. Factors determining nematode distributions at Cape Hallett and Gondwana station, Antarctica. *Antarctic Science* **25**(3): 347-57.
- Rudolph, E.D. 1963. Vegetation of Hallett Station area, Victoria Land, Antarctica. *Ecology* **44**: 585–86.
- Ruprecht, U., Lumbsch, H.T., Brunauer, G., Green, T.G.A. & Türk, R. 2012. Insights into the diversity of Lecanoraceae (Lecanorales, Ascomycota) in continental Antarctica (Ross Sea region). *Nova Hedwigia* **94**(3): 287–306. doi:10.1127/0029-5035/2012/0017
- Sinclair, B.J., M.B. Scott, C.J. Klok, J.S. Terblanche, D.J. Marshall, B. Reyers & S.L. Chown. 2006. Determinants of terrestrial arthropod community composition at Cape Hallett, Antarctica. *Antarctic Science* **18**(3): 303-12.
- Smykla, J., Krzewicka, B., Wilk, K., Emslie, S.D. & Sliwa, L. 2011. Additions to the lichen flora of Victoria Land, Antarctica. *Polish Polar Research* **32**(2): 123-38.

(An extensive bibliography is available through the Latitudinal Gradient Project at <http://www.lgp.aq>)

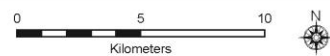


Map 1: ASPA No. 106 - Cape Hallett - Regional Map

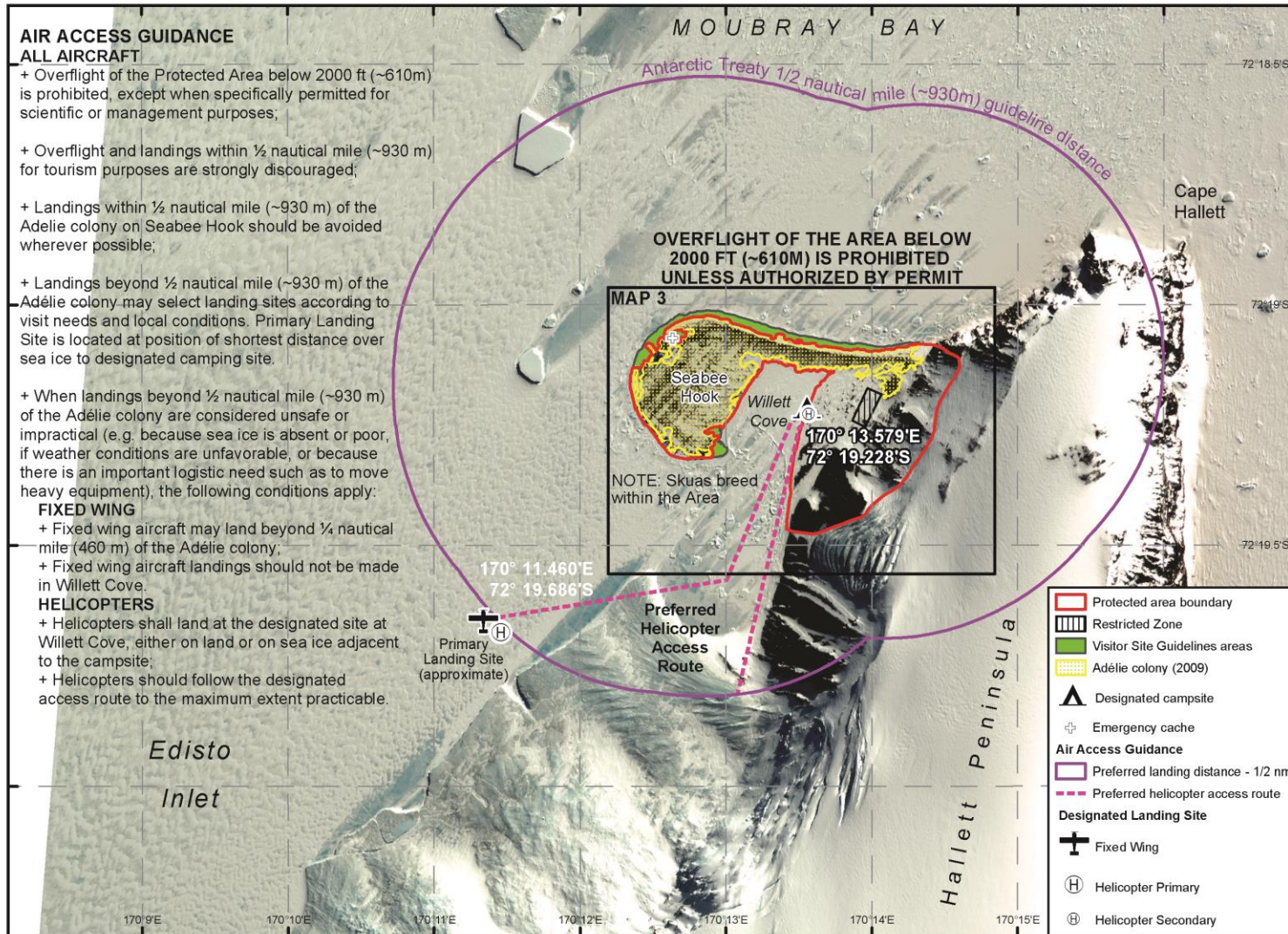
02 Mar 2015 (Map ID: 10068.0007.01)
 United States Antarctic Program
 Environmental Research & Assessment



