Management Plan

for Antarctic Specially Managed Area No. 2 MCMURDO DRY VALLEYS, SOUTHERN VICTORIA LAND

Introduction

The McMurdo Dry Valleys are the largest relatively ice-free region in Antarctica with approximately thirty percent of the ground surface largely free of snow and ice. The region encompasses a cold desert ecosystem, whose climate is not only cold and extremely arid (in the Wright Valley the mean annual temperature is –19.8°C and annual precipitation is less than 100 mm water equivalent), but also windy. The landscape of the Area contains mountain ranges, nunataks, glaciers, ice-free valleys, coastline, ice-covered lakes, ponds, meltwater streams, arid patterned soils and permafrost, sand dunes, and interconnected watershed systems. These watersheds have a regional influence on the McMurdo Sound marine ecosystem. The Area's location, where large-scale seasonal shifts in the water phase occur, is of great importance to the study of climate change. Through shifts in the ice-water balance over time, resulting in contraction and expansion of hydrological features and the accumulations of trace gases in ancient snow, the McMurdo Dry Valley terrain also contains records of past climate change. The extreme climate of the region serves as an important analogue for the conditions of ancient Earth and contemporary Mars, where such climate may have dominated the evolution of landscape and biota.

The Area was jointly proposed by the United States and New Zealand and adopted through Measure 1 (2004). This Management Plan aims to ensure the long-term protection of this unique environment, and to safeguard its values for the conduct of scientific research, education, and more general forms of appreciation. The Management Plan sets out the values, objectives and general rules for conduct within the region, and includes a number of maps and appendices that provide more specific guidelines for particular activities and designated zones within the Area, arranged according to the following structure:

1. Values to be protected and activities to be managed

The McMurdo Dry Valleys are characterized by unique ecosystems of generally low macrobiotic biodiversity and reduced food web complexity, although recent research has shown evidence of highly diverse microbial communities across relatively small areas, as well as between valleys. Moreover, as the largest ice-free region in Antarctica, the McMurdo Dry Valleys also contain relatively diverse habitats compared with other ice-free areas. The Area contains unusual microhabitats and biological communities (such as endolithic and cryoconite systems) as well as rare glaciological and geological features (for example, a brine-rich sub- glacial lake, hyper-saline surface lakes, unique marine deposits and undisturbed desert pavements). These glaciological and geological features are of value because they contain an extremely long record of natural events. The McMurdo Dry Valleys contain indicators of past and present regional climate change, as well as features that play a role in influencing local climate change. A Long Term Ecological Research (LTER) site was established in the Taylor Valley in 1993, and substantial research has been conducted by the program every season for almost twenty years, not only in the Taylor Valley but also more generally across the McMurdo Dry Valleys. The long-term environmental data sets that have been collected through this program, and through a range of other research initiatives in the McMurdo Dry Valleys, are some of the longest in Antarctica. These scientific values are of global and regional importance.

The Area is a valuable resource for understanding landscape processes and the stability of Antarctic ice sheets. The McMurdo Dry Valleys contain unique surface deposits including glacially deposited and modified sediments, sand dunes, desert pavement, glacio-lacustrine sediments, and marine fjord sediments containing valuable records of planetary change. The soil, rock, water, and ice environments and their associated biota are of scientific value as model ecosystems that allow deep insights into natural processes operating throughout the biosphere. Finally, the species that reside in the McMurdo Dry Valleys provide a biological resource for understanding adaptation to extreme environments, and are true end members of ecological continua.

The isolation of the McMurdo Dry Valleys and the extreme environment has generally protected it from human introductions of species from outside of Antarctica. Many parts of the Area are only rarely visited, and one (the Barwick and Balham Valleys protected area) has been set aside as a reference area where entry has been very strictly controlled for almost 40 years and overflight is prohibited. The relatively pristine condition of the McMurdo Dry Valleys, and the relative lack of introduced species established within the Area, are rarely observed elsewhere in the world and have both high scientific and ecological value, especially for comparative studies.

Sites of historic value originating from early exploration of the Area have also been noted, such as 'Granite House' at Botany Bay, Granite Harbor, which was constructed by members of the 1910–1913 British Antarctic Expedition and is designated as Historic Site No. 67.

The McMurdo Dry Valleys are also valued for their aesthetic and wilderness qualities. They represent a relatively pristine environment largely undisturbed and uncontaminated by humans. The dramatic landscape, composed of precipitous mountains, high ridges and sweeping valleys, imposing layered geological formations of dark dolerite set against pale sandstones, and contrasts of ice-free and glacier-covered terrain creates unique vistas with high aesthetic value.

Activities conducted in the area include a variety of scientific research, operations in support of science, media, arts, education and other official National Program visitors, and tourism.

The Area requires special management to ensure that its scientific, environmental, ecological, historic, aesthetic and wilderness values are protected, including that data sets collected over the last 100 years will continue to be of high value. Increasing human activity and potentially conflicting interests have made it necessary to manage and coordinate activities more effectively within the Area.

2. Aims and objectives

The aim of this Management Plan is to conserve and protect the unique and outstanding environment of the McMurdo Dry Valleys by managing and coordinating human activities in the Area such that the values of the McMurdo Dry Valleys are protected and sustained in the long term, especially the value of the extensive scientific datasets that have been collected.

The specific objectives of management in the Area are to:

- Facilitate scientific research while maintaining stewardship of the environment;
- Assist with the planning and coordination of human activities in the McMurdo Dry Valleys to manage actual or potential conflicts among different values (including those of different scientific disciplines), activities and operators;
- Ensure the long-term protection of scientific, ecological, aesthetic, wilderness and other values of the Area by minimizing disturbance to or degradation of these values, including disturbance to natural features and fauna and flora, and by minimizing the cumulative environmental impacts of human activities;
- Prevent the unintended introduction of species not native to the Area, and minimize as far as practicable the unintended transfer of native species within the Area;
- Minimize the footprint of all facilities and scientific experiments established in the Area, including the proliferation of field camps;
- Minimize any physical disturbance, contamination and wastes produced within the Area, and take all practical steps to contain, treat, remove or remediate these whether produced in the course of normal activities or by accident;
- Promote use of energy systems and modes of transport within the Area that have the least environmental impact, and minimize as far as practicable the use of fossil fuels for the conduct of activities within the Area;
- Improve the understanding of natural processes and human impacts in the Area, including through the conduct of monitoring programs; and
- Encourage communication and co-operation between users of the Area, in particular through dissemination of information on the Area and the provisions that apply.

3. Management activities

To achieve the aims and objectives of this Management Plan, the following management activities are to be undertaken:

- National Programs operating within the Area should convene as required, and at least annually, a McMurdo Dry Valleys Management Group (hereafter the Management Group) to oversee coordination of activities in the Area, including to:
  - facilitate and ensure effective communication among those working in or visiting the Area;
  - provide a forum to resolve any actual or potential conflicts in use;
  - help minimize the duplication of activities;
  - maintain a record of activities and, where practical, impacts in the Area;
  - develop strategies to detect and address cumulative impacts;
  - disseminate information on the Area, in particular on the activities occurring and the management measures that apply within the Area, including through maintaining this information electronically at http://www.mcmurdodryvalleys.aq/;
  - review past, existing, and future activities and evaluate the effectiveness of management measures; and
  - make recommendations on the implementation of this Management Plan.
- National Programs operating within the Area shall maintain copies of the current version of the management plan and supporting documentation in appropriate stations and research hut facilities and make these available to all persons in the Area, as well as electronically at http://www.mcmurdodryvalleys.aq/;
- National Programs operating within the Area and tour operators visiting should ensure that their personnel (including staff, crew, passengers, scientists and any other visitors) are briefed on, and are aware of, the requirements of this Management Plan, and in particular the *General Environmental Guidelines* (Appendix A) that applies within the Area;

- Tour operators and any other group or person responsible for planning and / or conducting non-governmental activities within the Area should coordinate their activities with National Programs operating in the Area in advance to ensure they do not pose risks to the values of the Area and that they comply with the requirements of the Management Plan;
- National Programs operating within the Area should seek to develop best practices with a view to achieving the objectives of the Management Plan, and to exchange freely such knowledge and information;
- Signs and / or markers should be erected where necessary and appropriate to show the location or boundaries of zones, research sites, landing sites or campsites within the Area. Signs and markers shall be secured and maintained in good condition, and removed when no longer necessary;
- Visits shall be made as necessary (no less than once every five years) to evaluate whether the Management Plan is effective and to ensure management measures are adequate. The Management Plan, Code of Conduct and Guidelines shall be revised and updated as necessary; and
- National Programs operating within the Area shall take such steps as are necessary and practical to ensure the requirements of the Management Plan are observed.

4. Period of designation

Designated for an indefinite period.

5. Maps and photographs

Table 1: List of maps included in the Management Plan

Map	Title	Source Scale	Estimated Error (+/- m)
Overviews			
Map 1	Overview-ASMA No.2 McMurdo Dry Valleys: boundary and zones	1:900,000	200
Map 2	Overview-Central Dry Valleys	1:400,000	200
Facilities Zones			
Map 3	Explorers Cove, New Harbor	1:25,000	2
Inset:	New Harbor Camp Facilities Zone	1:3000	2
Map 4	Lake Fryxell – Commonwealth Glacier	1:25,000	2
Inset:	F-6 Camp Facilities Zone	1:3000	2
Map 5	Lake Fryxell – Canada Glacier	1:25,000	2
Inset:	Lake Fryxell Camp Facilities Zone	1:3000	2
Map 6	Lake Hoare, Canada Glacier	1:25,000	2
Map 7	Lake Hoare Camp Facilities Zone	1:3000	2
Map 8	Lake Bonney, Taylor Valley	1:25,000	2
Inset:	Lake Bonney Camp Facilities Zone	1:3000	2
Map 9	Mount Newall, Asgard Range	1:25,000	50
Inset:	Mount Newall Radio Repeater Facilities Zone	1:3000	2
Map 10	Marble Point, McMurdo Sound	1:35,000	5
Inset:	Marble Point Refueling Station Facilities Zone	1:5000	2
Map 11	Lower Wright Valley	1:25,000	50
Inset:	Lower Wright Hut Facilities Zone	1:3000	2
Map 12	Lake Vanda, Wright Valley	1:25,000	50
Inset 1:	Lake Vanda Hut Facilities Zone	1:3000	2
Inset 2:	Bull Pass Hut Facilities Zone	1:3000	2
Map 13	Cape Roberts, Granite Harbor	1:10,000	10
Inset:	Cape Roberts Hut Facilities Zone	1:3000	10

Map	Title	Source Scale	Estimated Error (+/- m)
Scientific Zones			
Map 14	Explorers Cove Scientific Zone	1:3000	2
Map 15	Boulder Pavement, Wright Valley	1:30,000	50
Inset:	Boulder Pavement Scientific Zone	1:10,000	50
Restricted Zones			
Map 16	Trough Lake Catchment Restricted Zone	1:70,000	10
Map 17	Mount Feather – Beacon Valley	1:130,000	50
Inset:	Mount Feather Sirius Deposit Restricted Zone	1:25,000	50
Map 18	Don Juan Pond, Wright Valley	1:50,000	50
Inset:	Don Juan Pond Restricted Zone	1:12,500	50
Map 19	Argo Gully, Wright Valley	1:30,000	50
Inset:	Argo Gully Restricted Zone	1:3000	15
Map 20	Prospect Mesa, Wright Valley	1:30,000	50
Inset:	Prospect Mesa Restricted Zone	1:5000	50
Map 21	Hart Glacier, Wright Valley	1:25,000	50
Inset:	Hart Ash Deposit Restricted Zone	1:3000	50
Map 22	Victoria Valley Sand Dunes Restricted Zone	1:50,000	50
Map 23	Battleship Promontory Restricted Zone	1:50,000	50
Visitor Zones			
Map 24	Taylor Valley, Lake Fryxell	1:25,000	2
Inset:	Taylor Valley Visitor Zone	1:5000	2

6. Description of the Area

The McMurdo Dry Valleys are located in southern Victoria Land along the western coast of McMurdo Sound, southern Ross Sea, at approximately 77°30'S, 162°00'E. An area of approximately 17,500 km^2 is designated as an Antarctic Specially Managed Area (hereafter referred to as the 'Area') to manage human activities in the region for the protection of scientific, environmental, ecological, historic, aesthetic and wilderness values.

Based on the Environmental Domains Analysis for Antarctica (Resolution 3(2008)) the McMurdo Dry Valleys are located within Environment S – McMurdo – South Victoria Land geologic**.**

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

All geographic coordinates in this Management Plan are given in degrees and decimal minutes (dd mm.mm) format.

The Area boundaries have been defined primarily on the basis of the hydrological catchments in the McMurdo Dry Valleys, including all of the ice-free ground and adjacent areas within these catchments, all of the Convoy Range in the north, and bounded by the Koettlitz Glacier in the south (Map 1). Offshore islands, except Tripp Island in the north and Heald Island in the south, are not included within the Area. Proceeding clockwise from the northeast, the boundary of the Area is defined as follows:

From the northeastern extremity of Tripp Island (76°38.09'S, 162°42.90'E) the boundary extends southward following the coastline at the mean low tide level to DeMaster Point (situated east of Marshall Valley at 78°04.20'S, 164°25.43'E), a distance of approximately 170 km. The boundary thence follows the northwestern margin of the Koettlitz Glacier in a southwesterly direction for approximately 25 km to Walcott Bay and Trough Lake, including within the Area all of the streams and lakes along the glacier margin (Map 16). The boundary thence follows the approximate southern grounding line of the Koettlitz Glacier margin in Walcott Bay, extending east towards The Bulwark and encompassing all of Trough Lake. The boundary thence continues east following Bulwark Stream for approximately 1.5 km to the northern extremity of The Bulwark. The boundary thence extends 3 km in a straight line northeast to the northwestern coastline of Heald Island, following around the northern coastline to the eastern extremity of the island at 78°15.00'S, 163°57.80'E.

The boundary extends from Heald Island approximately 14.8 km southwest to the summit of The Pyramid (854 m) (78°20.64'S, 163°29.95'E). The boundary thence continues southwest approximately 13.3 km to the foot of Highway Ridge (78°23.97'S, 162°58.57'E), from where it follows up the ridgeline in a northwesterly direction approximately 3.8 km to the summit of Shark Fin (2242 m) (78°22.11'S, 162°54.66'E). The boundary extends from Shark Fin northwest approximately 6.7 km to the summit of Mount Kempe (3004 m) (78°19.35'S, 162°43.18'E). The boundary continues northwest in a straight line from the summit of Mount Kempe approximately 83 km to the summit of Mount Wisneski (2320 m) (77°57.65'S, 159°33.73'E), which is the most southerly peak of the Lashley Mountains.

From Mount Wisneski, the boundary extends northwards for approximately 8.7 km to Mount Crean (2550 m) (77°53.00'S, 159°30.66'E), the highest peak in the Lashley Mountains. The boundary continues 5.6 km northward to the summit of Mount Koger (2450 m) (77°50.05'S, 159°33.09'E), the most northerly peak in the Lashley Mountains.

The boundary thence extends northeast approximately 15.3 km to Depot Nunatak (1980 m) (77°44.88'S, 160°03.19'E), and thence northwest approximately 19.6 km to the western extremity of the ice-free ground at Horseshoe Mountain (77°34.52'S, 159°53.72'E). The boundary continues north approximately 40 km to the summit of Mount DeWitt (2190 m) (77°13.05'S, 159°50.30'E), thence extends northwest approximately 38.4 km to the summit of Carapace Nunatak (2321 m) (76°53.31'S, 159°23.76'E), and continues a further 39 km north to the summit of Battlements Nunatak (2128 m) (76°32.27'S, 159°21.41'E).

The boundary extends east from Battlements Nunatak approximately 51 km to the summit of Mount Douglas (1750 m) (76°31.25'S, 161°18.64'E), and thence approximately 18 km in a southeasterly direction to the summit of Mount Endeavour (1870 m) (76°32.49'S, 161°59.97'E). The boundary extends southeast from Mount Endeavour approximately 21.3 km to the northeastern extremity of Tripp Island.

The principal basis for the coordinates given above is the USGS / LINZ 1:50,000 digital base map prepared for the McMurdo Dry Valleys, which has an estimated maximum error of +/- 50 m. Because this map does not extend to cover the western boundary, coordinates in these areas are from the USGS 1:250,000 map, with an estimated maximum error of +/- 200 m.

Accurate mapping with a maximum error of +/- 2 m is available for a limited number of sites within the Area (see Table 1), mostly in the Taylor Valley, and accurate GPS coordinates are available to describe only parts of the boundaries. The 1:50,000 series was selected as the primary map base for boundary coordinates to ensure that these are given using a map datum that is defined to a consistent standard over most of the Area. For these reasons, GPS coordinates for the boundaries are likely to differ from the coordinates given above by up to 50 m, or in the west by up to ~200 m.

6(ii) Restricted and managed zones within the Area

This Management Plan establishes four types of zones within the Area: Facilities, Scientific, Restricted and Visitor. The management objectives of the different types of zones are set out in Table 2. Maps 1 and 2 show the location of the different types of zones, and Maps 3-24 (which appear in the relevant appendices) show each zone in its context of surrounding geography and the detailed features or infrastructure present at each site (usually shown within an inset). A new zone or zone type may be considered by the Management Group as the need arises, and those no longer needed may be delisted. Zoning updates should be given particular consideration at the time of Management Plan reviews.

Table 2: Management Zones designated within the Area and their specific objectives.

Management Zones	Specific Zone Objectives	Plan Appendix
Facilities Zone	To ensure that science support facilities and related human activities within the Area are contained and managed within designated areas.	C
Scientific Zone	To ensure those planning science or logistics within the Area, and all visitors to the Area, are aware of sites of current or long-term scientific investigation that may be sensitive to disturbance or have sensitive scientific equipment installed, so these may be taken into account during the planning and conduct of activities within the Area.	D
Restricted Zone	To restrict access into a particular part of the Area and/or activities within it for a range of reasons, e.g. owing to special scientific or ecological values, because of sensitivity, presence of hazards, or to restrict emissions or constructions at a particular site. Access into Restricted Zones should normally be for compelling reasons that cannot be served elsewhere within the Area.	E
Visitor Zone	To provide a means of managing the activities of visitors, including program personnel and/or tourists, so their impacts may be contained and, as appropriate, monitored and managed.	F

The overall policies applying within the zones are outlined in the sections below, while site- specific guidelines for the conduct of activities at each zone are found in Appendices D to F.

Facilities Zones

Facilities Zones have been established to contain temporary and semi-permanent facilities within pre-defined areas and thereby control their distribution and footprint. Facilities Zones may be areas where human presence is intended to be semi-permanent or for a defined period of time in which significant activity is occurring. They may also be areas where human presence is expected to have regular occupation and/or repetitive activity such as field camps. The establishment of new Facilities Zones should be designed to minimize the footprint of facilities and associated materials.

