

Management Plan For Antarctic Specially Protected Area No. 116 NEW COLLEGE VALLEY, CAUGHLEY BEACH, CAPE BIRD, ROSS ISLAND

1. Description of values to be protected

An area at Cape Bird, Ross Island was originally designated as Site of Special Scientific Interest (SSSI) No. 10, Caughley Beach by Recommendations XIII-8 (1985) and Specially Protected Area (SPA) No. 20, New College Valley by Recommendation XIII-12 (1985) after proposals by New Zealand on the grounds that the area contains some of the richest stands of moss and associated microflora and fauna in the Ross Sea region of Antarctica. This is the only area on Ross Island where protection is specifically given to plant assemblages and associated ecosystems.

SPA No. 20 was originally enclosed within SSSI No. 10 in order to provide more stringent access conditions to this part of the Area. SSSI No. 10 was incorporated into SPA No. 20 by Measure 1 (2000), with the former Area of SPA No. 20 becoming a Restricted Zone within the SPA. The boundaries of the Area were revised from the boundaries in the original recommendations, in view of improved mapping and to follow more closely the ridges enclosing the catchment of New College Valley. Caughley Beach itself was adjacent to, but never a part of, the original Area, and for this reason the entire Area was renamed as New College Valley, which was within both of the original sites. The Area was redesignated by Decision 1 (2002) as Antarctic Specially Protected Area (ASPA) No. 116 and a revised Management Plan was adopted through Measure 1 (2006) and Measure 1 (2011).

The boundaries of the Area closely follow the ridges enclosing the catchment of New College Valley and cover approximately 0.33 km². Moss in this Area is restricted to localised areas of water-flushed ground, with cushions and carpets up to 20 m² in area. A diverse range of algal species also inhabit streams in the Area, and springtails, mites and nematodes are plentiful on water surfaces and underneath rocks. The absence of lichens makes the species assemblage in this Area unique on Ross Island.

The susceptibility of mosses to disturbance by trampling, sampling, pollution or introductions of non-native species is such that the Area requires long-term special protection. Designation of this Area is intended to ensure examples of this habitat type are adequately protected from visitors and overuse from scientific investigations. The ecosystem at this site remains of exceptional scientific value for ecological investigations and the Restricted Zone is valuable as a reference site for future comparative studies.

2. Aims and objectives

Management of New College Valley, Caughley Beach, Cape Bird aims to:

- avoid degradation of, or substantial risk to, the values of the Area by preventing unnecessary human disturbance to the Area;
- preserve a part of the natural ecosystem of the Area as a reference area for the purpose of future comparative studies;

- allow scientific research on the ecosystem, in particular on mosses, algae and invertebrates in the Area, while ensuring protection from over-sampling;
- allow other scientific research in the Area provided it is for compelling reasons which cannot be served elsewhere;
- prevent or minimise the introduction to the Area of alien plants, animals and microbes;
- allow visits for management purposes in support of the aims of the Management Plan.

3. Management activities

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

- Copies of this Management Plan including maps of the Area shall be made available at adjacent operational research/field stations.
- Rock cairns or signs illustrating the location and boundaries, with clear statements of entry restrictions, shall be placed at appropriate locations on the boundary of the Area and the Restricted Zone to help avoid inadvertent entry.
- 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 required.
- 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 management and maintenance measures are adequate.
- National Antarctic Programmes operating in the Area shall consult together with a view to ensuring the above management activities are implemented.

4. Period of designation

Designated for an indefinite period.

5. Maps

Map A: New College Valley, Caughley Beach, Cape Bird, Ross Island, Regional Topographic Map. Map specifications: Projection - Lambert conformal conic. Standard parallels - 1st 76° 40' 00" S; 2nd 79° 20' 00" S. Central Meridian - 166° 30' 00" E. Latitude of Origin - 78° 01' 16. 211" S. Spheroid - WGS84.

Map B: New College Valley, Caughley Beach, Cape Bird, Ross Island, Vegetation Coverage Map. Map specification: Projection - Lambert conformal conic. Standard parallels – 1st -76.6° S; 2nd - 79.3° S. Spheroid - WGS84. Map includes vegetation coverage and streams.