- | | | |
|-----------------|-----------------------|--------------------------------|
| Permanent ice | Coastline | Glacier flow line |
| Ice shelf | Index contour (1000m) | Spot height (m) |
| Ice free ground | Contour (200m) | Fuel cache & geology camp (IT) |



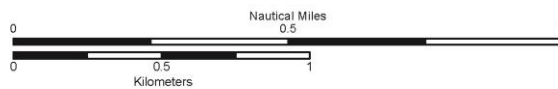
Projection: Lambert Conformal Conic
 Spheroid and horizontal datum: WGS84;
 Data: SCAR Antarctic Digital Database v5 (2007)
 Contour interval: 200 m; Heights in meters.



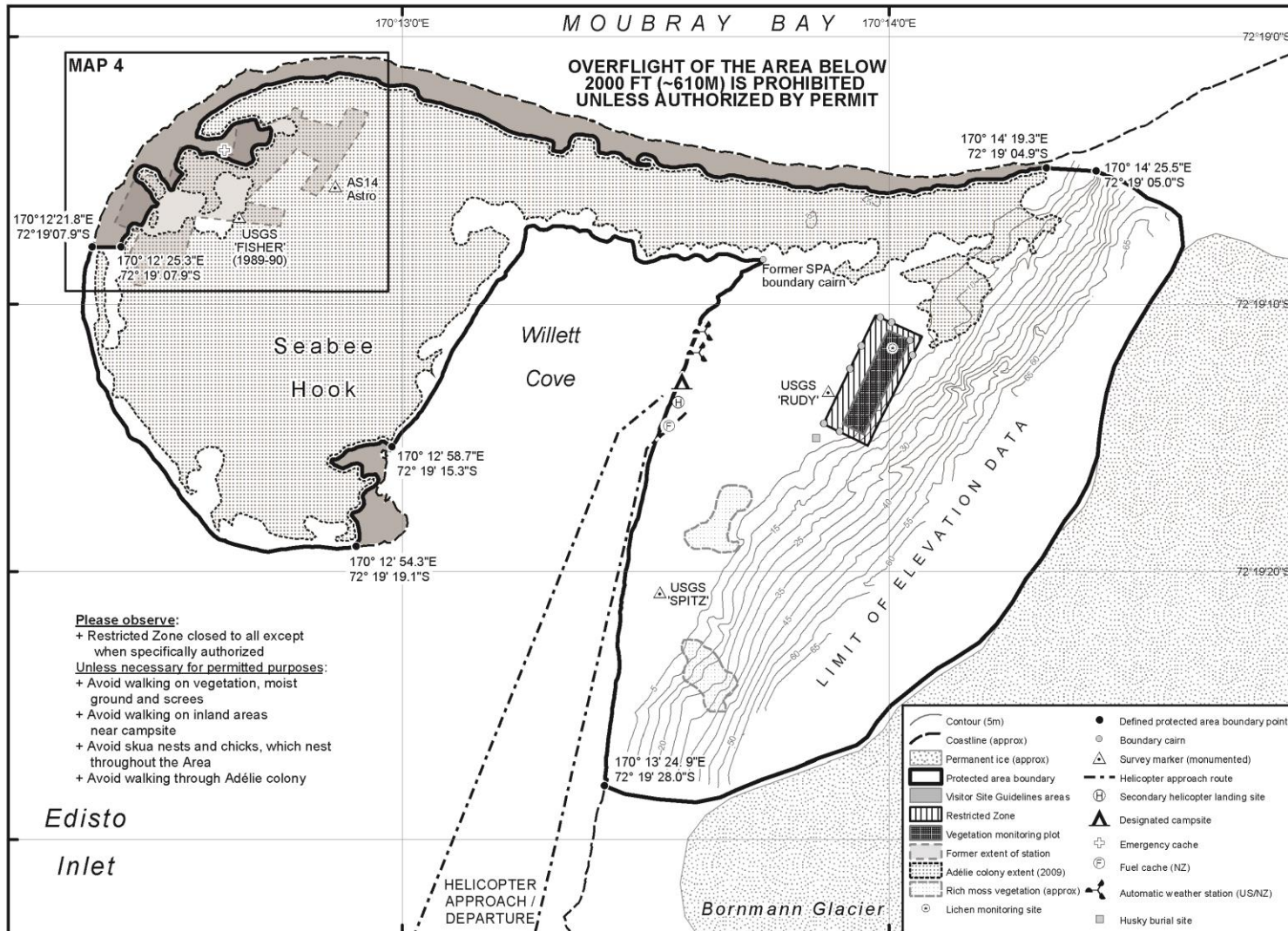
Map 2: ASPA No.106 - Cape Hallett - Air access guidance