The following provisions should be observed for Facilities Zones:

- Substantial and repeatedly used facilities, camping sites, helicopter pads, and materials / supplies stores should be located within the boundaries of the Facilities Zones;
- Existing infrastructure, camping and storage sites within the Facilities Zones should be re-used where practicable;
- Provisions for fuel storage and handling within the Facilities Zones should take account of the requirements set out in the *General Environmental Guidelines for the McMurdo Dry Valleys* (Appendix A) by providing secondary containment, appropriate equipment for refilling, decanting or servicing operations, secure storage and appropriate spill response materials;
- Alternative energy sources and energy efficiency should be considered in the planning and maintenance of activities within the Facilities Zones;
- Waste minimization and management should be considered in the planning and maintenance of activities within the Facilities Zone and all waste should be stored securely and then be removed; and
- Contingency plans for emergencies should be developed as appropriate, to take into account the special needs of specific Facilities Zones.

Facilities Zones should not be located within Restricted Zones or Antarctic Specially Protected Areas (ASPAs), or at sites that could otherwise jeopardize the values of the Area.

Facilities Zones are listed in Appendix C with locations, boundary and infrastructure descriptions, designated landing sites, and maps.

Scientific Zones

The Scientific Zones listed in Appendix D have been designated to raise visitor awareness of specific sites of current and on-going scientific research in order to help ensure important scientific values or experiments are not disturbed. There are no general access restrictions that apply within Scientific Zones, although visitors should familiarize themselves with the provisions set out in Appendix D prior to visiting or planning work at these zones.

Restricted Zones

Restricted Zones have been designated at sites of high scientific value and which are particularly sensitive to human disturbance. Restricted Zones are outlined in Appendix E with a brief description of the boundaries, site features, impacts, and any specific guidelines for access and activities. Access to Restricted Zones should be for compelling reasons that cannot be served elsewhere within the Area, and any additional measures to ensure their protection as specified in Appendix E should be strictly observed when visits are made.

Visitor Zones

The Taylor Valley Visitor Zone is designated in order to manage visits by tourists or non- governmental expeditions to the Area within a defined area where the exceptional aesthetic and wilderness values of the McMurdo Dry Valleys can be appreciated at the same time as ensuring that potential impacts by tourist visits on other values present within the Area, particularly scientific and environmental values, are minimized.

The Taylor Valley Visitor Zone is located in the Taylor Valley near the Canada Glacier terminus (Map 24), at a site where safe and relatively easy access and movement can be reasonably assured with minimal impact to science activities or the environment. This site was selected following consultation among the National Programs operating in the Area, tour operators and International Association of Antarctic Tour Operators (IAATO). Specific guidelines for the conduct of activities within the Visitor Zone are included in Appendix F as the Antarctic Treaty Visitor Site Guide: Taylor Valley, Southern Victoria Land, Ross Sea.

6(iii) Structures within and near the Area

The main structures within the Area are located in the Facilities Zones designated within the central McMurdo Dry Valleys (Maps 2 and 13). The Taylor Valley has five semi-permanent field camps (Maps 3-8), and three semi-permanent field camps are present in the Wright Valley (Maps 11 and 12). The most substantial structures are located at the Marble Point Refueling Facility (Map 10), and buildings are also located at Mount Newall (Map 9) and at Cape Roberts (Map 13).

There are a number of sites of scientific and operational instrumentation located throughout the Area outside of Facilities Zones, the most substantial of which are listed in Table 3. Other structures not listed include several Automatic Weather Stations (AWS), radio repeater sites (Mount Cerverus, Mount JJ Thompson), stream weirs and glacier mass balance devices.

Table 3: Structures within the Area outside of Facilities Zones.

Name	MP[1]	Location[2]	Location Description	Structures
Mount Coates Radio Repeater	US	77° 47.16'S 161° 58.23'E	Near summit of Mount Coates (1894 m), Kukri Hills. ~14 km from Lake Bonney Facilities Zone, Taylor Valley.	Radio repeater and associated equipment contained in two orange plastic cases. There is one antenna at the site.
Hjorth Hill Radio Repeater	US	77° 30.97'S 163° 37.22'E	Near summit of Hjorth Hill (790 m) ~ 6 km from Cape Bernacchi, northeast of Explorers Cove and the Taylor Valley.	Radio repeater and associated equipment at small hut (2.4m x 2.6m). The antenna is installed on the hut.

[1] Maintaining Party [2] Coordinates approximate

There are also several sites in the McMurdo Dry Valleys where semi-permanent camps have been decommissioned and removed (Table 4).

Table 4: ***Known sites of decommissioned semi-permanent camps in the Area.***

Decommissioned site	RP[1]	Geographic coordinates[2]
Asgard Hut	NZ	77° 35'S, 161° 36'E
Brownworth Hut	NZ	77° 27'S, 162° 53'E
Bull Pass Hut(US structures at Bull Pass Hut Facilities Zone remain)	NZ	77° 31.01'S, 161° 51.08'E
Meserve Glacier Camp	US	77° 30.8'S, 162° 17'E
Miers Valley Hut	NZ	78° 08'S, 163° 50'E
Old Lake Bonney Hut	US	77° 42.2'S, 162° 30.6'E
Lake Fryxell Hut	NZ	77° 37'S, 163° 03'E
Vanda Station (some structures relocated to Lake Vanda Hut Facilities Zone)	NZ	77° 31.6'S, 161° 40.1'E
Commonwealth Glacier Camp	NZ	77° 34.94'S, 163° 35.81'E
Old New Harbor Camp	US	77° 34.5'S, 163° 29.9'E
Odell Glacier Camp	US	76° 40.86'S, 159° 54.8'E

[1] Responsible Party [2] Coordinates approximate

Eight sites within the Area were drilled, several with multiple boreholes, as a part of the McMurdo Dry Valley Drilling Project (DVDP) carried out between 1971 and 1975. Drill sites for the project are located at Lake Vanda (DVDP 4) (drilled 85.8 m below ice surface), Don Juan Pond (DVDP 5, 3.4 m; DVDP 13, 75 m),Wright Valley North Fork basin (DVDP 14, 78 m), Lake Vida (DVDP 6, 305.8 m; permanently capped and closed by the US Program in 2006-07 and now several meters below the lake surface), Lake Fryxell (DVDP 7, 11.1 m), New Harbor (DVDP 8, 157.5 m; DVDP 9, 38.3 m; DVDP 10, 187 m), Commonwealth

Glacier (DVDP 11, 328 m), and Lake Hoare (DVDP 12, 185 m).

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

Entry to an Antarctic Specially Protected Area (ASPA) is prohibited unless a permit for entry has been issued by a national authority. Four ASPAs are designated within the Area (Maps 1 and 2):

ASPA No. 123 Barwick and BalhamValleys, Southern Victoria Land (Maps 1, 2);

ASPA No. 131 Canada Glacier, Lake Fryxell, Taylor Valley, Victoria Land (Maps 2, 5, 24); ASPA No. 138 Linnaeus Terrace, Asgard Range, Victoria Land (Maps 2, 18);

ASPA No. 154 Botany Bay, Cape Geology, Victoria Land (Map 1).

7. Code of Conduct

The Code of Conduct in this section is the main instrument for the management of activities in the Area. It outlines the overall management and operational principles for the Area.

In addition, further guidance is provided in the *General Environmental Guidelines for the McMurdo Dry Valleys* (Appendix A), *Environmental Guidelines for Scientific Research*

(Appendix B), and in the List of Facilities Zone (Appendix C), Scientific Zones (Appendix D), Restricted Zones (Appendix E), and the Visitor Zone (Appendix F). All visitors to the McMurdo Dry Valleys should be aware of the *General Environmental Guidelines* in Appendix A, as a minimum, before entering the Area.

7(i) Access to and movement within the Area

The Area is large and has numerous potential access points. Access to the Area is normally made by helicopter from Ross Island, or over sea ice via New Harbor or Marble Point. Where practical, designated helicopter landing sites should be used: these are listed and shown on maps in Appendices C-F describing the management zones. Designated landing sites within ASPAs are defined and mapped in their relevant Management Plans. Where designated landing sites are unavailable, previously used landing sites should be selected when possible. Where it is expected that helicopters will be used for repetitive access to a particular location, consideration should be given to establishing a designated site for landing. Such suggestions should be referred to the Management Group. Overflight restrictions apply over ASPA No. 123 in the Barwick and Balham Valleys, ASPA No. 131 at Canada Glacier, ASPA No. 154 at Botany Bay, and over the Don Juan Pond and Victoria Valley Sand Dunes Restricted Zones.

All pedestrian access routes and movement within the Area should be undertaken so as to minimize disturbance to the soil and vegetated surfaces. There are a number of walking routes in the Area. In the Taylor Valley, these include routes between F-6 Camp and Lake Fryxell Camp, F-6 Camp and Lake Hoare Camp, Lake Hoare Camp and Lake Fryxell Camp, and Lake Hoare Camp and Lake Bonney Camp. There is a route from the edge of Lake Fryxell to the weir at Canada Stream. There are also routes outside the immediate vicinity of F-6, Lake Fryxell, Lake Bonney, and Lake Hoare camps. A route is defined to manage pedestrian movements within the Taylor Valley Visitor Zone (Appendix F). In the Wright Valley, there is a route between the Vanda Weir and the Vanda Huts. A loosely defined route exists along the Onyx River between Lake Vanda and Lake Brownworth, and tracks from overland vehicles moving along this route in the 1970's remain in evidence.

In some places where there has been sustained activity, foot tracks have developed in loose moraine soils, forming well-defined routes such as may be found near Facilities Zones and at field sites such as along the northern margin of the lower Taylor Glacier. In such cases, pedestrians should by preference use the existing tracks, unless it becomes evident that to do so would be either unsafe or result in greater impact than following an alternative route.

The use of vehicles within the Area should be restricted to lake ice or sea ice except where specifically authorized to operate on land at Marble Point (Map 11), New Harbor (Maps 3 and 14), and Cape Roberts (Map 13), where vehicles should use existing vehicle tracks.

Access into Restricted Zones should be avoided unless required for compelling reasons, and should be coordinated with National Programs operating within the Area.

Access by tourists and non-governmental expeditions should only be made to the Taylor Valley Visitor Zone in accordance with the guidelines adopted in Appendix F, and shall be coordinated in advance with National Programs operating within the Area.

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

Activities which may be conducted in the area include scientific research; operations in support of science; media, arts, education or other official national program visitors; management activities including maintenance or removal of facilities; and tourism visits within the Visitor Zone, where these activities do not jeopardize the values of the Area.

All activities in the McMurdo Dry Valleys should be conducted in such a manner as to minimize impacts on the environment. Alternative energy sources (e.g. solar, wind, fuel cells) should be used wherever practicable in order to minimize fossil fuel usage. Specific guidelines for the conduct of activities in the Area are provided in Appendices A-E.

Tourism and non-governmental expeditions should additionally ensure their activities have minimal impact on the scientific activities being conducted within the Area, and are carried out in accordance with the Antarctic Treaty Visitor Site Guide: Taylor Valley (Appendix F).

7(iii) Installation, modification, or removal of structures

Care should be exercised when locating and establishing installations to minimize their impact on the environment. Consideration should be given to maximizing the use of existing facilities or sharing those of other programs before new facilities are constructed, and the footprint of all installations should be kept to the minimum practicable. Past installation sites should be re-used where possible and appropriate. In general, permanent or semi-permanent structures should not be installed outside of Facilities Zones, unless they are small in size and pose no significant threat to the values of the Area (e.g. an Automatic Weather Station (AWS) or a small solar- and battery-powered radio repeater with minimal associated infrastructure).

All installations should be maintained while operational and removed when no longer necessary. Installations should be identified by the National Program responsible, name of the principal investigator and year of installation. The types of installations and their coordinates should be recorded, with information provided to the responsible National Program and then shared by the Management Group.

National Programs should exchange information though the Management Group on proposals for new installations in advance of their construction, with the aim of coordinating activities and minimizing the need for new or potentially disruptive or duplicative installations.

7(iv) Field camps

In the McMurdo Dry Valleys, a field camp is considered to be a small temporary camp set up for research in a field season, and generally may comprise a number of tents and include temporary shelters for laboratory work or cooking. Field camps should generally only be established when the work they are intended to support cannot be accomplished practically by access from within one of the Facilities Zones.

Care should be exercised when locating and establishing field camps to minimize their impact on the environment. Consideration should be given to maximizing the use of past or existing field camp sites, or sharing those of other programs before new field camps are established, and the footprint of all field camps should be kept to the minimum practicable.

All field camps should be maintained while operational and removed when no longer necessary. Special care should be taken to secure camp equipment from dispersal by wind.

The coordinates of field camp sites should be recorded, with information provided to the responsible National Program and then shared by the Management Group.

Designated field camp sites outside of Facilities Zones or other zones within the Area are listed in Table 5.

Table 5: Designated field camp sites outside of Facilities Zones or other zones within the Area.

Name	MP[1]	Location	Location Description	Field camp description
Blood Falls field camp site	US	77°43.24' S 162°16.29' E 1 helicopter landing site at above location	Northwestern shore of Lake Bonney ~100 m from the terminus of Taylor Glacier and Blood Falls.	Slopes extending ~100 m upslope above the lake shoreline and for ~200 m northeast from Lawson Creek to a permanent survey benchmark (TP02) ~20 m from the lake shore. Tent sites are marked by stone circles. The designated helicopter landing site is located close to a cluster of tent sites in the southwest part of the field camp site.

[1] Maintaining Party

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

Taking or harmful interference with native flora or fauna is prohibited, except in accordance with a permit issued under Article 3 of Annex II to the Protocol by the appropriate national authority specifically for that purpose. Where animal taking or harmful interference is involved, this should, as a minimum standard, be in accordance with the Scientific Committee on Antarctic Research (SCAR) Code of Conduct for the Use of Animals for Scientific Purposes in Antarctica.

To help maintain the ecological and scientific values of the Area visitors should take special precautions against the introduction of non-native species. Of particular concern are introductions from other Antarctic sites, including stations, or from regions outside Antarctica. Visitors should ensure that sampling equipment and markers brought into the Area are clean. Visitors should thoroughly clean all equipment (including backpacks, carry-bags and tents), clothing and footwear before entering the Area. Visitors should also be aware of the risk of transfer of species from one part of the Dry Valleys to another, which may also affect the values of the Area. In particular, visitors should aim to minimize the movement of soils from one site to another within the Dry Valleys by cleaning their equipment (e.g. camping and sampling equipment, vehicles, footwear) before transfer to another site.

7(vi) Collection or removal of material found in the Area

Material not covered by 7(v) above should only be collected or removed from the Area for scientific and associated educational purposes or essential management purposes and should be limited to the minimum necessary for those needs. Any meteorites taken are to be collected and curated according to accepted scientific standards, and made available for scientific purposes. Material of human origin likely to compromise the values of the Area should be removed unless the impact of removal is likely to be greater than leaving the material in place. If this is the case the appropriate authority should be notified.

7(vii) Waste management

All materials taken into the Area should, to the maximum extent practicable, be collected and removed from the Area when no longer required. Water used for any human purposes, including scientific purposes, should be removed and/or treated in a gray water evaporator (and residuals removed). All human wastes should be removed from the Area, including residues from incineration.

In accordance with Article 4 of Annex III to the Protocol, wastes shall not be disposed of onto ice-free areas, into freshwater systems or onto snow or in deep ice pits in ice which terminates in ice free areas or in areas of high ablation.

7(viii) Requirements for reports

Reports of activities in the Area should be maintained by the Management Group to the maximum extent practicable, and made available to all Parties.

In accordance with Article 10 of Annex V to the Protocol, arrangements shall be made for collection and exchange of reports of inspection visits and on any significant changes or damage within the Area.

Tour operators should record their visits to the Area, including the number of visitors, dates, and incidents in the Area, and submit these data in accordance with the procedures for reporting on expeditions adopted by the Antarctic Treaty Parties and IAATO.

8. Provisions for the exchange of information in advance of proposed activities

In addition to the normal exchange of information by means of the annual, national reports to the Parties of the Antarctic Treaty, and to SCAR and Council of Managers of National Antarctic Programs (COMNAP), Parties operating in the Area should exchange information through the Management Group.

9. Supporting documentation

Electronic information

National Programs operating within the Area have established a website for the purpose of providing additional information and supporting documentation on the McMurdo Dry Valleys, including up-to-date management documents, protected area management plans, maps, descriptions and policies. This information may be accessed at http://www.mcmurdodryvalleys.aq

Management Plans

Management Plan for Antarctic Specially Protected Area No. 123 Barwick and Balham Valleys, South Victoria Land.

Management Plan for Antarctic Specially Protected Area No. 131 Canada Glacier, Taylor Valley, Victoria Land.

Management Plan for Antarctic Specially Protected Area No. 138 Linnaeus Terrace, Asgard Range, Victoria Land.

Management Plan for Antarctic Specially Protected Area No. 154 Botany Bay, Cape Geology, Victoria Land.

APPENDIX A: General Environmental Guidelines for the McMurdo Dry Valleys

Why are the McMurdo Dry Valleys considered to be so important? The McMurdo Dry Valleys ecosystem contains geological and biological features that date back thousands to millions of years. Many of these ancient features could be easily and irreversibly damaged by human actions. Unusual communities of microscopic life forms, low biodiversity, simple food webs with limited trophic competition, severe temperature stress, aridity and nutrient limitations are other characteristics that make the McMurdo Dry Valleys unique. This ancient desert landscape and its biological communities have very little natural ability to recover from disturbance. Research in such systems must aim to minimize impacts to protect the environment for future generations.

Before you travel to the Area:

- Ensure that your planned activities follow the requirements of the Code of Conduct in the Management Plan, the Environmental Guidelines in Appendices A and B, and any specific guidelines that apply within management zones (Appendices C-F).
- Plan all activities such as travel, camp set up, fuel handling and secondary containment, and waste management (and minimisation), with the aim of minimizing environmental impacts. Individuals or groups should ensure sufficient equipment and survival gear is brought into the Area or available on-site for safety.
- To help prevent the unintended introduction of non-native species to the McMurdo Dry Valleys, thoroughly clean all equipment (including backpacks, carry-bags and tents), clothing and footwear before travel to the Area.

Travel and activities within the Area:

- To reduce the risk of transfer of species from one part of the Dry Valleys to another, clean equipment, vehicles, clothing and footwear before travel to another site.
- Be aware of the site-specific guidelines in Appendices C-F, and avoid Restricted Zones unless access is required for a compelling reason that cannot be served elsewhere within the Area.
- Stream crossings should be avoided; when it is necessary to cross streams, designated crossing points should be used whenever possible.
- Avoid swimming or diving in lakes, unless authorized by a National Program for scientific purposes.
- Avoid disturbing mummified seals or birds.
- Cairns should not be built in the Area unless authorized by a National Program.
- Do not leave any travel equipment behind (e.g. ice screws, pitons).

Pedestrian travel:

- Some biological communities and geological formations are especially fragile, even when concealed by snow; be alert and avoid such features when travelling within the Area. For example, avoid walking on vegetated areas, in streams or on stream bank sides, on dunes, through long-term soil experiments, on raised delta surfaces, on delicate rock formations, or over other sensitive features.
- Where practicable, keep to designated or established tracks. Please refer to site- specific guidelines for Zones (Appendices C-F) for further guidance.