6. Description of the Area

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

Cape Bird is at the northwest extremity of Mount Bird (1,800 m), an inactive volcanic cone which is probably the oldest on Ross Island. New College Valley is located south of Cape Bird on ice-free slopes above Caughley Beach, and lies between two Adélie penguin colonies known as the Cape Bird Northern and Middle Rookeries (Map A). The Area, comprising veneered glacial moraines at

the foot of the Cape Bird Ice Cap, consists of seaward dipping olivine-augite basalts with scoriaceous tops erupted from the main Mount Bird cone.

The northwest corner of the north boundary of the Area is approximately 100 m south of the Cape Bird hut (New Zealand) and is marked by an ASPA sign post (77° 13.128'S, 166° 26.147'E) (Map B). The north boundary of the Area extends upslope and eastward toward a prominent terminal moraine ridge, approximately 20 m from the Cape Bird Ice Cap and is marked with a rock cairn (77° 13.158'S, 166° 26.702'E).

The eastern boundary follows the terminal moraine ridge from the rock cairn (77° 13.158'S, 166° 26.702'E) southeast until the ridge disappears where it joins the Cape Bird Ice Cap. The boundary continues southeast following the glacier edge to the southern boundary.

The southern boundary is a straight line crossing the broad southern flank of New College Valley, and is marked with rock cairns at the south-western corner of the Area (77° 13.471'S, 166° 25.832'E) and the south-eastern corner of the area on the hilltop 100 m from the Cape Bird Ice Cap glacier edge (77° 13.571'S, 166° 27.122'E).

The west boundary of the Area follows the top of the coastal cliffs of Caughley Beach from the south-western corner rock cairn (77° 13.471'S, 166° 25.832'E) for a distance of 650 m to the northwest corner of the Area (77° 13.128'S, 166° 26.147'E) where the ASPA signpost is.

New College Valley, Caughley Beach is located within Environment S – McMurdo – South Victoria Land geologic based on the Environmental Domains Analysis for Antarctica (Resolution 3 (2008)) and in Region 9 – South Victoria Land based on the Antarctic Conservation Biogeographic Regions (Resolution 6 (2012))

Northwest-facing New College Valley drains meltwater from the Cape Bird Ice Cap during the summer. Streams in the Area are fed by melt from persistent summer snow drifts and have eroded their own shallow gullies and channels. The ground is largely covered by stones and boulders of volcanic origin which have been reworked by glacial action.

The Area contains the most extensive ephemeral stream course distributions of the moss *Hennediella heimii* on Ross Island. Surveys have shown that this moss, together with much lower occurrences of two other species – *Bryum subrotundifolium* and *Bryum pseudotriquetrum* – are confined almost entirely to the stream courses across the steep till and scoria covered slopes (Map B). The mosses are generally associated with algal growths, namely rich, red-brown oscillatorian felts and occasional reddish-black growths of *Nostoc commune*. The Area includes the full course of three stream systems that contain significant growths of algae, together with the mosses.

The Area supports a terrestrial invertebrate community including populations of springtails *Gomphiocephalus hodgsonii* (Collembola: Hypogastruridae), mites *Nanorchestes antarcticus* and *Stereotydeus mollis* (Acari: Prostigmata) and nematodes (*Panagrolaimus davidi*, *Plectus antarcticus*, *Plectus frigophilus*, *Scottnema lindsayae* and *Eudorylaimus antarcticus*) with the presence of rotifers, tardigrades, and ciliate and flagellate protozoa noted. The distribution of terrestrial invertebrates at this site is related to the abiotic environment with most arthropod species being associated with macroscopic vegetation or soil algal biomass level, although this relationship does not describe the distribution of all taxa.

Skuas (*Catharacta maccormicki*) frequently rest on Caughley Beach and overfly, land and nest within the Area. Adélie penguins (*Pygoscelis adeliae*) from the nearby rookeries do not nest in the Area, but have been observed occasionally to traverse across New College Valley.