18 Mar 2015 (Map ID: 10068.0008.01)
 United States Antarctic Program
 Environmental Research & Assessment

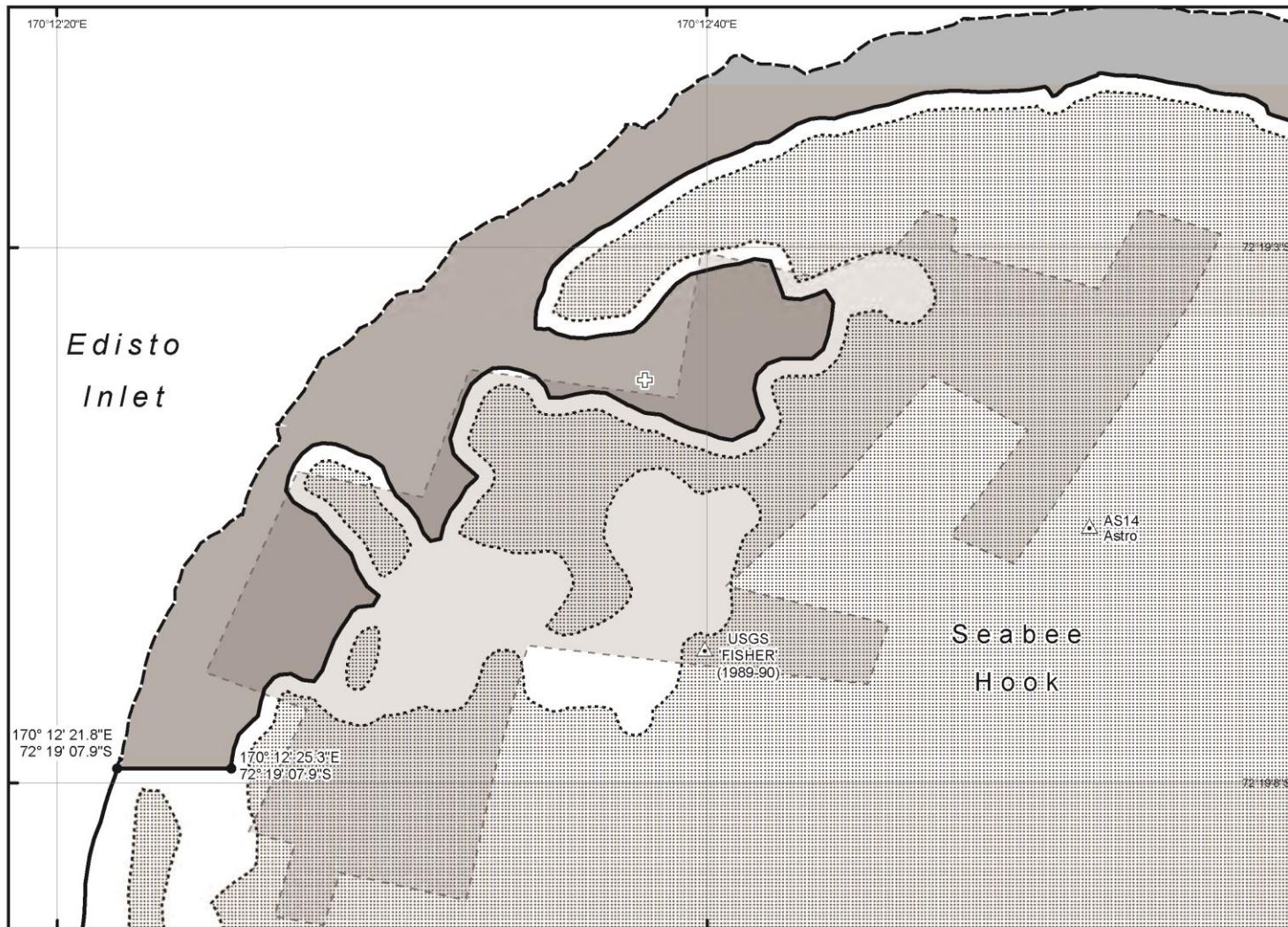


Projection: Lambert Conformal Conic;
 Spheroid: WGS84; Horizontal datum: USGS 'Fisher';
 Data sources: ERA field survey (27 Nov - 03 Dec 09);
 Base imagery: Quickbird 12 Oct 2009;
 (Imagery © 2009 Digital Globe; NGA Commercial Imagery Program).

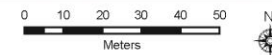


Map 3: ASPA No.106 - Cape Hallett - Topography, boundaries & features













Map 4: ASPA No.106 - Cape Hallett - Former Hallett Station area



18 Mar 2015 (Map ID: 10068.0010.01)
United States Antarctic Program
Environmental Research & Assessment

-  Coastline (approx)
-  Protected area boundary
-  Visitor Site Guidelines areas
-  Former extent of station
-  Adelle colony extent (2009)
-  Defined protected area boundary points
-  Survey marker (monumented)
-  Emergency cache

Projection: Lambert Conformal Conic;
Spheroid: WGS84; Horizontal datum: USGS "Fisher"; Contour interval: 5 m;
Data sources: Coastline, penguin colony, AS14 Astro
& emergency cache: ERA field survey (27 Nov - 03 Dec 09).