Vehicle use:

- Vehicle use should be restricted to ice surfaces unless specifically authorized to do otherwise, or at Marble Point, Cape Roberts, and New Harbor.
- Vehicles should keep to established tracks wherever these are present.
- Vehicles should always be parked over a secondary containment unit or a drip tray.
- Vehicles should be used on lake ice only when essential, and they should be parked on permanent lake ice rather than moat ice during the period of summer melt.

Helicopter use:

- Designated helicopter pads should be used for helicopter landings where available. Otherwise, known previous landing sites should be used when possible. Designated helicopter pads are listed in Appendices C-F and are shown on Maps 3-24.
- Designated helicopter pads should be marked so they are clearly visible from the air and markers used should be well-secured and durable.
- Helicopter landings on lakes should be avoided as far as practicable.
- Helicopter operations should not use smoke bombs, except for essential safety purposes.
- Care should be taken to ensure that helicopter sling loads are properly secured. Trained personnel should supervise these operations.

Field camps: location and set up

- Before new campsites are established, use designated, former or existing campsites, or share those of other programs to the maximum extent practicable.
- Minimize the footprint of all campsites.
- Campsites should be located as far as practical from lakeshores, streambeds, and long- term experiments to avoid damage or contamination. Do not camp in streambeds, even if they are dry.
- Rocks moved for new campsites or other activities in areas not previously disturbed should be replaced after the activity in their original footprint, if possible, and at a minimum should be placed with the salt-encrusted side faced-down. If the campsite is intended for multi-year activity additional guidance should be sought from the supporting National Program.
- The location of field camps should be recorded and submitted to the supporting National Program.
- Ensure that equipment and supplies are properly secured at all times to avoid dispersion by high winds.

Energy use:

- As far as practicable use energy systems and modes of travel within the Area that have the least environmental impact and minimize the use of fossil fuels.

Use of Materials:

- Everything taken into the Area should be removed and returned to the appropriate National Program station for proper handling.
- Activities that could result in the dispersal of foreign materials should be avoided (e.g. do not use spray paint to mark rocks) or should be conducted inside a hut or tent (e.g. all cutting, sawing and unpacking).
- Explosives should not be used within the Area, unless approved by a National Program for use in support of essential scientific or management purposes.
- Where possible, ensure that nothing is left frozen into glaciers, snow or lake ice that may ablate out and cause later contamination.

Fuel and chemicals:

- Avoid all fuel and chemical spills as far as possible.
- Steps should be taken to prevent the accidental release of chemicals including laboratory reagents and isotopes (stable or radioactive). Chemicals of all kinds should be dispensed over drip trays or other forms of containment. When permitted to use radioisotopes, safety and handling instructions should be followed precisely.
- When using chemicals or fuels, ensure that spill kits and secondary containment units appropriate to the volume of the substance are available. Those working with chemicals and fuels should be familiar with their use and with appropriate spill response procedures.
- Chemical and fuel containers should be securely positioned and capped, particularly on lake ice.
- All fuel drums should be stored with secondary containment.
- Fuel cans with spouts should be used when refueling generators.
- Generators and vehicles should be refueled over drip trays with absorbent spill pads.
- Vehicle oil should not be changed except over a drip tray.

Waste and spills:

- Water used for ANY human purpose should be removed and/or treated in a gray water evaporator (and residuals removed).
- All human waste should be collected and removed.
- Individuals or groups should always carry proper containers for human waste and gray water so that they may be properly and safely transported for disposal.
- Clean up any spills and/or releases to the maximum extent possible and report the location(s) including coordinates, to the appropriate National Program.

APPENDIX B: Environmental Guidelines for Scientific Research

Scientific activities in the McMurdo Dry Valleys include research on climate, glaciers, streams, lakes, soils, and local geology and geomorphology. The following environmental guidelines for scientific research seek to reduce the impact of research activities specific to key environments in the Area. These guidelines are based on the report McMurdo Dry Valley Lakes: Impacts of Research Activities (Wharton, R.A. and Doran, P.T., 1998), the product of an international workshop of scientists conducting research in the Area.

General requirements

- Do not displace or collect specimens of any kind, including fossils, except under permit for scientific and associated educational purposes.
- The location of sampling (including biological transects), drilling and soil excavation sites, and of any installations (e.g. stream control structures and instrumentation) should be recorded, and the coordinates submitted to the supporting National Program.
- Installations and equipment should pose minimal risk of harmful emissions to the environment (e.g. use gel cells or other non-spill batteries).
- Ensure all installations, materials and equipment are securely stored when not in use and are removed when no longer required.
- Any markers installed should be durable and fastened securely.
- Metadata records describing data collected should be submitted to the supporting National Program and included within the Antarctic Master Directory.

Sampling and experimental sites

- All scientific equipment, particularly equipment used for sampling and drilling, should be clean before being brought into the Area, and cleaned before being transferred to other sites for re-use within the Area.
- Securely tether all sampling equipment where there is a reasonable risk that it could be irretrievably lost.
- Sample sizes of all biomass and non-biological materials should be limited to the minimum required for effective completion of the planned analyses and archiving.
- Sampling sites (e.g. in lake ice, on glaciers or in soils) should be kept clean.
- Minimize, and where possible avoid, the use of drilling fluids.
- Experimental or monitoring sites intended to be used for more than one season should be clearly identified by country, name of the principal investigator and year of installation.

Scientific installations

For scientific installations, including meteorological stations, geographic monuments, communication repeaters, lake monitoring systems, and level recorders:

- Installations should be sited carefully, should be easily retrievable when required, and properly secured at all times to avoid dispersal by high winds.
- All installations in the Area should be clearly identified by country, name of the principal investigator and year of installation.
- Installations should be as energy-efficient as possible and use renewable energy sources wherever practicable.
- Installations should pose minimal risk of harmful emissions to the environment (e.g. use gel cells or other non-spill batteries).
- Installations should be periodically evaluated for deterioration, usefulness, and potential removal. The frequency of evaluation may depend on installation characteristics and the site, although in general this is likely to be needed at least once every 3-5 years.
- Installations should be designed and constructed so they can be decommissioned and removed at the end of their use.

Scientific equipment, fuels and materials

- Minimize the use of fossil-fuel-powered equipment; use solar-powered and hand devices when possible.
- Properly tune generators to minimize emissions and use only when necessary. Always place generators and fuel cans in drip pans.
- Carefully manage fuels, glycol, chemical waste, and all other liquids to avoid spills.
- Always refuel using drip pans.
- Ensure spill kits are always available on-site where liquid fuels or wastes (including chemicals and water extracted from lakes) are present.
- Materials liable to shatter at low temperatures, for example many polyethylene based plastics, should be avoided. Wooden and fabric components in semi-permanent structures should be avoided as these are subject to wind abrasion and occasional failure.

Streams

- Use flumes rather than weirs.
- To the extent practicable, use local materials to construct water measuring and control structures.
- Limit the number of tracer and manipulative experiments. Whenever possible, use modeling approaches to extend the application of experimental results to other streams and lake basins.
- Use only naturally occurring tracers and document tracer use.
- Design tracer experiments to limit the movement of tracers in lakes. The incremental flux from the experiment should be appropriately small in proportion to the average annual total flux for that solute from streams. Choose an experimental site with a long enough reach such that reactions will be completed by the end of the reach.
- Establish specific sites for biomass sampling and document geographic locations, sampling extent, and frequency.
- Develop and apply methods (e.g. spectral analysis) that do not rely on removal of samples for quantifying changes in biomass in streams.

Lakes

- Minimize the duration and extent to which structures are placed on the ice. When placing structures on the ice near shore, place them on the perennial ice rather than the moat (the moat is highly susceptible to rapid melting). Document the geographic location of the placement of structures on the ice.
- Use barriers (e.g. drip pans) between equipment (e.g. motors, tools) and ice to minimize the potential for hydrocarbon introduction into the ice as well as the physical melting of the ice surface.
- Document the area and the extent to which lake ice has been excavated, taking geographic coordinates. Areas that have been used for sampling or accessing the lake should be reused to the greatest extent possible.
- Minimize the use of motorized vehicles. All-terrain vehicles with four-stroke engines are preferable to snowmobiles with two-stroke engines (less efficient combustion in two- stroke engines causes an increase in the release of hydrocarbons and particulates).
- Use extreme caution when driving motorized vehicles to avoid rolling the vehicle or breaking through the ice cover.
- Remove materials brought up from beneath the ice. Do not dump or deposit water and sediment samples on the lake ice.
- Reduce helicopter overflights after the ice surfaces begin to melt and keep landings on lakes to a minimum.
- Avoid storage of materials on the lake ice surface.
- Use separate samplers (e.g. water collectors, plankton nets) and instruments, if feasible, for each lake to avoid cross contamination. Samplers or instruments used in more than one lake should be thoroughly cleaned (sterilize if possible) prior to reuse in a different lake.
- Carefully manage gray water extracted from lakes to avoid spills.
- Consider laboratory-based alternatives to *in situ* experiments involving any radioisotope, stable isotope, or other tracer in view of the future integrity of the biological and chemical properties of the lakes. Complete preliminary calculations to ascertain the potential impact of isotope experiments. Document and record any introductions.
- Incorporate metal-free haul lines and sampling containers such as “go-flow” bottles into sampling protocols to minimize metal contamination of the lakes.
- Promote use of an environmentally friendly substitute for glycol for use in melting access holes (e.g. a biodegradable antifreeze).
- Minimize the amount of gray water waste by collecting the least volume of water and sediment needed for research purposes.
- Train individuals working on the lake ice to take steps to reduce the loss of equipment through ice holes.
- Provide adequate training for research divers and support teams so that impacts to the lake environment are minimized.
- Prior to conducting diving or ROV operations in a particular lake, consider previous diving history at the proposed research site, the proximity of other areas of interest, and the vulnerability of the water column and benthos to disturbance. These considerations should also be applied to other sampling and measuring activities.
- Assemble and maintain records of diving and ROV activities, including timing, intensity, and duration.
- Use technological developments (e.g. rebreather apparatus, push-pull systems) that mitigate the environmental impacts of diving.

Soils

- Minimize surface and subsurface disturbance to the maximum extent practicable
- Restore disturbed surfaces as close as possible to their natural state upon completion of the work. For larger-scale excavations (greater than 1 m^2), take photographs prior to breaking ground to provide a basis for restoration. Record the location of the remediated site.
- Place excavated soil on mats or groundsheets during soil sampling.
- Backfill all excavations to approximate original contour and replace desert pavement where possible. The desert pavement can be skimmed from the surface prior to digging and kept aside for replacement.
- Conduct thorough environmental assessment of proposed exogenous amendment experiments.
- Limit use of mechanical equipment (e.g. Cobra drills, oil augers).

Glaciers

- Minimize the use of liquid water (e.g. with hot water drills).
- Avoid the use of chemicals and chemical solutions on the ice.
- If stakes or other markers are placed on a glacier, use the minimum number of stakes required to meet research needs; where possible, label these with event number and project duration.
- Use electric chainsaws powered by a four-stroke generator whenever possible for large- scale sawing operations (less contamination than from two-stroke engines). Avoid the use of chainsaw blade lubricants when cutting cold ice.
- Upon completion of a research project, remove all materials – wood, metal, and sensors – embedded in the ice to minimize contamination.

APPENDIX C: Guidelines for Facilities Zones

Facilities Zones include a designated area around the following facilities operated by National Programs in the Area:

- New Harbor Camp, Taylor Valley;
- F-6 Camp, Taylor Valley;
- Lake Fryxell Camp, Taylor Valley;
- Lake Hoare Camp, Taylor Valley;
- Lake Bonney Camp, Taylor Valley;
- Mount Newall Radio Repeater, Asgard Range;
- Marble Point Refueling Station, Marble Point;
- Lower Wright Camp, Wright Valley;
- Lake Vanda Hut, Wright Valley;
- Bull Pass Hut, Wright Valley;
- Cape Roberts Camp, Granite Harbor.

The locations, boundaries, helicopter landings sites, and infrastructure at Facilities Zones, together with an identification of the Maintaining Party are listed in Table C-1, which is followed by maps of the Facilities Zones and their local geographical context (Maps 3-13).

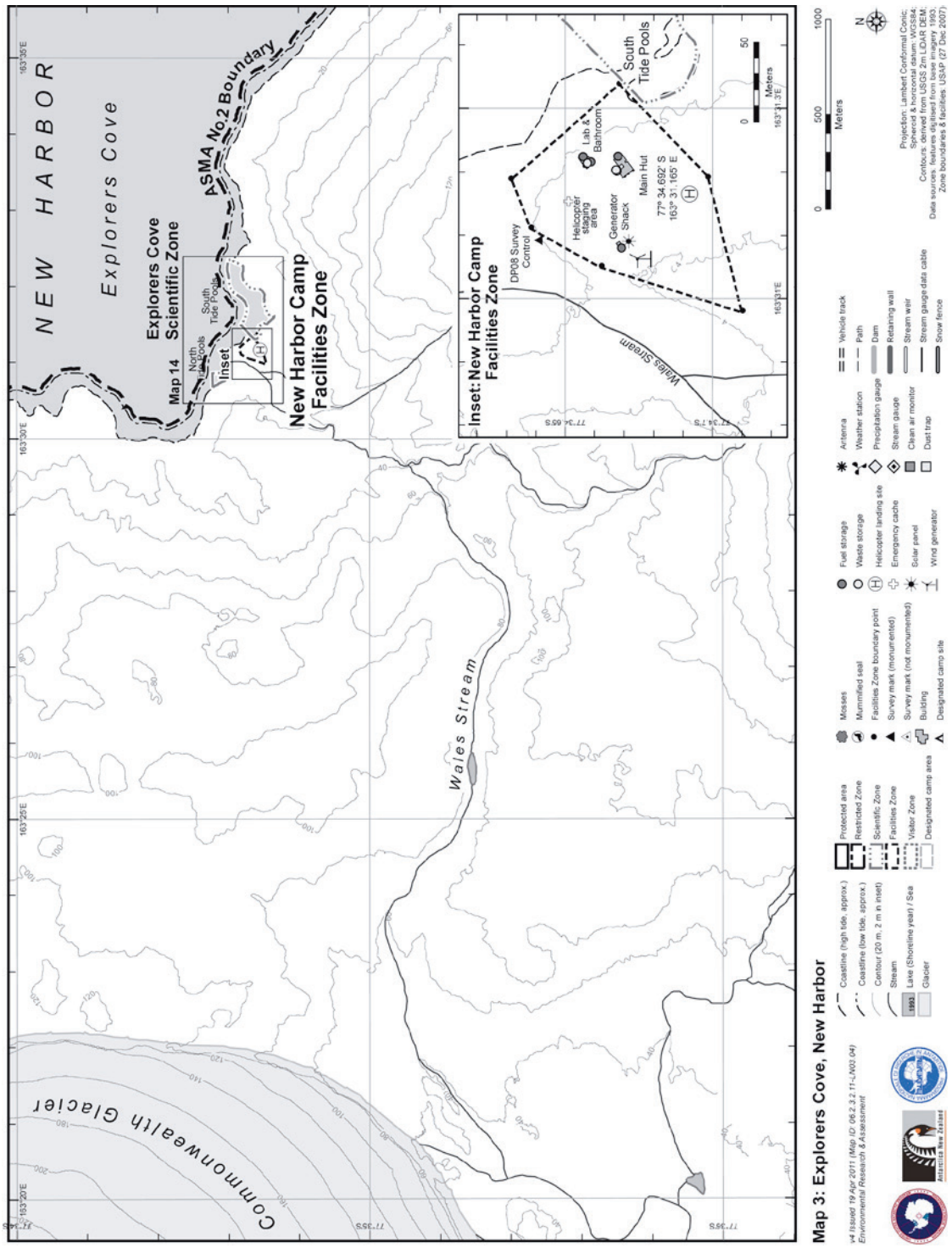
Table C-1: Description of Facilities Zones within the McMurdo Dry Valleys.