6(ii) Special zones within the Area

An area of New College Valley is designated as a Restricted Zone in order to preserve part of the Area as a reference site for future comparative studies, while the remainder of the Area (which is similar in biology, features and character) is more generally available for research programmes and sample collection. The Restricted Zone encompasses ice-free slopes within New College Valley above Caughley Beach some of which are north-facing with snow drifts which provide a ready supply of melt water to foster moss and algal growth.

The northwest corner ($77^{\circ} 13.164'S$, $166^{\circ} 26.073'E$) of the Restricted Zone is 60 m to the south and across a small gully from the northwest corner of the Area. The north boundary of the Restricted Zone extends 500 m upslope from the northwest corner to a cairn ($77^{\circ} 13.261'S$, $166^{\circ} 26.619'E$), then following a faint but increasingly prominent ridge southeast to a point in the upper catchment of New College Valley marked by a cairn approximately 60 m from the ice terminus of the Cape Bird Ice Cap ($77^{\circ} 13.368'S$, $166^{\circ} 26.976'E$). The Restricted Zone boundary extends 110 m southwest across the valley to a cairn marking the southeast corner of the Restricted Zone ($77^{\circ} 13.435'S$, $166^{\circ} 26.865'E$). The south boundary of the Restricted Zone extends in a straight line from this cairn ($77^{\circ} 13.435'S$, $166^{\circ} 26.865'E$) 440 m northwest down a broad and relatively featureless slope to the southwest corner of the Area ($77^{\circ} 13.328'S$, $166^{\circ} 26.006'E$). A cairn is placed on the southwest boundary of the Restricted Zone to mark the lower position of the south boundary ($77^{\circ} 13.226'S$, $166^{\circ} 25.983'E$).

Access to the Restricted Zone is allowed only for compelling scientific and management purposes that cannot be served by visits elsewhere in the Area.

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

Structures known to exist within the Area include a United States Navy Astrofix marker, cairns marking the boundaries of the Area and the Restricted Zone, a signpost situated at the northwest corner of the Area and an approximately one meter square wooden frame marking the site of an experimental oil spill from 1982.

A field hut (New Zealand), stores hut and toilet are located north of the northwest corner of the Area (Map B).

6(iv) Location of other protected areas in the vicinity

The nearest protected areas are:

- Lewis Bay, Mount Erebus, Ross Island (ASPANo. 156), approximately 25 km SE;
- Tramway Ridge, Mount Erebus, Ross Island (ASPANo. 175) 30 km SSE;
- Cape Crozier, Ross Island (ASPANo. 124) 75 km SE;
- Cape Royds, Ross Island (ASPANo. 121 and No. 157) and Cape Evans, Ross Island (ASPANo. 155) 35 km and 45 km south on Ross Island respectively; and
- Beaufort Island, McMurdo Sound, Ross Sea (ASPANo. 105) 40 km to the north.

7. Terms and conditions for entry Permits

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:

- outside of the Restricted Zone, it is issued only for scientific study of the ecosystem, or for compelling scientific reasons that cannot be served elsewhere, or for essential management purposes consistent with the Management Plan objectives such as inspection or review;
- access to the Restricted Zone is allowed only for compelling scientific or management reasons that cannot be served elsewhere in the Area;
- the actions permitted are not likely to jeopardise the ecological or scientific values of the Area or other permitted activities;
- any management activities are in support of the objectives of the Management Plan;
- the actions permitted are in accordance with the Management Plan;
- the Permit, or a copy, shall be carried within the Area;
- a visit report shall be supplied to the authority named in the Permit;
- the Permit shall be issued for a stated period.

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

Helicopters are prohibited from landing within the Area. Two helicopter landing sites are located outside the Area. Between October to February, the preferred landing site is below the cliffs on Caughley Beach, 100 m west of the west boundary of the Area 77° 13.221'S, 166° 25.812'E (Maps A and B). Between March and September, an alternative helicopter landing site is located adjacent to the Cape Bird field hut (New Zealand), above Caughley Beach 77° 13.093S, 166° 26.168' E (Map B).

Between October and February the preferred flight path is an approach from the south above Middle Rookery (Map A). Flights north of the helicopter pad may be necessary under certain wind conditions but should follow the recommended aircraft approach and departure routes, and to maximum extent possible, follow the 'Guidelines for the Operation of Aircraft Near Concentrations of Bird in Antarctica' (Resolution 2, 2004). See Map A for the recommended aircraft approach routes into and out of Cape Bird.

Overflight of the Area lower than 50 m (~150 ft) above ground level is prohibited. Hovering over the Area is not permitted lower than 100 m (~300 ft) above ground level. Use of helicopter smoke grenades within the Area is prohibited.

Vehicles are prohibited within the Area and all movement within the Area should be on foot. Access into the Area should preferably follow the track from the Cape Bird Hut (New Zealand). Visitors should avoid areas of visible vegetation and care should be exercised walking in areas of moist ground, particularly the stream course beds, where foot traffic can easily damage sensitive soils, plant and algal communities, and degrade water quality. Avoid walking on such areas by walking on ice or rocky ground. 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 minimise effects.

Access to regions south of the Area from the Cape Bird Hut should be made by a route below the cliffs along Caughley Beach.

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

- Compelling scientific research which cannot be undertaken elsewhere and which will not jeopardise the ecosystem or values of the Area or interfere with existing scientific studies;

- Essential management activities, including monitoring and inspection.

7(iii) Installation, modification or removal of structures

No structures are to be erected within the Area, or scientific equipment installed, except for compelling scientific or management reasons, as specified in a Permit. All markers, structures or scientific equipment installed in the Area must be authorised by Permit and clearly identified by country, name of the principal investigator or agency, year of installation and date of expected removal. All such items should be free of organisms, propagules (e.g. seeds, eggs) and non-sterile soil, and be made of materials that pose minimal risk of contamination of the Area. Removal of specific structures or equipment for which the Permit has expired shall be a condition of the Permit.

7(iv) Location of field camps

Camping within the Area is prohibited. A field hut (New Zealand), stores hut and toilet are located north of the northwest corner of the Area (Map B).

7(v) 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 and precautions listed in 7(ix) shall be taken against accidental introductions. No poultry products shall be brought into the Area. No herbicides or pesticides shall be brought into the Area. Any other chemicals, including radio-nuclides or stable isotopes, which may be introduced for scientific or management purposes specified in the Permit, shall be removed from the Area at or before the conclusion of the activity for which the Permit was granted. Fuel or other chemicals shall not be stored in the Area, unless required for essential purposes connected with the activity for which the Permit has been granted, and must be contained within an emergency cache authorized by an appropriate authority. All materials introduced shall be for a stated period only, shall be removed at or before the conclusion of that stated period, and shall be stored and handled so that risk of their introduction into the environment is minimised.

7(vi) Taking or harmful interference with native flora or fauna

Taking of, or harmful interference with native flora or fauna is prohibited, except in accordance with a separate Permit issued in accordance with Annex II of the Protocol on Environmental Protection to the Antarctic Treaty. Where taking 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(vii) The collection or removal of materials not imported 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. Similarly, sampling is to be carried out using techniques which minimise disturbance to the Area as well as duplication. Material of human origin likely to compromise the values of the Area, which was not brought into the Area by the Permit holder or otherwise authorised and is not an historical artefact or abandoned relic, may be removed from any part of the Area, including the Restricted Zone, unless the environmental impact of removal is likely to be greater than leaving the material *in situ*. If this is the case the appropriate national authority must be notified and approval obtained.

7(viii) Disposal of waste

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

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

Permits may be granted to enter the Area to:

- carry out biological monitoring and Area inspection activities, which may involve the collection of a small number of samples or data for analysis or review;
- to erect or maintain signposts, structures or scientific equipment; or
- for management activities.

Any specific sites of long-term monitoring shall be appropriately marked.

To help maintain the ecological and scientific values of the isolation and relatively low level of human impact at the Area, visitors shall take special precautions against 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, visitors shall thoroughly clean footwear and any equipment to be used in the area particularly sampling equipment and markers before entering the Area.

7(x) 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 no later than six months after the visit has been completed. Such visit reports should include, as applicable, the information identified in the recommended visit report form [contained in Appendix 4 of the Guide to the Preparation of Management Plans for Antarctic Specially Protected Areas appended to Resolution 2 (1998)] [available from the website of the Secretariat of the Antarctic Treaty www.ats.aq].