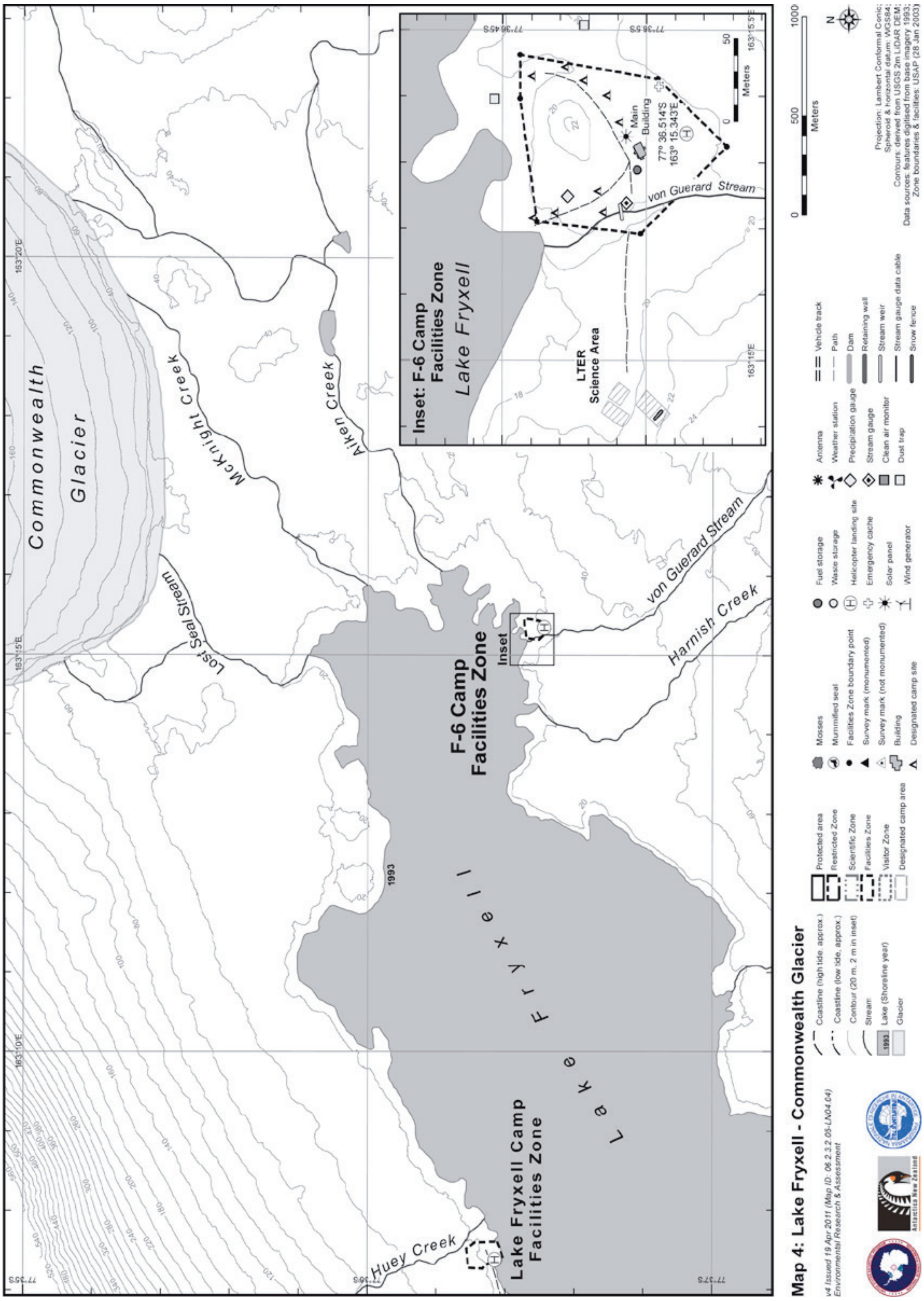
Facilities Zone	Map No.	Boundary Description	Boundary Coordinates	Helicopter Landing Site Coordinates	MP[1]	Structures in Zone
New Harbor Camp	3	The boundary goes from a point northwest of the generator shed (on the bank edge), southwest beyond the sling load area, east to a point south of the helicopter pad, northeast to a point east of the main Jamesways, northwest to a point north of the lab building, southwest to a point just north of the old bore hole, and southwest along the bank edge back to the point by the generator shed.	77° 34.66'S, 163° 31.05'E 77° 34.71'S, 163° 30.98'E 77° 34.70'S, 163° 31.19'E 77° 34.67'S, 163° 31.34'E 77° 34.63'S, 163° 31.19'E 77° 34.64'S, 163° 31.11'E	77° 34.692'S, 163° 31.165'E 1 helicopter landing pad plus sling load area.	US	Main building consists of two Jamesways connected by a wooden passageway, one 42 m^2 (448 sq. ft.) and the other 30 m^2 (320 sq. ft.). Adjacent to the main building are a 3 m^{2S} (32 sq. ft.) storage shed and a 1.5 m^2 (16 sq. ft.) outhouse. The camp also includes a 21 m^2 (224 sq. ft.) James ways that serves as a laboratory, an 8.9 m^2 (96 sq. ft.) generator shack, and a 1.5 m^2 (16 sq. ft.) diving equipment storage box. One survival cache box and one wind generator tower.
F-6 Camp	4	The boundary goes from a point southwest of the helicopter pad, northeast to a point just east of the emergency cache (survival box), north around the northern- easternmost tent site, west to a point northwest of the tent sites (by the lake), south around the stream weir, and southeast to the original point by the helicopter pad.	77° 36.53'S, 163° 15.32'E 77° 36.50'S, 163° 15.43'E 77° 36.46'S, 163° 15.46'E 77° 36.46'S, 163° 15.40'E 77° 36.46'S, 163° 15.21'E 77° 36.50'S, 163° 15.19'E	77° 6.514'S, 163° 15.343'E 1 helicopter landing pad.	US	A 42 m^2 (448 sq. ft.) main building with outhouse adjacent. Emergency cache.
Lake Fryxell Camp	5	The boundary follows the lake edge in the southeast corner to a point southwest of the helicopter pad, up to the small plateau below a hill, behind the farthest tent site in the northwest corner, east to the stream, southeast along the stream bank to the eastern most tent and south back to original point by the lake.	77° 36.38'S, 163° 07.60'E 77° 36.40'S, 163° 07.37'E 77° 36.34'S, 163° 07.31'E 77° 36.34'S, 163° 07.26'E 77° 36.29'S, 163° 07.27'E 77° 36.29'S, 163° 07.51'E 77° 36.31'S, 163° 07.59'E 77° 36.38'S, 163° 07.60'E	77° 36.383'S, 163° 07.430'E 2 helicopter landing pads plus sling load area. Secondary pad is 32 m NW of the main pad.	US	A 62.7 m^2 (675 sq. ft.) Jamesway (main building), four 13.9 m^2 (150 sq. ft.) laboratories, and one 13.9 m^2 (150 sq. ft.) generator building. Wind generator tower, solar panel and one outhouse. Emergency cache.
Lake Hoare Camp	6 & 7	The boundary goes from the rocky area southeast of the helicopter pads, north around the emergency cache, northeast to a rock northwest of the westernmost tent site, northeast to a point north of another tent site, northeast again to the northeastern most tent site, south along the stream/glacier to a point east of the old Lake Hoare facilities (shower and dive storage buildings), southwest to the end of the spit, northwest to the beach below the main building, and northwest to the original point by the helicopter pads.	77° 37.40'S, 162° 53.87'E 77° 37.39'S, 162° 53.86'E 77° 37.35'S, 162° 53.87'E 77° 37.31'S, 162° 53.96'E 77° 37.26'S, 162° 54.28'E 77° 37.26'S, 162° 54.35'E 77° 37.39'S, 162° 54.40'E 77° 37.47'S, 162° 54.34'E 77° 37.41'S, 162° 54.05'E	77° 373.72'S, 162° 53.989'E 2 helicopter landing pads plus sling load area. Secondary pad is 46 m SW of the main pad.	US	A 55.7 m^2 (600 sq. ft.) main building, three 13.9 m^2 (150 sq. ft.) labs, a generator building (96 sq. ft.), a tool shed (96 sq. ft.), and three outhouses: two 2.2 m^2 (24 sq. ft.) and one 1.7 m^2 (18 sq. ft.). Below the active camp are the old Lake Hoare Camp buildings, which are still in use. These include a 37 m^2 (400 sq. ft.) Jamesway used primarily for storage, a 6 m^2 (64 sq. ft.) generator shed, and a 7.5 m^2 (81 sq. ft.) old laboratory used as a shower room. Emergency cache.

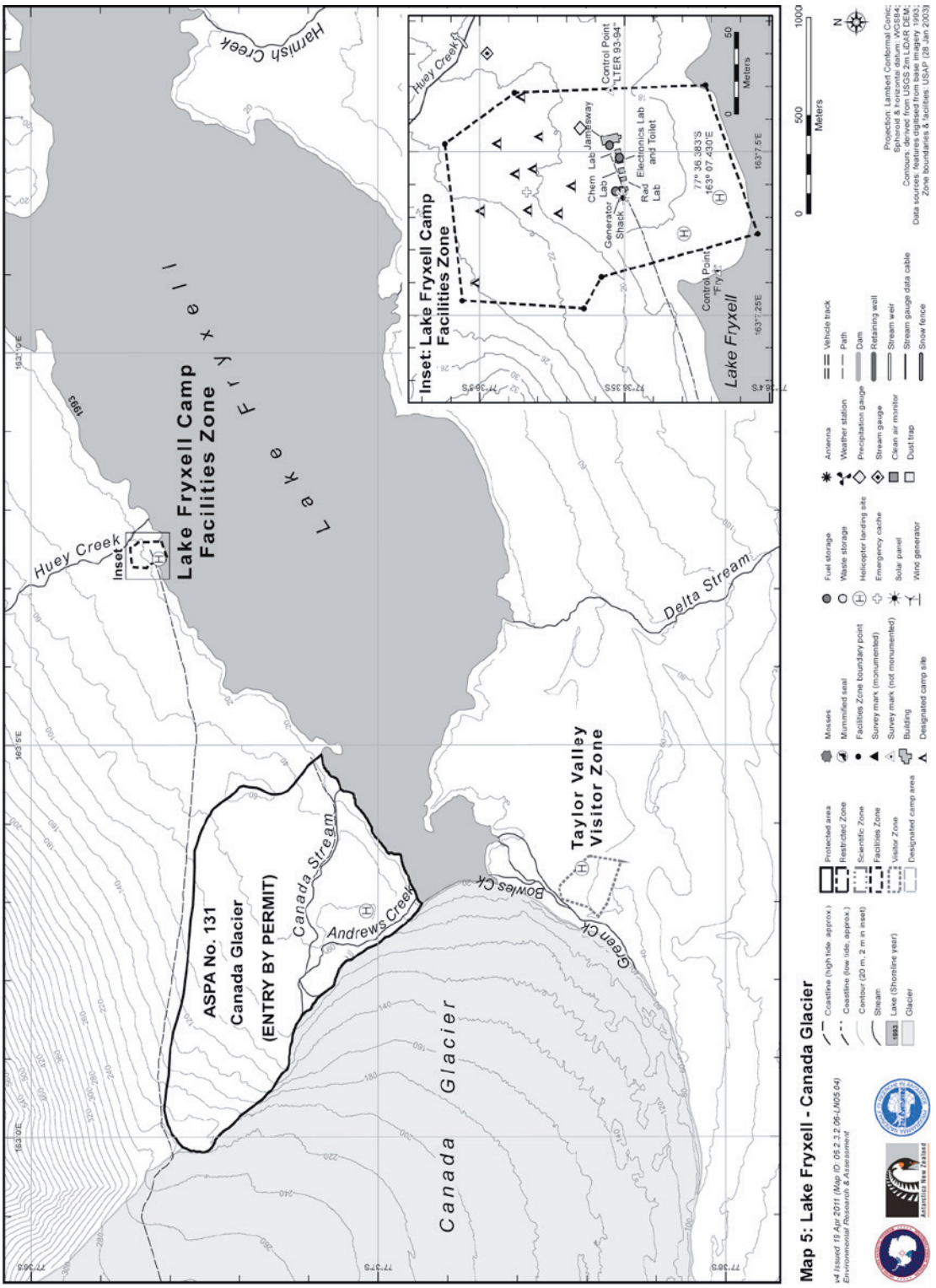
Facilities Zone	Map No.	Boundary Description	Boundary Coordinates	Helicopter Landing Site Coordinates	MP[1]	Structures in Zone
Lake Bonney Camp	8	The boundary goes from a point west of the generator shed by the lake, southeast up to a boulder behind a tent site, northeast to a hill above a tent site, northeast to a point northeast of the easternmost tent site, west to the shoreline, southwest along the shoreline passing north of the helicopter landing pad, continuing southwest along the lake shore to a point northwest of the meteorological station and back to the original point below the generator shed.	77° 42.96'S, 162° 27.37'E 77° 42.99'S, 162° 27.56'E 77° 42.97'S, 162° 27.79'E 77° 42.95'S, 162° 27.93'E 77° 42.90'S, 162° 27.73'E 77° 42.92'S, 162° 27.61'E	77° 42.95'S, 162° 27.65'E 1 helicopter landing pad.	US	A 55.7 m^2 (600 sq. ft.) Jamesway, a 2.2 m^2 (24 sq. ft.) outhouse, an 8.9 m^2 (96 sq. ft.) generator building, and three 8.9 m^2 (96 sq. ft.) laboratories. Emergency cache. For 2010 - Two outhouses (5.6 m^2).
Mount Newall Radio Repeater	9	The boundary goes from the northeastern most point northeast of the green equipment shelter, southwest along the southeastern side of the ridge around the green equipment shelter, the NZ Repeater, the wind turbine, the AFTEC Hut, the antenna, the survival camp hut, the survival cache, around the helicopter landing pad, northeast along the north western side of the ridge around the camp hut, the antenna, the AFTEC Hut, the wind turbine, the NZ Repeater, and the green equipment shelter back to the original point.	77° 30.23'S, 162° 37.60'E 77° 30.25'S, 162° 37.60'E 77° 30.26'S, 162° 37.55'E 77° 30.27'S, 162° 37.52'E 77° 30.27'S, 162° 37.52'E 77° 30.29'S, 162° 37.46'E 77° 30.31'S, 162° 37.33'E 77° 30.29'S, 162° 37.28'E 77° 30.28'S, 162° 37.40'E 77° 30.26'S, 162° 37.49'E 77° 30.23'S, 162° 37.56'E	77° 30.295'S, 162° 37.340'E 1 helicopter landing pad.	US/ NZ	The site includes both a US and a NZ radio repeater. There are three huts on Mt. Newall, including an 8.9 m2 (96 sq. ft.) survival hut, a 22.3 m2 (240 sq. ft.) shed encompassing a hybrid power system (both US), and a green equipment shelter 2.2 m2 (24 m2.) housing the NZ repeater. US repeater equipment contained in two orange plastic cases. There are two antennae (one US, one NZ) and a wind turbine (US) at the site.
Marble Point Refueling Station	10	The boundary goes from the easternmost point (east of soil pits), northwest around the main facilities area, northwest around the fuel storage tanks and pipe, northwest along the road, southwest around the end of the road and staging area, southeast along the road and around the helicopter pads, southeast around the pond, and northeast back to the point east of the soil pits.	77° 24.86'S, 163° 41.41'E 77° 24.82'S, 163° 41.22'E 77° 24.81'S, 163° 41.02'E 77° 24.80'S, 163° 40.81'E 77° 24.71'S, 163° 40.25'E 77° 24.74'S, 163° 40.15'E 77° 24.86'S, 163° 40.74'E 77° 24.89'S, 163° 41.27'E	77° 24.82'S, 163° 40.76'E 4 helicopter landing pads. The four pads are in close proximity (~25 m – 30 m apart). Coordinates are given for the central pad (second from main fuel tanks).	US	A 69.7 m2 (750 sq. ft.) main building, a 41.8 m2 (450 sq. ft.) bunkhouse, a 55.7 m2 (600 sq. ft.) bunkhouse, a 7.4 m2 (80 sq. ft.) fuel shack, 6 fuel storage tanks (25,000 gallons each), a 2.2 m2 (24 sq. ft.) outhouse and incinerator for solid waste, a 1.9 m^2 (20 sq. ft.) storage shed, a 21 m^2 (224 sq. ft.) generator shed, a 27 m^2 (288 sq. ft.) workshop and storage building, and a 7 m^2 (76 sq. ft.) ASOS weather station. Fuel shed and outhouse at refuelling station.
Lower Wright Hut	11	The boundary encompasses the hut, a marked helicopter landing site, and an emergency box and is bounded by rising slopes on the western and eastern sides, a large pavement crack at the southern end and rocky areas at the northern end. A met screen and weir are outside the zone within walking distance of the site.	77° 26.56'S, 162° 39.04'E 77° 26.53'S, 162° 39.02'E 77° 26.53'S, 162° 39.13'E 77° 26.55'S, 162° 39.15'E	77° 26.537'S, 161° 39.070'E 1 helicopter landing pad.	NZ	One small hut with accommodation for 2 people with a floor area of 6 m^2 (65 sq. ft.). Emergency cache.

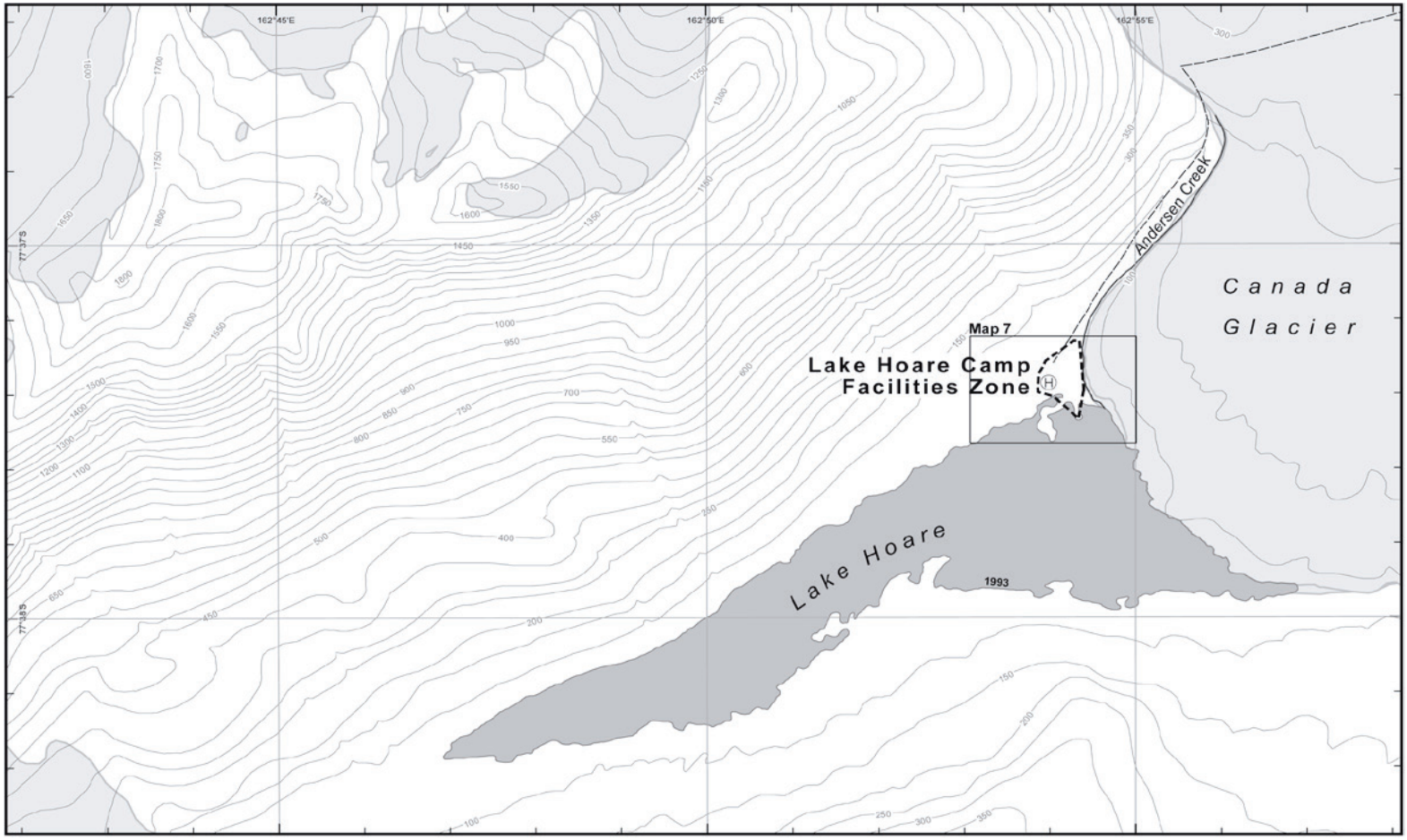
Facilities Zone	Map No.	Boundary Description	Boundary Coordinates	Helicopter Landing Site Coordinates	MP[1]	Structures in Zone
Lake Vanda Hut	12 Inset 1	The boundary follows the edge of the flat area on which the huts, AWS, marked helicopter landing site and tent sites are located.	77° 31.42'S, 161° 41.15'E 77° 31.40'S, 161° 41.17'E 77° 31.34'S, 161° 41.45'E 77° 31.34'S, 161° 41.51'E 77° 31.36'S, 161° 41.51'E 77° 31.41'S, 161° 41.25'E	77° 31.361'S, 161° 41.442'E 1 helicopter landing pad.	NZ	Three interconnected huts with a total floor area of 30 m^2 (323 sq. ft.). Automatic Weather Station (AWS).
Bull Pass Hut	12 Inset 2	The boundary encompasses the pebbly flat ground on which the huts and tent sites are situated, and is bounded by a large boulder to the north, small rocky ridges to the east and west, and a line between ridge ends to the south. An AWS is established well to the west of the zone boundary.	77° 31.09'S, 161° 51.23'E 77° 31.07'S, 161° 50.96'E 77° 30.98'S, 161° 51.11'E 77° 31.00'S, 161° 51.35'E	77° 31.056'S, 161° 51.048'E 1 helicopter landing pad.	US	Two shelters located at this site, an equipment shelter and an environmental shelter approximately 28.7 m^2 (290 sq. ft.) which houses a hybrid power system.
Cape Roberts Camp	13	The boundary encompasses all of the flat area between north and south beaches on Cape Roberts, including the two huts and fuel rack. The southeast corner of the zone is at the fuel rack, and the boundary continues north along the edge of a bouldery slope, west along the edge of a rocky area, and south behind the huts along the edge another rocky slope. The zone is bounded to the south by the shoreline of a small bay.	77° 2.08'S, 163° 10.73'E 77° 2.08'S, 163° 10.79'E 77° 2.09'S, 163° 10.84'E 77° 2.16'S, 163° 10.79'E	No helicopter landing pads.	NZ	Two huts on the ice-free area of Cape Roberts with accommodation for four people (approximately 10 m^2.) as well a living hut 19 m^2 (205 sq. ft.). A storage rack for drummed fuel is also at the site.