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 maintain a record of such activities and report them in the Annual Exchange of Information. Parties should, wherever possible, deposit originals or copies of such original visit reports in a publicly accessible archive to maintain a record of usage, for the purposes of any review of the management plan and in organising the scientific use of the Area.

8. Bibliography

- Ainley, D.G., Ballard, G., Barton, K.J., Karl, B.J., Rau, G.H., Ribic, C.A. and Wilson, P.R. 2003. Spatial and temporal variation of diet within a presumed metapopulation of Adelie penguins. *Condor* 105: 95-106.
- Ainley, D.G., Ribic, C.A., Ballard, G., Heath, S., Gaffney, I., Karl, B.J., Barton, K.J., Wilson, P.R. and Webb, S. 2004. Geographic structure of Adelie penguin populations: overlap in colony-specific foraging areas. *Ecological monographs* 74(1): 159- 178.
- Block, W. 1985. Ecological and physiological studies of terrestrial arthropods in the Ross Dependency 1984-85. *British Antarctic Survey Bulletin* 68: 115-122.
- Broady, P.A. 1981. Non-marine algae of Cape Bird, Ross Island and Taylor Valley, Victoria Land, Antarctica. Report of the Melbourne University Programme in Antarctic Studies No. 37.
- Broady, P.A. 1983. Botanical studies at Ross Island, Antarctica, in 1982-83; preliminary report. Report of the Melbourne University Programme in Antarctic Studies.
- Broady, P.A. 1985. The vegetation of Cape Bird, Ross Island, Antarctica. Melbourne University Programme in Antarctic Studies, No. 62.
- Broady, P.A. 1985. A preliminary report of phycological studies in northern Victoria Land and on Ross Island during 1984-85. Report of the Melbourne University Programme in Antarctic Studies, Report No. 66.
- Broady, P.A. 1989. Broadscale patterns in the distribution of aquatic and terrestrial vegetation at three ice-free regions on Ross Island, Antarctica. *Hydrobiologia* 172: 77-95.
- Butler, E.R.T. 2001. Beaches in McMurdo Sound, Antarctica. Unpublished PhD, Victoria University of Wellington, New Zealand. (pg 219)
- Cole, J.W. and Ewart, A. 1968. Contributions to the volcanic geology of the Black Island, Brown Peninsula, and Cape Bird areas, McMurdo Sound, Antarctica. *New Zealand Journal of Geology and Geophysics* 11(4): 793-823.
- Dochat, T.M., Marchant, D.R. and Denton, G.H. 2000. Glacial geology of Cape Bird, Ross Island, Antarctica. *Geografiska Annaler* 82A (2-3): 237-247.
- Duncan, K.W. 1979. A note on the distribution and abundance of the endemic collembolan *Gomphiocephalus hodgsonii* Carpenter 1908 at Cape Bird, Antarctica. *Mauri Ora* 7: 19-24.
- Hall, B.L., Denton, G.H. and Hendy, C.H. 2000. Evidence from Taylor Valley for a Grounded Ice Sheet in the Ross Sea, Antarctica. *Geografiska annaler* 82A(2-3): 275-304.
- Konlechner, J.C. 1985. An investigation of the fate and effects of a paraffin-based crude oil in an Antarctic terrestrial ecosystem. *New Zealand Antarctic Record* 6(3): 40-46.
- Lambert, D.M., Ritchie, P.A., Millar, C.D., Holland, B., Drummond, A.J. and Baroni, C. 2002. Rates of evolution in ancient DNA from Adélie penguins. *Science* 295: 2270-2273.

McGaughran, A., Convey, P., Redding, G.P. and Stevens, M.I. 2010. Temporal and spatial metabolic rate variation in the Antarctic springtail *Gomphiocephalus hodgsoni*. *Journal of Insect Physiology* 56: 57-64.

McGaughran, A., Convey, P. and Hogg, I.D. 2011. Extended ecophysiological analysis of *Gomphiocephalus hodgsoni* (Collembola): flexibility in life history strategy and population response. *Polar Biology* 34: 1713-1725.

McGaughran, A., Hogg, I.D. and Stevens, M.I. 2008. Patterns of population genetic structure for springtails and mites in southern Victoria Land, Antarctica. *Molecular phylogenetics and evolution* 46: 606-618.

McGaughran, A., Redding, G.P., Stevens, M.I. and Convey, P. 2009. Temporal metabolic rate variation in a continental Antarctica springtail. *Journal of Insect Physiology* 55: 130-135.

Nakagawa, S., Möstl, E. and Waas, J.R. 2003. Validation of an enzyme immunoassay to measure faecal glucocorticoid metabolites from Adelie penguins (*Pygoscelis adeliae*): a non-invasive tool for estimating stress? *Polar biology* 26: 491-493.

Peterson, A.J. 1971. Population studies on the Antarctic Collembolan *Gomphiocephalus hodgsonii* Carpenter. *Pacific Insects Monograph* 25: 75-98.

Ritchie, P.A., Millar, C.D., Gibb, G.C., Baroni, C., Lambert, D.M. 2004. Ancient DNA enables timing of the Pleistocene origin and Holocene expansion of two Adelie penguin lineages in Antarctica. *Molecular biology and evolution* 21(2): 240-248.

Roeder, A.D., Marshall, R.K., Mitchelson, A.J., Visagathilagar, T., Ritchie, P.A., Love, D.R., Pakai, T.J., McPartlan, H.C., Murray, N.D., Robinson, N.A., Kerry, K.R. and Lambert, D.M. 2001. Gene flow on the ice: genetic differentiation among Adélie penguin colonies around Antarctica. *Molecular Ecology* 10: 1645-1656.

Seppelt, R.D. and Green, T.G.A. 1998. A bryophyte flora for Southern Victoria Land, Antarctica. *New Zealand Journal of Botany* 36: 617-635.

Sinclair, B.J. 2000. The ecology and physiology of New Zealand Alpine and Antarctic arthropods. Unpublished PhD, University of Otago, New Zealand. (pg 231)

Sinclair, B. J. 2001. On the distribution of terrestrial invertebrates at Cape Bird, Ross Island, Antarctica. *Polar Biology* 24(6): 394-400.

Sinclair, B. J. and Sjurksen, H. 2001. Cold tolerance of the Antarctic springtail *Gomphiocephalus hodgsonii* (Collembola, Hypogastruridae). *Antarctic Science* 13(3): 271-279.

Sinclair, B.J. and Sjurksen, H. 2001. Terrestrial invertebrate abundance across a habitat transect in Keble Valley, Ross Island, Antarctica. *Pedobiologia* 45: 134-145.