[1] Maintaining Party


NEW HARBOR
Explorers Cove
Explorers Cove
Scientific Zone
Map 14
North Tide Pools
South Tide Pools
Inset
ASMA No.2 Boundary
New Harbor Camp
Facilities Zone
Commonwealth Glacier
Wales Stream
Inset: New Harbor Camp
Facilities Zone
DP08 Survey Control
Helicopter staging area
Lab & Bathroom
Generator Shack
Main Hut
77° 34.692' S
163° 31.165' E
South Tide Pools
Meters
Map 3: Explorers Cove, New Harbor
v4 Issued 19 Apr 2011 (Map ID: 05.2.3.2.11-LN03.04)
Environmental Research & Assessment
Coastline (high tide, approx.)
Coastline (low tide, approx.)
Contour (20 m, 2 m in inset)
Stream
Lake (Shoreline year) / Sea
Glacier
Protected area
Restricted Zone
Scientific Zone
Facilities Zone
Visitor Zone
Designated camp area
Mosses
Mummified seal
Facilities Zone boundary point
Survey mark (monumented)
Survey mark (not monumented)
Building
Designated camp site
Fuel storage
Waste storage
Helicopter landing site
Emergency cache
Solar panel
Wind generator
Antenna
Weather station
Precipitation gauge
Stream gauge
Clean air monitor
Dust trap
Vehicle track
Path
Dam
Retaining wall
Stream weir
Stream gauge data cable
Snow fence
Projection: Lambert Conformal Conic;
Spheroid & horizontal datum: WGS84;
Contours: derived from USGS 2m LiDAR DEM;
Data sources: features digitised from base imagery 1993;
Zone boundaries & facilities: USAP (27 Dec 2007)


Map 4: Lake Fryxell - Commonwealth Glacier
Commonwealth Glacier
Mcknight Creek
Aiken Creek
Lost Seal Stream
von Guerard Stream
Harnish Creek
Huey Creek
F-6 Camp Facilities Zone
Lake Fryxell Camp Facilities Zone
Lake Fryxell
Inset
Inset: F-6 Camp Facilities Zone
LTER Science Area
Main Building
77° 36.514'S
163° 15.343'E
1993
Meters


Lake Fryxell Camp Facilities Zone
Lake Fryxell
Harnish Creek
Huey Creek
Inset
ASPA No. 131
Canada Glacier
(ENTRY BY PERMIT)
Canada Stream
Andrews Creek
Canada Glacier
Bowles Ck
Green Ck
Taylor Valley Visitor Zone
Delta Stream
Inset: Lake Fryxell Camp Facilities Zone
Chem Lab
Jamesway
Generator Shack
Rad Lab
Electronics Lab and Toilet
Control Point "LTER 93-94"
77° 36.383'S
163° 07.430'E
Control Point "Fryx"
Meters
Map 5: Lake Fryxell - Canada Glacier
v4 Issued 18 Apr 2011 (Map ID: 08.2.3.2.06-LM05.04)
Environmental Research & Assessment
Coastline (high tide, approx.)
Coastline (low tide, approx.)
Contour (20 m, 2 m in inset)
Stream
Lake (Shoreline year)
Glacier
Protected area
Restricted Zone
Scientific Zone
Facilities Zone
Visitor Zone
Designated camp area
Mosses
Mummified seal
Facilities Zone boundary point
Survey mark (monumented)
Survey mark (not monumented)
Building
Designated camp site
Fuel storage
Waste storage
Helicopter landing site
Emergency cache
Solar panel
Wind generator
Antenna
Weather station
Precipitation gauge
Stream gauge
Clean air monitor
Dust trap
Vehicle track
Path
Dam
Retaining wall
Stream weir
Stream gauge data cable
Snow fence
Projection: Lambert Conformal Conic; Spheroid & horizontal datum: WGS84;
Contours: derived from USGS 2m LiDAR DEM;
Data sources: features digitised from base imagery 1993;
Zone boundaries & facilities: USAF (28 Jan 2003)



Map 6: Lake Hoare, Canada Glacier

v4 Issued 19 Apr 2011 (Map ID: 06.2.3.2.07-LN06.04)
Environmental Research & Assessment

Coastline (high tide, approx.)
Coastline (low tide, approx.)
Contour (20 m)
Stream
1993 Lake (Shoreline year)
Glacier

Protected area
Restricted Zone
Scientific Zone
Facilities Zone
Visitor Zone
Designated camp area

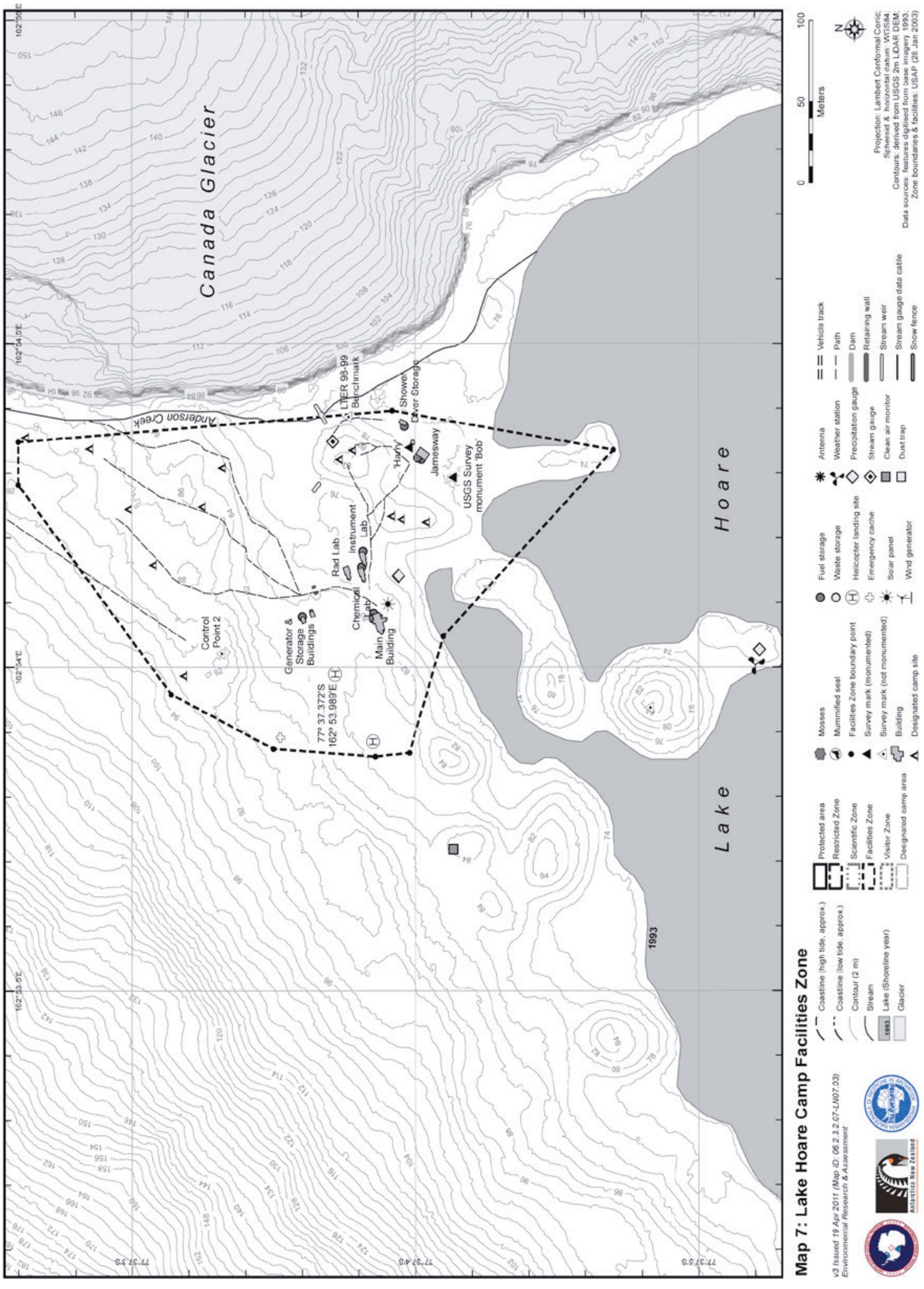
Mosses
Mummified seal
Facilities Zone boundary point
Survey mark (monumented)
Survey mark (not monumented)
Building
Designated camp site

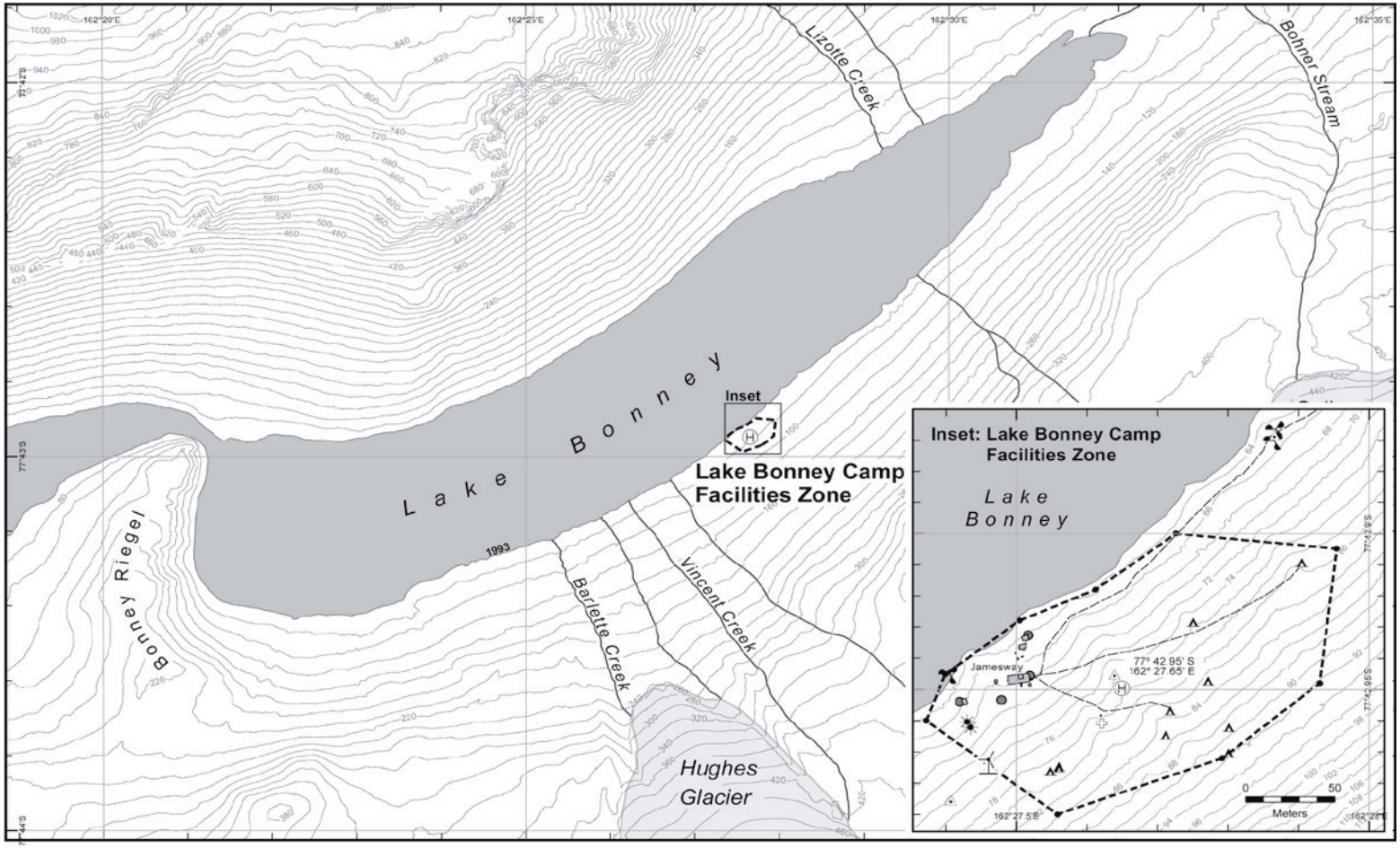
Fuel storage
Waste storage
Helicopter landing site
Emergency cache
Solar panel
Wind generator

Antenna
Weather station
Precipitation gauge
Stream gauge
Clean air monitor
Dust trap

Vehicle track
Path
Dam
Retaining wall
Stream weir
Stream gauge data cable
Snow fence

Projection: Lambert Conformal Conic;
Spheroid & horizontal datum: WGS84;
Contours: derived from USGS 50K map series;
Data sources: features digitised from base imagery 1993;
Zone boundaries & facilities: USAP (28 Jan 2003)


Map 7: Lake Hoare Camp Facilities Zone
v3 Issued 19 Apr 2011 (Map ID: 06.2.3.2.07-LN07.03)
Environmental Research & Assessment
Canada Glacier
Lake Hoare
Anderson Creek
LTER 98-99 Benchmark
Shower Over Storage
'Harry'
Jamesway
USGS Survey monument 'Bob'
Rad Lab
Instrument Lab
Chemical Lab
Main Building
Generator & Storage Buildings
Control Point 2
77° 37.372'S 162° 53.983'E
1993
Coastline (high tide, approx.)
Coastline (low tide, approx.)
Contour (2 m)
Stream
Lake (Shoreline year)
Glacier
Protected area
Restricted Zone
Scientific Zone
Facilities Zone
Visitor Zone
Designated camp area
Mosses
Mummified seal
Facilities Zone boundary point
Survey mark (monumented)
Survey mark (not monumented)
Building
Designated camp site
Fuel storage
Waste storage
Helicopter landing site
Emergency cache
Solar panel
Wind generator
Antenna
Weather station
Precipitation gauge
Stream gauge
Clean air monitor
Dust trap
Vehicle track
Path
Dam
Retaining wall
Stream weir
Stream gauge data cable
Snow fence
Meters
Projection: Lambert Conformal Conic;
Spheroid & horizontal datum: WGS84;
Contours: derived from USGS 2m LIDAR DEM;
Data sources: features digitised from base imagery 1993;
Zone boundaries & facilities: USAP (28 Jan 2003)



Map 8: Lake Bonney, Taylor Valley

v4 Issued 19 Apr 2011 (Map ID: 06.2.3.2.02-LN08.04)
Environmental Research & Assessment

Coastline (high tide, approx.)
Coastline (low tide, approx.)
Contour (20 m, 2 m in inset)
Stream
1993 Lake (Shoreline year)
Glacier

Protected area
Restricted Zone
Scientific Zone
Facilities Zone
Visitor Zone
Designated camp area

Mosses
Mummified seal
Facilities Zone boundary point
Survey mark (monumented)
Survey mark (not monumented)
Building
Designated camp site

Fuel storage
Waste storage
Helicopter landing site
Emergency cache
Solar panel
Wind generator

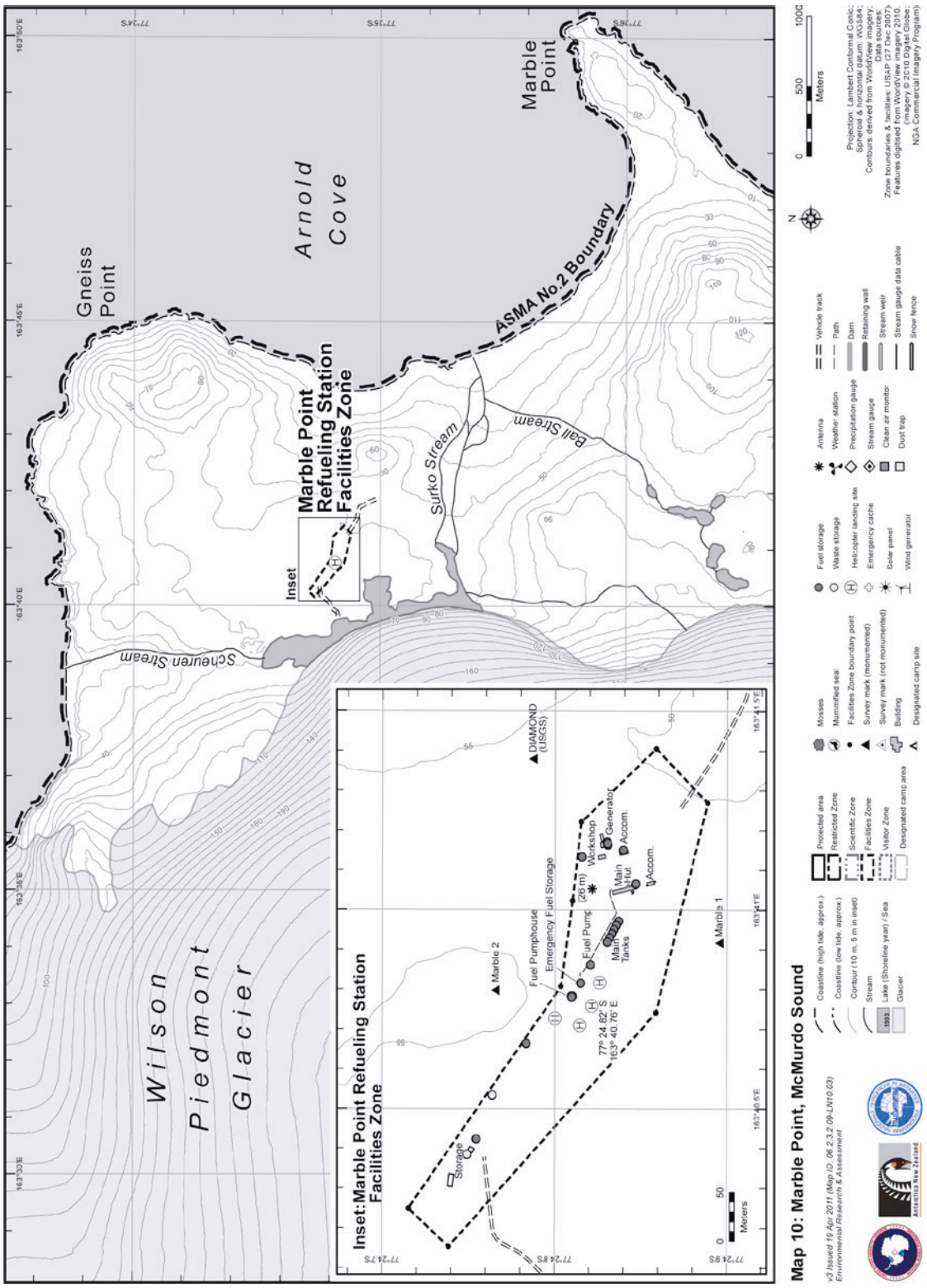
Antenna
Weather station
Precipitation gauge
Stream gauge
Clean air monitor
Dust trap

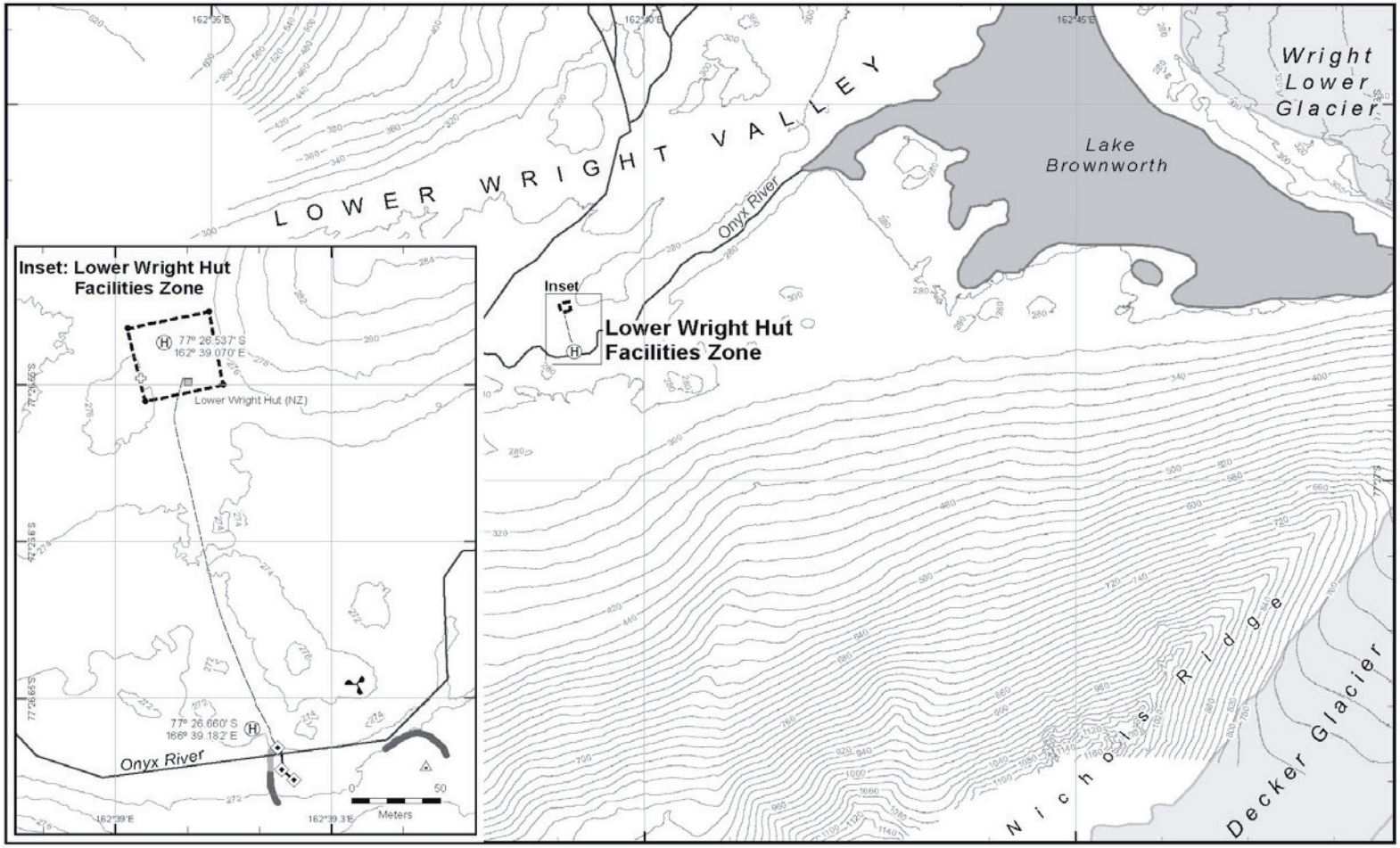
Vehicle track
Path
Dam
Retaining wall
Stream weir
Stream gauge data cable
Snow fence

0 500 1000
Meters

N

Projection: Lambert Conformal Conic;
Spheroid & horizontal datum: WGS84;
Contours: in meters derived from USGS 2m LiDAR DEM;
Data sources: features digitised from base imagery 1993;
Zone boundary & facilities: USAP (2008)


Map 10: Marble Point, McMurdo Sound
Wilson Piedmont Glacier
Arnold Cove
Gneiss Point
Marble Point
Marble Point Refueling Station Facilities Zone
ASMA No.2 Boundary
Schneuren Stream
Surko Stream
Bail Stream
Inset
Inset: Marble Point Refueling Station Facilities Zone
Storage
Marble 2
Fuel Pumphouse
Emergency Fuel Storage
Fuel Pump (26 m)
Workshop
Generator
Main Tanks
Main Hut
Accom.
Accom.
DIAMOND (USGS)
Marble 1
77° 24.82' S
163° 40.76' E
Meters
Coastline (high tide, approx.)
Coastline (low tide, approx.)
Contour (10 m, 5 m in inset)
Stream
Lake (Shoreline year) / Sea
Glacier
Protected area
Restricted Zone
Scientific Zone
Facilities Zone
Visitor Zone
Designated camp area
Mosses
Mummified seal
Facilities Zone boundary point
Survey mark (monumented)
Survey mark (not monumented)
Building
Designated camp site
Fuel storage
Waste storage
Helicopter landing site
Emergency cache
Solar panel
Wind generator
Antenna
Weather station
Precipitation gauge
Stream gauge
Clean air monitor
Dust trap
Vehicle track
Path
Dam
Retaining wall
Stream weir
Stream gauge data cable
Snow fence
N
0
500
1000
Meters
Projection: Lambert Conformal Conic
Spheroid & horizontal datum: WGS84
Contours: derived from WorldView imagery
Zone boundaries & facilities: USAP (27 Dec 2007)
Features digitised from WorldView imagery 2010
(imagery © 2010 DigitalGlobe;
NGA Commercial Imagery Program)
v3 Issued 19 Apr 2011 (Map ID: 06.2.3.2.09-LN10.03)
Environmental Research & Assessment
Antarctica New Zealand



Map 11: Lower Wright Valley

v4 Issued 20 Apr 2011 (Map ID: 06.2.3.2.08-LN11.04)
Environmental Research & Assessment

Coastline (high tide, approx.)
Coastline (low tide, approx.)
Contour (20 m, 2 m in inset)
Stream
1993 Lake (Shoreline year)
Glacier

Protected area
Restricted Zone
Scientific Zone
Facilities Zone
Visitor Zone
Designated camp area

Mosses
Mummified seal
Facilities Zone boundary point
Survey mark (monumented)
Survey mark (not monumented)
Building
Designated camp site

Fuel storage
Waste storage
Helicopter landing site
Emergency cache
Solar panel
Wind generator

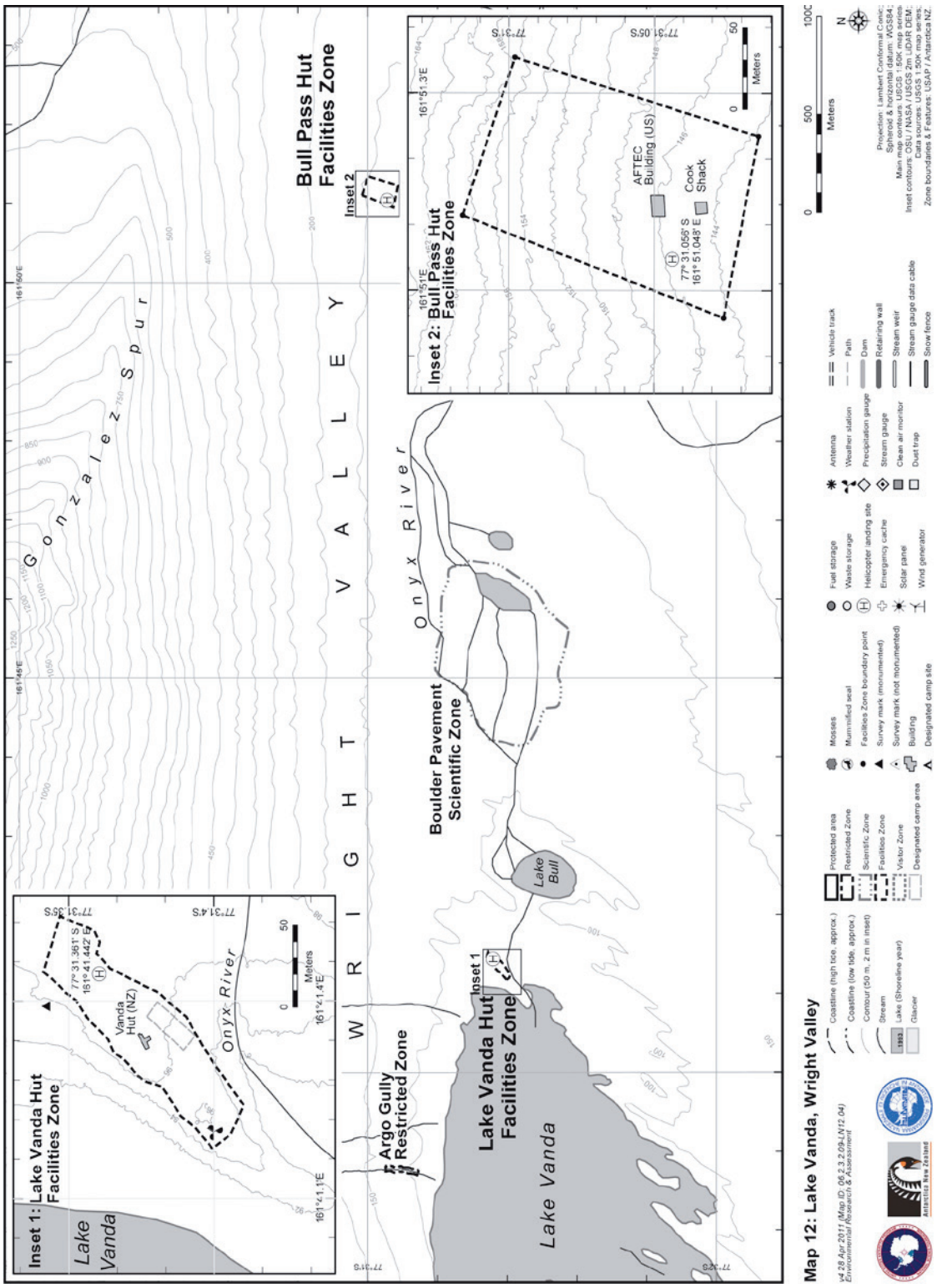
Antenna
Weather station
Precipitation gauge
Stream gauge
Clean air monitor
Dust trap

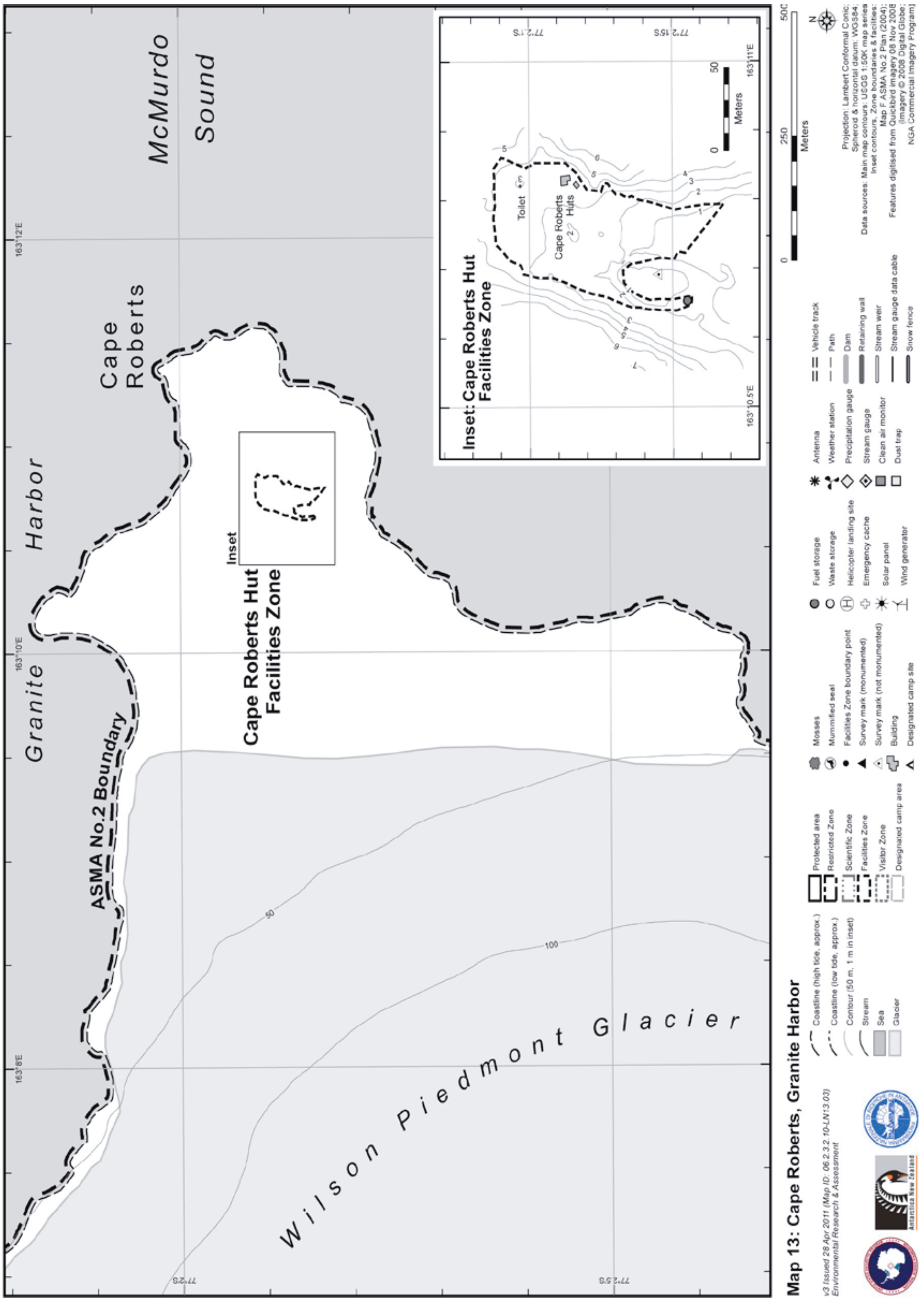
Vehicle track
Path
Dam
Retaining wall
Stream weir
Stream gauge data cable
Snow fence

0 500 1000
Meters

N

Projection: Lambert Conformal Conic;
Spheroid & horizontal datum: WGS84;
Contours: derived from USGS 2mLiDAR DEM;
Data source: USGS 1:50K map series;
Zone boundaries & facilities: USAP (2008)


Inset 1: Lake Vanda Hut Facilities Zone
Lake Vanda
77°31.35'S
77°31.4'S
77° 31.361' S
161° 41.442' E
Vanda Hut (NZ)
Onyx River
0
50
Meters
161°41.1'E
161°41.4'E
Inset 2: Bull Pass Hut Facilities Zone
161°51.1E
161°51.3E
77°31.05'S
77° 31.056' S
161° 51.048' E
AFTEC Building (US)
Cook Shack
Bull Pass Hut Facilities Zone
Inset 2
Gonzalez Spur
WRIGHT VALLEY
Onyx River
Boulder Pavement Scientific Zone
Argo Gully Restricted Zone
Lake Vanda Hut Facilities Zone
Inset 1
Lake Bull
Lake Vanda
161°45'E
161°50'E
77°31'S
77°32'S
Map 12: Lake Vanda, Wright Valley
v4 28 Apr 2011 Map ID: 06.2.3.2.09-LV12.04)
Environmental Research & Assessment
Coastline (high tide, approx.)
Coastline (low tide, approx.)
Contour (50 m, 2 m in inset)
Stream
Lake (Shoreline year)
Glacier
Protected area
Restricted Zone
Scientific Zone
Facilities Zone
Visitor Zone
Designated camp area
Mosses
Mummified seal
Facilities Zone boundary point
Survey mark (monumented)
Survey mark (not monumented)
Building
Designated camp site
Fuel storage
Waste storage
Helicopter landing site
Emergency cache
Solar panel
Wind generator
Antenna
Weather station
Precipitation gauge
Stream gauge
Clean air monitor
Dust trap
Vehicle track
Path
Dam
Retaining wall
Stream weir
Stream gauge data cable
Snow fence
0
500
1000
Meters
N
Projection: Lambert Conformal Conic;
Spheroid & horizontal datum: WGS84;
Main map source: USGS 1:50K map series;
Inset contours: OSU / NASA / USGS 2m LiDAR DEM;
Data sources: USGS 1:50K map series;
Zone boundaries & Features: USAP / Antarctica NZ.



Map 13: Cape Roberts, Granite Harbor

v3 Issued 28 Apr 2011 (Map ID: 06.2.3.2.10-LN13.03)
Environmental Research & Assessment

APPENDIX D: Guidelines for Scientific Zones

The following sites within the Area are designated Scientific Zones:

- Explorers Cove, New Harbor, Taylor Valley;
- Boulder Pavement, Wright Valley.

Brief site descriptions, guidelines for activities within each Scientific Zone, and Maps 14 and 15 showing the zone boundaries are attached.

Scientific Zone: Explorers Cove

Location

New Harbor, Taylor Valley Two components centered on: North tide pools (490 m^2): 77° 34.57′ S, 163° 30.79′ E; and South tide pools (4360 m^2): 77° 34.66′ S, 163° 31.82′ E.

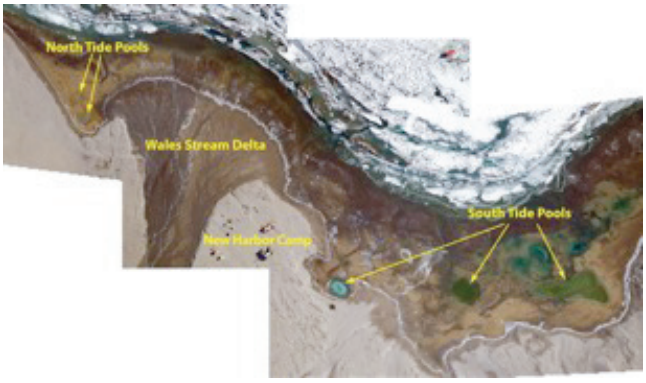


Photo montage: S. Bowser, USAP (28 Jan 2005)

Purpose

To avoid disturbance to local marine environment and ecology which are the subject of long-term scientific studies.

Description

Zone area: 4850 m^2

The Scientific Zone comprises two tide pool systems on the coast of Explorers Cove, both located close to the New Harbor Camp Facilities Zone and extending ~ 75 – 100 m offshore (Map 14). The southern component lies immediately east of New Harbor Camp, extending along the coast for ~ 500 m. The smaller northern component lies ~ 200 m northwest of New Harbor Camp, immediately west of the Wales Stream delta, and extends along the coast for ~ 100 m. These tidally inundated sand flats are characterized by tide pools containing benthic mats of diatoms and cyanobacteria, a significant source of nutrients for the Explorers Cove near-shore marine ecosystem.