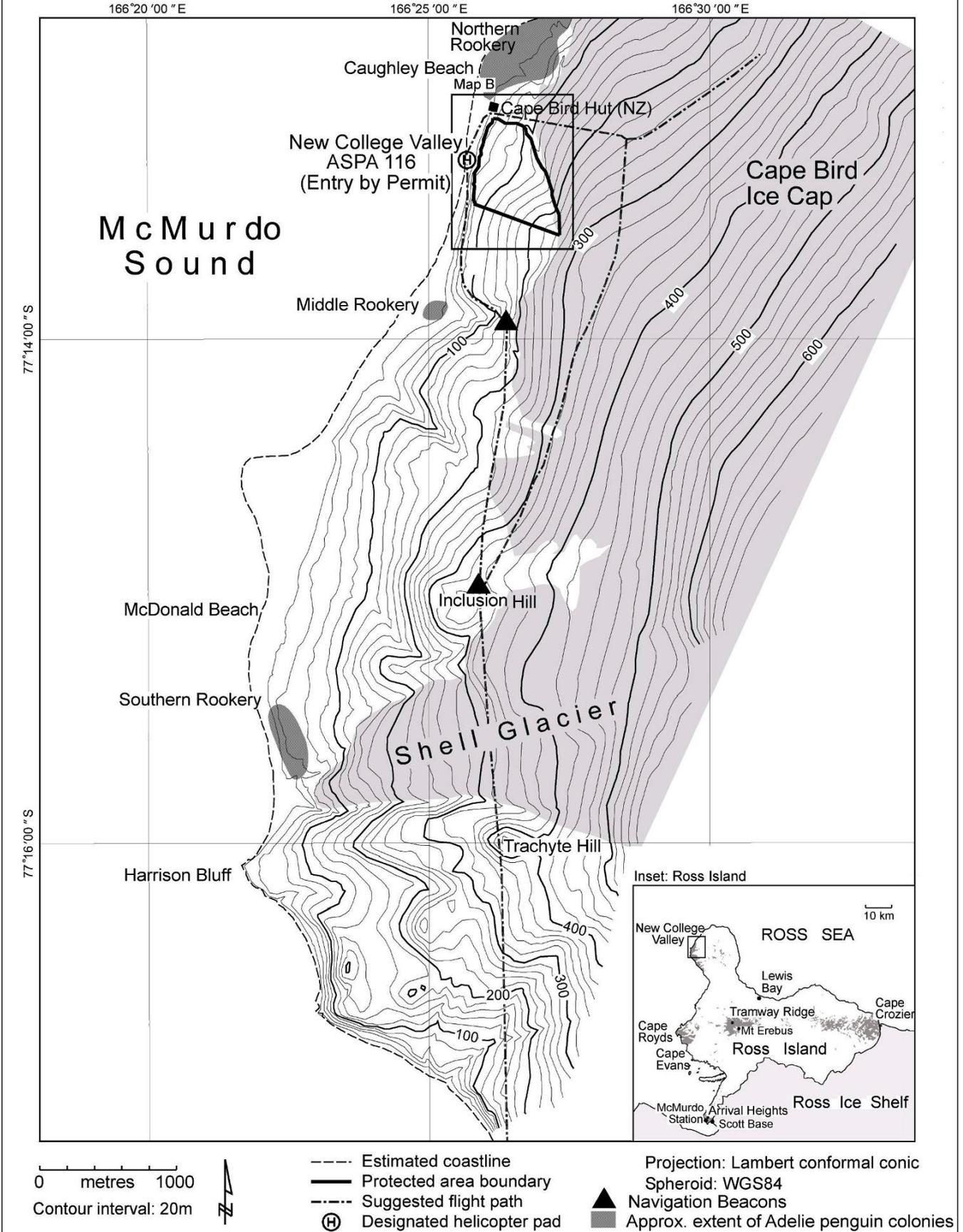
Smith, D.J. 1970. The ecology of *Gomphiocephalus hodgsonii* Carpenter (Collembola, Hypogasturidae) at Cape Bird, Antarctica. Unpublished MSc Thesis, University of Canterbury, Christchurch, New Zealand.

Stevens, M.I. and Hogg, I.D. 2003. Long-term isolation and recent expansion from glacial refugia revealed for the endemic springtail *Gomphiocephalus hodgsonii* from Victoria Land, Antarctica. *Molecular ecology* 12: 2357-2369.

Wilson, P.R., Ainley, D.G., Nur, N., Jacobs, S.S., Barton, K.J., Ballard, G. and Comisco, J.C. 2001. Adélie penguin population change in the Pacific sector of Antarctica: relation to sea-ice extent and the Antarctic Circumpolar Current. *Marine ecology progress series* 213: 301-309.