Boundaries

The coastline boundary of both tide pools follows the mean high water mark, while the seaward boundary extends parallel to the coast following the approximate grounding line of sea ice pressure ridges (when present), which occur ~ 75 – 100 m offshore (see Map 14).

South Tide Pools:

The western boundary extends 100 m NE from the coast at the NE corner of the New Harbor Camp Facilities Zone. The eastern extent of the Scientific Zone is marked on the shore of a small coastal promontory ~ 500 m east of the Facilities Zone by a small rock cairn, from which the eastern boundary extends due north ~ 30 m offshore.

North Tide Pools:

The western boundary extends 100 m along the coast from a small embayment west of the Wales Stream delta. The northern boundary thence extends ~ 80 m due east from the coast, while the eastern boundary extends 70 m due north from the coast at the edge of the Wales Stream delta.

Impacts

Known Impacts

None.

Potential Impacts

- Shoreline sediments are soft and easily disturbed when ot frozen.

Access requirements

Helicopter Access

Use designated helicopter landing site at New Harbor Facilities Zone: 77o 34.692' S, 163o 31.165' E

Surface Access

Access to the New Harbor Facilities Zone over sea ice may pass through the southern component of the Scientific Zone.

Special site guidance

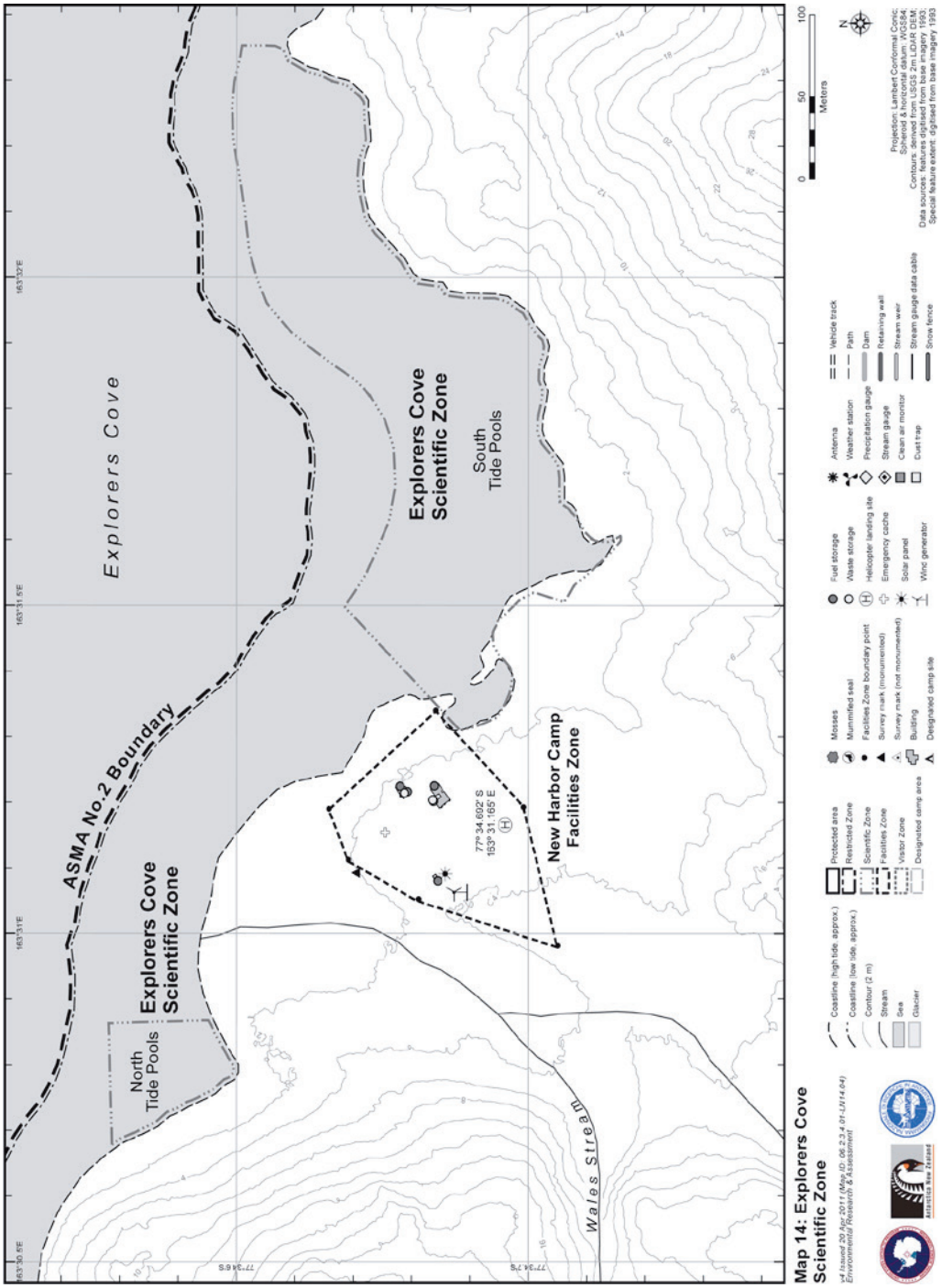
- Avoid walking in the zone unless conducting scientific research, especially when the ice has thawed.
- Sterilize all sampling equipment before sampling at the site to avoid introducing non-native species.

Key references

Gooday, A.J., Bowser, S.S. & Bernhard, J.M. 1996. Benthic foraminiferal assemblages in Explorers Cove, Antarctica: A shallow-water site with deep-sea characteristics. Progress in Oceanography 37: 117-66.

Site Map

Map 14.



Scientific Zone: Boulder Pavement

Location

Onyx River, central Wright Valley, 4 km east and upstream from Lake Vanda: 77° 31.33′ S; 161° 54.58′ E

Purpose

To avoid disturbance to extensive microbial mats and ecology which are the subject of long-term scientific studies.

Description

Zone area: 0.47 km^2

The Scientific Zone comprises a part of the Onyx River which fans out and flows slowly through an extensive and relatively flat area of boulders, where conditions are favorable for the growth of algae and cyanobacteria, forming the most extensive microbial mats in the Wright Valley and a biofilter for Lake Vanda.

Boulder Pavement: N. Biletnikoff, USAP (29 Jan 2009)

Boundaries

The Scientific Zone extends to the perimeter of the extensive flat boulder pavement that is typically inundated by the Onyx River, which comprises an area ~ 0.8 km wide and 1.5 km long (Map 15).

Impacts

Known Impacts

None.

Potential Impacts

- Trampling may damage the microbial mats. The mats may be difficult to identify when the site is frozen. Activities within the zone increase the risk of the introduction of non-native species.

Access requirements

Helicopter Access

Helicopter landings within the Scientific Zone should be avoided. Where practicable, visitors should use the designated helicopter landing sites at Lake Vanda Hut Facilities Zone (77° 31.361′ S; 161° 41.442′ E) or Bull Pass Hut Facilities Zone (77° 31.056′ S;161° 51.048′ E) (Maps 12 & 15).

Surface Access

The zone should be accessed on foot. Avoid walking in this area unless necessary for scientific or management purposes.

Special site guidance

- Avoid crossing the Scientific Zone unless necessary for scientific purposes, such as sampling.
- Walk only on the rocks and avoid trampling the microbial mats.
- Avoid the introduction of non-native species by sterilizing all sampling equipment before use at this site.

Key references

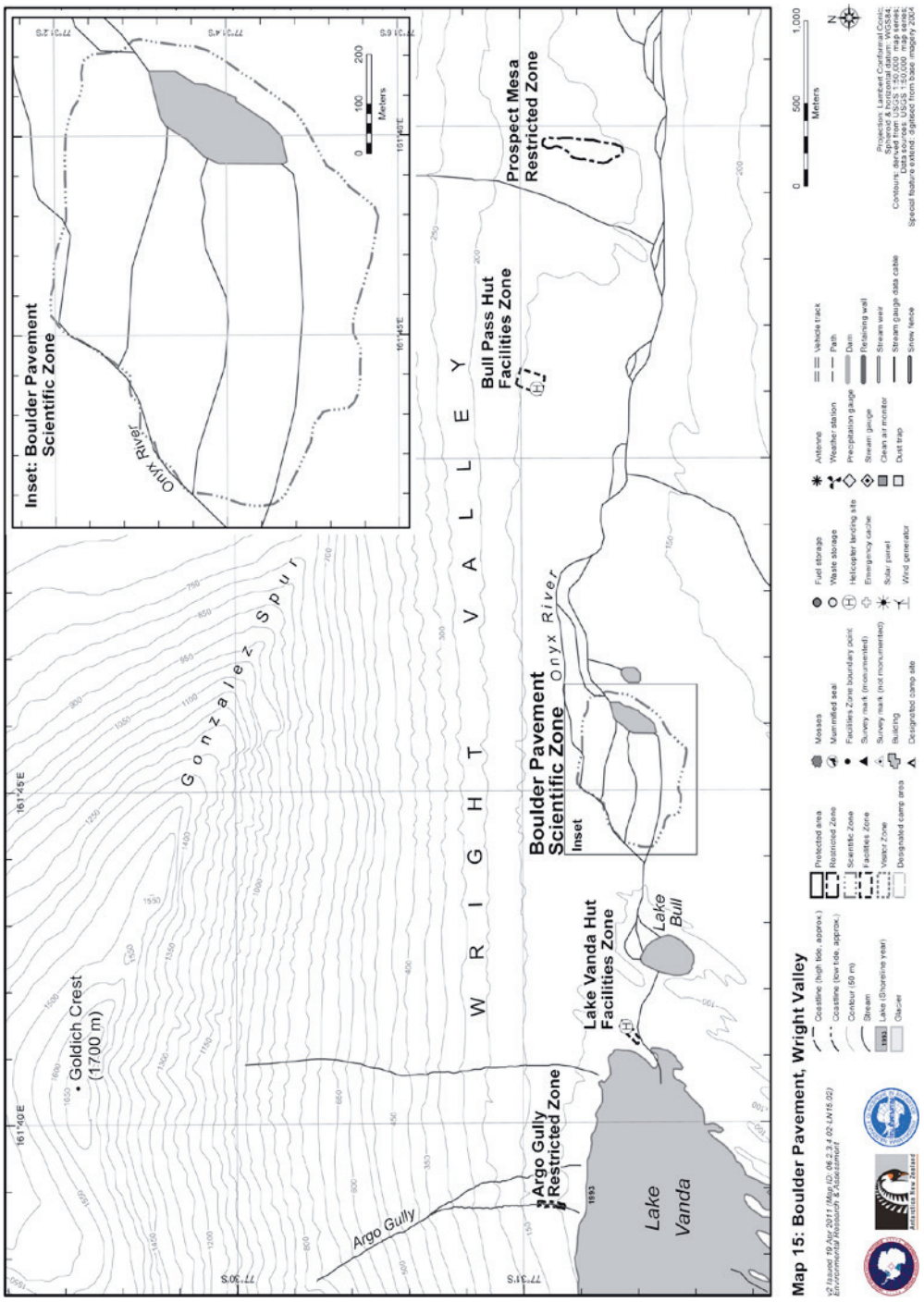
Howard-Williams, C., Vincent, C.L., Broady, P.A. & Vincent, W.F. 1986. Antarctic stream ecosystems: variability in environmental properties and algal community structure. *International Revue der gesamten Hydrobiologie und Hydrographie* **71**(4): 511-44.

Howard-Williams, C., Hawes, I., Schwarz, A.M. & Hall, J.A. 1997. Sources and sinks of nutrients in a polar desert stream, the Onyx River, Antarctica. In: Lyons, W.B., Howard-Williams, C. & Hawes, I. (Eds) *Ecosystem processes in Antarctic ice-free landscapes*. Proceedings of an International Workshop on Polar Desert Ecosystems, Christchurch, New Zealand: 155-70.

Green, W.J., Stage, B.R., Preston, A., Wagers, S., Shacat, J. & Newell, S. 2005. Geochemical processes in the Onyx River, Wright Valley, Antarctica: major ions, nutrients, trace metals. *Geochimica et Cosmochimica Acta* **69**(4): 839-50.

Site Map

Map 15.


Inset: Boulder Pavement Scientific Zone
Onyx River
Prospect Mesa Restricted Zone
Bull Pass Hut Facilities Zone
W R I G H T V A L L E Y
Gonzalez Spur
• Goldich Crest (1700 m)
Boulder Pavement Scientific Zone
Onyx River
Inset
Lake Vanda Hut Facilities Zone
Lake Bull
Argo Gully Restricted Zone
Argo Gully
Lake Vanda
Meters
Protected area
Restricted Zone
Scientific Zone
Facilities Zone
Visitor Zone
Designated camp area
Coastline (high tide, approx.)
Coastline (low tide, approx.)
Contour (50 m)
Stream
Lake (Shoreline year)
Glacier
Mosses
Mummified seal
Facilities Zone boundary point
Survey mark (monumented)
Survey mark (not monumented)
Building
Designated camp site
Fuel storage
Waste storage
Helicopter landing site
Emergency cache
Solar panel
Wind generator
Antenna
Weather station
Precipitation gauge
Stream gauge
Clean air monitor
Dust trap
Vehicle track
Path
Dam
Retaining wall
Stream weir
Stream gauge data cable
Snow fence
Map 15: Boulder Pavement, Wright Valley

APPENDIX E: Guidelines for Restricted Zones

The following sites within the Area are designated Restricted Zones:

- Trough Lake catchment, Pyramid Trough, Royal Society Range;
- Mount Feather Sirius Deposit, Mount Feather;
- Don Juan Pond, South Fork, Wright Valley
- Argo Gully, Lake Vanda, Wright Valley;
- Prospect Mesa, Wright Valley;
- Hart Ash Deposit, Wright Valley;
- Victoria Valley sand dunes, Victoria Valley;
- Battleship Promontory, Alatna Valley, Convoy Range.

Brief site descriptions, guidelines for activities within each Restricted Zone, and maps showing the zone boundaries (Maps 16 – 23) are attached.

Restricted Zone: Trough Lake Catchment

Location

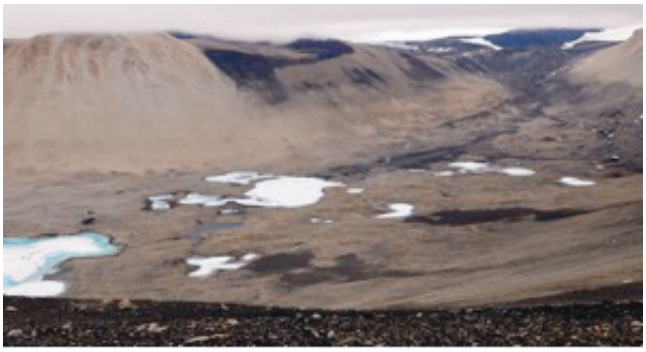
Trough Lake catchment, Royal Society Range, several km northwest of the Koettlitz Glacier and southwest of Walcott Bay: 78° 18.17′ S, 163° 20.57′ E

Purpose

To avoid disturbance to a pristine hydrological catchment and its ecology, and to ensure the aesthetic and wilderness values of the zone are maintained.

Description

Zone area: 79.8 km²



Pyramid Trough: C. Harris, ERA / USAP (09 Dec 2009)

Pyramid Trough: C. Harris, ERA / USAP (09 Dec 2009)

The Trough Lake catchment is enclosed by Mount Dromedary (2485 m), The Pyramid (854 m), The Bulwark (~ 600 m) and Seahorse (1008 m), and comprises a network of four main drainage systems feeding into Trough Lake (Map 16). The valley floor of Pyramid Trough contains a significant wetland system comprising a variety of pond and stream habitats in a confined area that support a range of rich biological communities that are representative of the region. Sparse communities of bryophytes and lichens are present. The catchment also contains some unique features, most notable of which are the presence of groups of cyanobacteria that are rare in other wetland systems in the region. Specifically, in addition to the common oscillatorian cyanobacteria, microbial mats in ponds and streams contain Dichothrix and Schizothrix, and a range of coccoid taxa. Trough Lake catchment has been visited infrequently compared to the other Dry Valleys, and the ecosystem is considered to be almost pristine.

Boundaries

The Restricted Zone boundary is defined by the Trough Lake catchment. Clockwise from The Pyramid, the boundary crosses a small tongue of the Koettlitz Glacier extending into the catchment, thence follows Backdrop Ridge to an unnamed peak (1618 m) at the top of West Aisle Ridge, thence northwest following the ridge to Mount Dromedary, from where it follows a ridge northeast to Seahorse. The boundary thence follows a ridge eastward and descends to Walcott Bay. The boundary proceeds due east ~800 m from the shoreline of Walcott Bay to the approximate grounding line of the Koettlitz Glacier, and thence follows the ASMA boundary to Bulwark Stream to the foot of the northeast ridge of The Bulwark. The boundary proceeds southward following The Bulwark ridge crest, crosses the head of the Upper Alph River, and follows the Koettlitz Glacier margin to ascend the northeastern ridge of The Pyramid.

Impacts

Known Impacts

- Rocks have been moved at the campsite, where an iron survey marker is installed on a small knoll at: 78° 17.17′ S, 163° 27.83′ E (18 m). Sampling has been undertaken at a number of lakes in the catchment.

Potential Impacts

- Disturbance to water bodies, terrestrial ecology and sensitive soils by sampling or trampling.
- Introduction of non-native species.

Access requirements

Helicopter Access

Helicopters should land at the designated site at: 78° 17.16′ S, 163° 27.84′ E (11 m).

Surface Access

Movement within the zone should generally be on foot. Helicopters may be used for essential travel to sites that would be impracticable to access on foot from the campsite.

Special site guidance

- Visits to this catchment should be minimized and semi-permanent structures should not be installed within the zone.
- Avoid the introduction of non-native species by sterilizing all sampling equipment before visiting this site.
- Camping within the Restricted Zone should be at the site previously used (adjacent to the designated helicopter landing site) at: 78° 17.15′ S, 163° 27.79′ E (11 m).