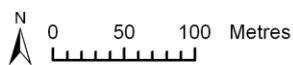
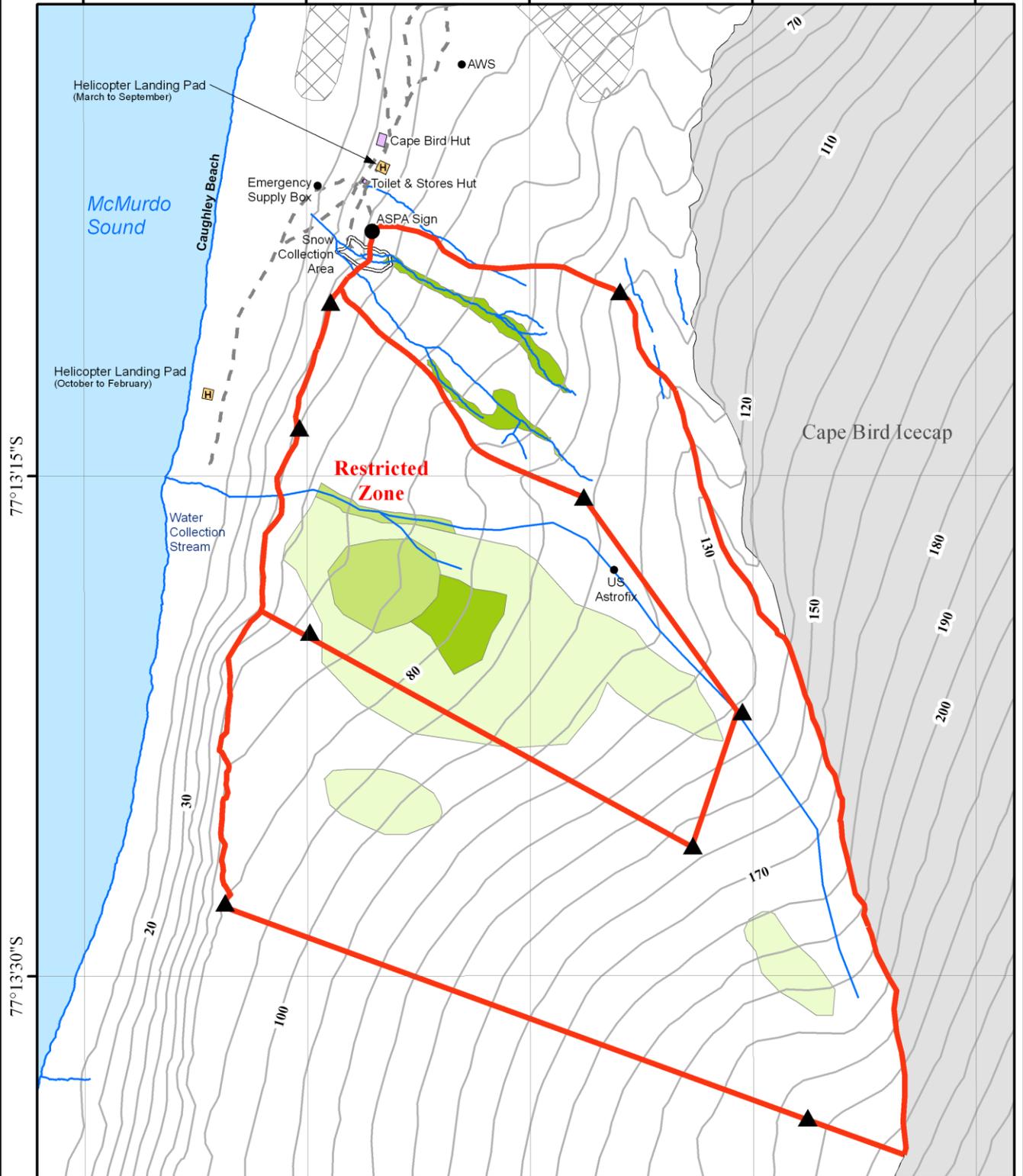
Wharton, D.A. and Brown, I.M. 1989. A survey of terrestrial nematodes from the McMurdo Sound region, Antarctica. *New Zealand Journal of Zoology* 16: 467-470.

Map A - New College Valley, Caughley Beach, Cape Bird, Ross Island
Antarctic Specially Protected Area 116: Regional Topographic Map



Map B - New College Valley, Caughley Beach, Cape Bird, Ross Island Antarctic Specially Protected Area 116: Vegetation Coverage Map

166°25'30"E 166°26'0"E 166°26'30"E 166°27'0"E 166°27'30"E



Datum / Projection: WGS 1984 / Lambert Conformal Conic

Data: K500D (05/06) & K518 (07/08)
 Cartography - Gateway Antarctica
 Map Version - 24th of March 2011

- Key:**
- Protected Area Boundary
 - Vegetation Coverage (5%-22%, 22%-38%, 38%-55%)
 - ▲ Boundary Cairns
 - - - Tracks
 - ▭ Buildings
 - ▨ Approx. extent of Adelie Penguin Colony
 - Contour (10m interval)