Key references

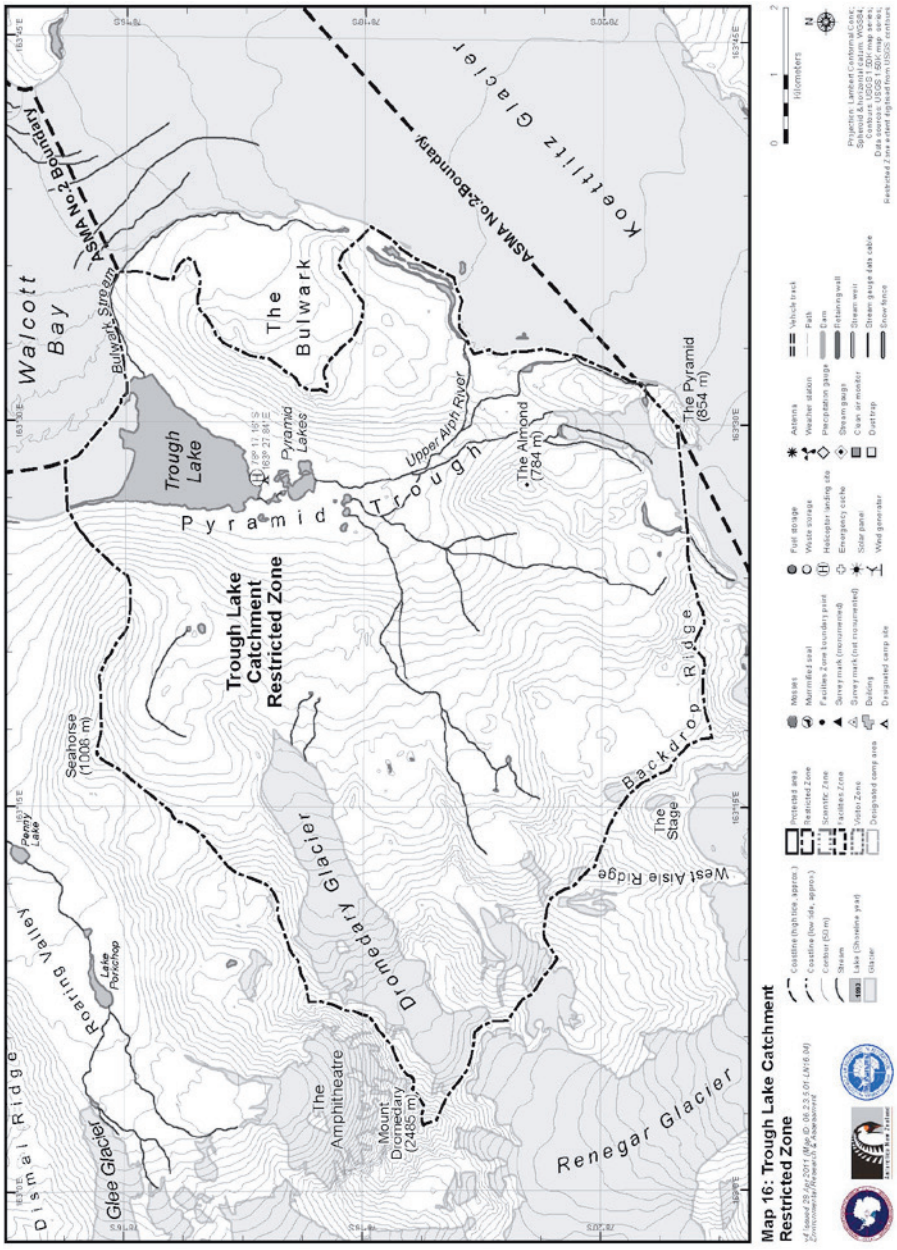
Chinn, T.J.H. 1993. Physical hydrology of Dry Valleys lakes. *Antarctic Research Series* **59**: 1 –51.

Hendy, C.H. & Hall, B.L. 2006. The radiocarbon reservoir effect in proglacial lakes: examples from Antarctica. *Earth and Planetary Science Letters* **241**: 413-21.

Hawes, I., Webster-Brown, J., Wood, S. & Jungblut, A. 2010. A brief survey of aquatic habitats in the Pyramid Trough region, Antarctica. Unpublished report prepared for USAP on the aquatic ecology of the Trough Lake catchment.

Site Map

Map 16



Restricted Zone: Mount Feather Sirius Deposi

Location

Northeast flank of Mount Feather (3011 m) between Lashley Glacier and the upper Ferrar Glacier: 77° 56.05′ S, 160o 26.30′ E

Mount Feather: C. Harris, ERA / USAP (11 Dec 2009)

Purpose

To avoid disturbance or damage to an area of Sirius Deposits, which are of high scientific value.

Description

Zone area: 0.57 km²

The Mount Feather Diamicton is an area of semi-lithified glacigenic deposits that have been included within the Sirius Group at the upper Ferrar Glacier, ~3 km NE of Mount Feather (3011 m) (Map 17). The deposits lie at an elevation of between ~2400-2650 m, extending over ground of relatively gentle slope near the ridge crest and also outcropping on the steep eastern cliffs of the Mount Feather massif above Friedmann Valley and the Ferrar Glacier. The diamicton surface has distinct melt-water runnels near its perimeter and on steeper slopes. The deposits, which extend over an area of ~1.5 km x 1 km, contain microfossils and other evidence of high scientific importance for interpretation of the

Neogene glacial history of the Dry Valleys and of the East Antarctic ice sheet as a whole.

Boundaries

The boundary of the Restricted Zone (Map 17) is defined based on the extent of the Mount Feather Diamicton as

mapped by Wilson et al. (2002: Fig.1). Owing to limitations in the accuracy of available mapping in the region, the boundary is considered approximate, with an estimated accuracy of at least +/- 100 m.

Impacts

Known Impacts

- Rock samples have been collected. At least four shallow drill cores (of 3.2 m in depth or less) have been recovered from the site, although drilling fluids were not employed.

Potential Impacts

- Drilling operations, especially those employing drilling fluids. Sampling and disturbance to sedimentary sequences.

Access requirements

Helicopter Access

Helicopter operations in this location can be difficult owing to altitude and winds, and no specific landing site has yet been designated.

Surface Access

Movement within the Restricted Zone should be on foot.

Special site guidance

- Do not move sediments, rocks and boulders, unless necessary for scientific purposes, and avoid disturbance to or alteration of the sedimentary sequences and melt-water runnels.
- Camping should be at the site previously used on adjacent snow surfaces at: 77 o 55.93′ S, 160 o 25.66′ E.

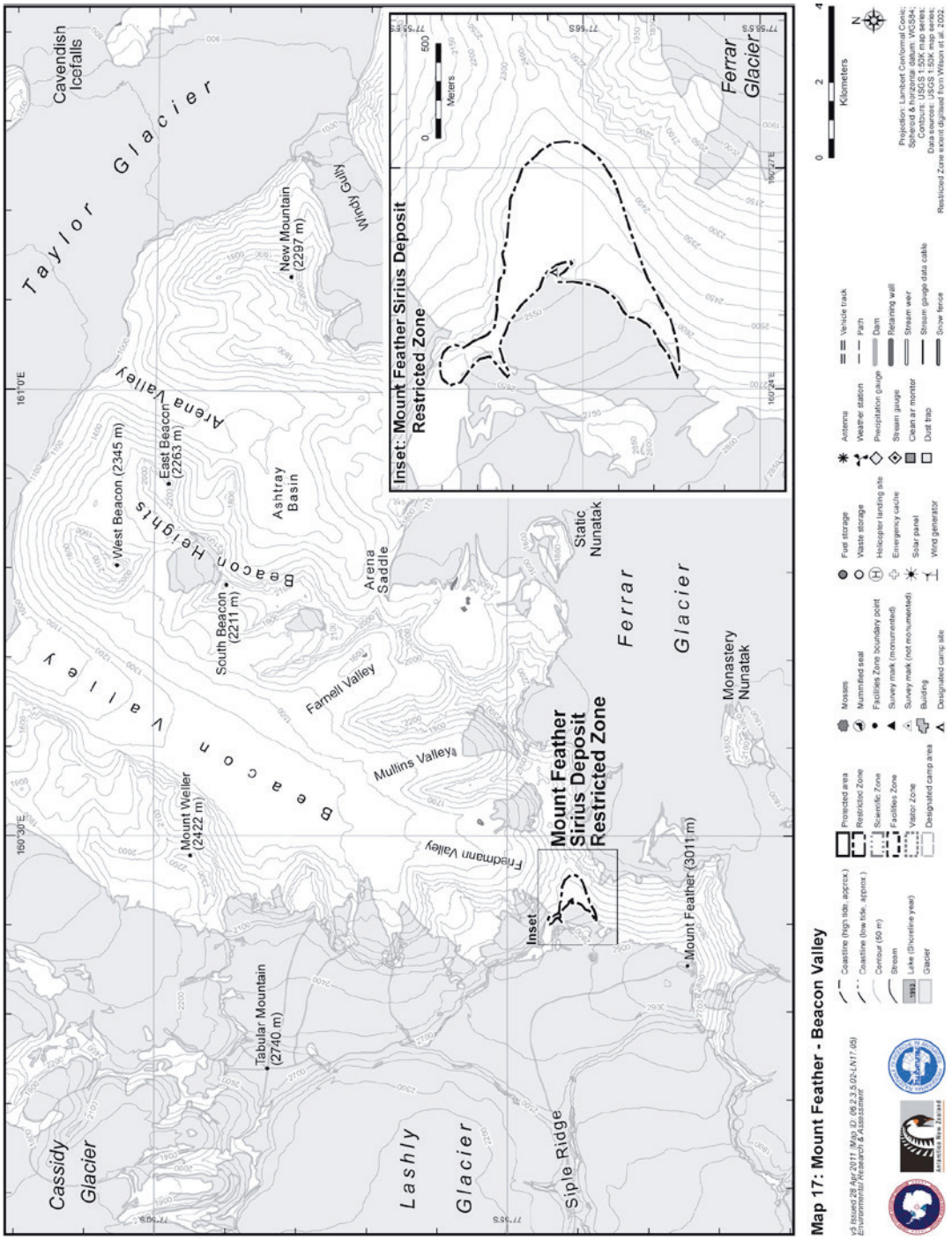
Key references

Wilson, G.S., Barron, J.A., Ashworth, A.C., Askin, R.A., Carter, J.A., Curren, M.G., Dalhuisen, D.H., Friedmann, E.I.,

Fyodorov-Davidov, D.G., Gilichinsky, D.A., Harper, M.A., Harwood, D.M., Hiemstra, J.F., Janecek, T.R, Licht, K.J., Ostroumov, V.E., Powell, R.D., Rivkina, E.M., Rose, S.A., Stroeven, A.P., Stroeven, P., van der Meer, J.J.M., and Wizevich M.C. 2002. The Mount Feather Diamicton of the Sirius Group: an accumulation of indicators of Neogene Antarctic glacial and climatic history. Palaeogeography, Palaeoclimatology, Palaeoecology 182: 117-31.

Site Map

Map 17


Map 17: Mount Feather - Beacon Valley
Taylor Glacier
Cavendish Icefalls
Arena Valley
Beacon Heights
Beacon Valley
Ashtray Basin
Windy Gully
New Mountain (2297 m)
East Beacon (2263 m)
West Beacon (2345 m)
South Beacon (2211 m)
Arena Saddle
Farrell Valley
Mullins Valley
Friedmann Valley
Mount Weller (2422 m)
Tabular Mountain (2740 m)
Cassidy Glacier
Lashly Glacier
Siple Ridge
Mount Feather Sirius Deposit Restricted Zone
Inset
Mount Feather (3011 m)
Monastery Nunatak
Static Nunatak
Ferrar Glacier
Inset: Mount Feather Sirius Deposit Restricted Zone
Meters
Kilometers
Projection: Lambert Conformal Conic;
Spheroid & horizontal datum: WGS84;
Contours: USGS 1:50K map series;
Data sources: see text for details;
Restricted Zone extent digitised from Wilson et al. 2002.

Restricted Zone: Don Juan Pond

Location

At the foot of a rock glacier in South Fork, Wright Valley, in a closed basin at 118 m elevation below the Dais, ~ 7.5 km from Lake Vanda: 77° 33.77′ S, 161° 11.32′ E

Don Juan Pond: C. Harris, ERA / USAP (14 Dec 2009)

Purpose

To protect a rare and sensitive hypersaline ecosystem of high scientific value from disturbance and damage.

Description

Zone area: 20 ha

Don Juan Pond is a small hypersaline lake currently of ~400 x 150 m containing a calcium-chloride-rich brine with a salinity level of ~40%, making it the most saline natural water body known on Earth. Water levels have fluctuated over time, although recently the pond has been ~10 cm in depth. While water levels vary, the Restricted Zone extends to the perimeter of the pond floor salt deposits (Map 18). Microbial life, including numerous heterotrophic bacteria and a yeast, are found in the pond. A mat of mineral material and detritus cemented together by organic matter, referred to as the Don Juan Pond Salt Deposits, is found at the edge of the pond where the calcium chloride concentrations are reduced. Don Juan Pond is also the site where Antarcticite ($CaCl_2$ $6H_20$), a hygroscopic colorless mineral, was first identified forming naturally.

Boundaries

The Restricted Zone boundary is defined by the outer extent of the Don Juan Pond Salt Deposits, which extend to the edge of the basin pond floor, occupying an area of ~720 x 300 m (Map 18).

Impacts

Known Impacts

- The Dry Valleys Drilling Project drilled two boreholes at Don Juan Pond: DVDP 5 (3.5 m depth) and DVDP 13 (75 m depth), situated within the salt deposit area ~60 m and ~110 m respectively east of the rock glacier. DVDP 13 remains in evidence as an iron tube (capped) protruding ~ 1 m above the dry pond floor (Map 18). Small quantities of waste (e.g. rusted cans) were observed in soils ~50-100 m south and east of the Restricted Zone in Dec 2009, most likely originating from early camps established near the site.

Potential Impacts

- Disturbance to water body, salt deposits and sensitive soils by sampling or trampling.

Access requirements

Helicopter Access

Helicopters should avoid landing in the Restricted Zone and avoid overflight below 50 m above ground level. Helicopters should land at the designated site ~250 m east of Don Juan Pond at: 77° 33.784′ S, 161° 12.948′ E.

Surface Access

Access to and movement within the Restricted Zone should be on foot.

Special site guidance

- Avoid walking through the pond and adjacent salt deposits unless necessary for scientific or management purposes.
- Walk carefully to minimize disturbance to the salt deposits and surrounding soft soils and sensitive slopes.
- Do not move any boulders.
- Camping is not permitted within the Restricted Zone.

Key references

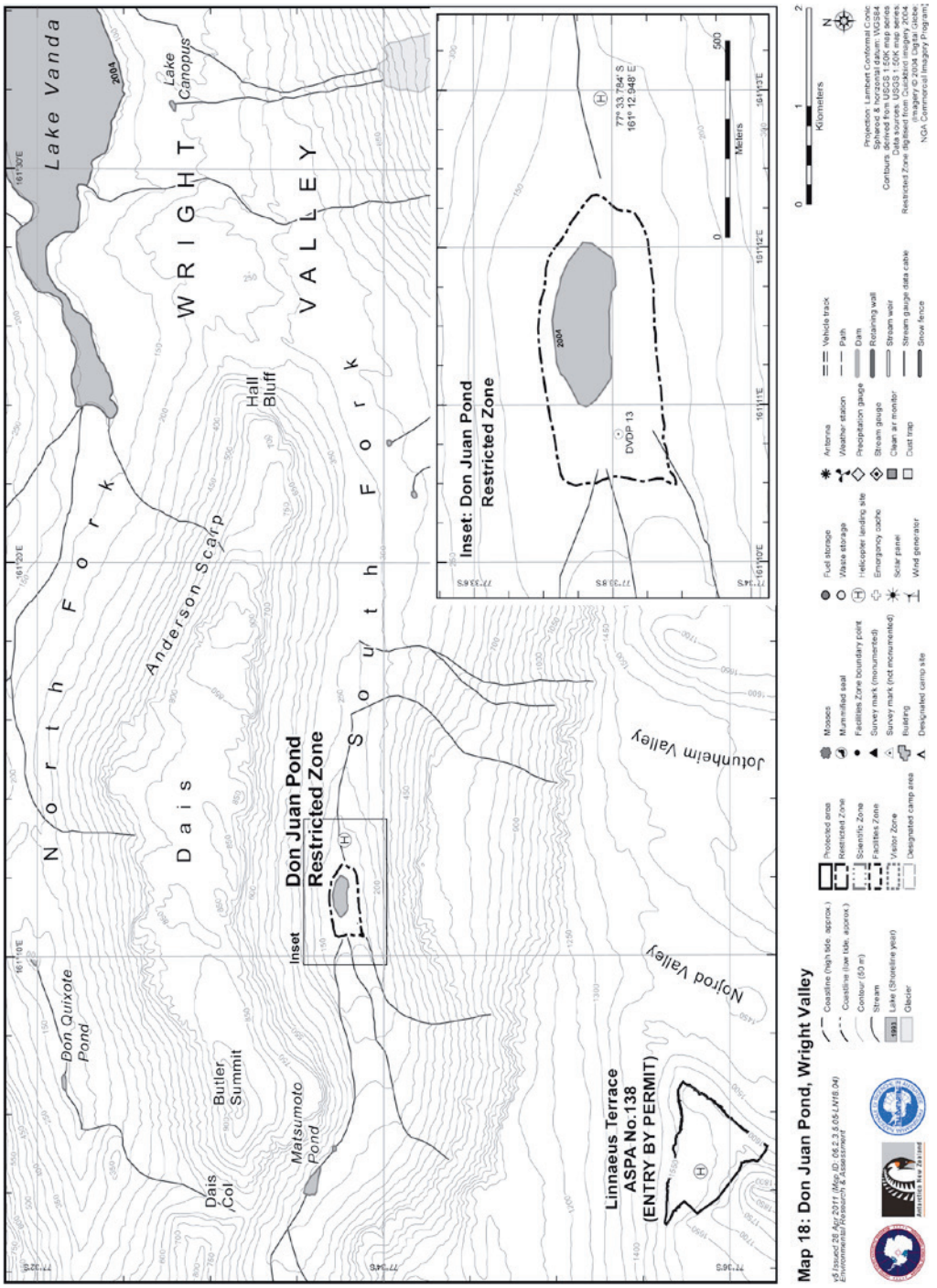
Harris, H.J.H. & Cartwright, K. 1981. Hydrology of the Don Juan Basin, Wright Valley, Antarctica. Antarctic Research Series 33: 161-84.

Chinn, T.J. 1993. Physical hydrology of the Dry Valley lakes. Antarctic Research Series 59: 1-51.

Samarkin, V.A., Madigan, M.T., Bowles, M.W., Casciotti, K.L., Priscu, J.C., McKay, C.P. & Joye, S.B. 2010. Abiotic nitrous oxide emission from the hypersaline Don Juan Pond in Antarctica. Nature Geoscience Online: 25 April 2010. DOI: 10.1038/NGEO847.

Site Map

Map 18


Lake Vanda
North Fork
Wright Valley
South Fork
Dais
Anderson Scarp
Hall Bluff
Lake Canopus
Don Quixote Pond
Butler Summit
Dais Col
Matsumoto Pond
Inset
Don Juan Pond
Restricted Zone
Linnaeus Terrace
ASPA No.138
(ENTRY BY PERMIT)
Nojord Valley
Jotunheim Valley
Inset: Don Juan Pond
Restricted Zone
DVDP 13
77° 33.794' S
161° 12.948' E
2004
Meters
Kilometers
Map 18: Don Juan Pond, Wright Valley

Restricted Zone: Argo Gully

Location

Northeastern shore of Lake Vanda, Wright Valley, below Mount Jason, at an elevation between 104 m and 235 m: 77° 31.09′ S, 161° 38.77′ E

Argo Gully: K. Pettway, USAP (31 Jan 2011)

Purpose

To avoid damage to exposed stratified marine fossiliferous deposits within the gully, which are of high scientific value.

Description

Zone area: 4800 m^2

Part of the lower reach of a prominent stream channel in Argo Gully, below Mount Jason (1920 m), Olympus Range (Map 19), contains exposed beds (up to 2.8 meters thick) of massive glacial silts containing abundant marine diatom and silicoflagellate material overlying sediment. Pecten shell fragments have reportedly been found in the upper few centimeters of the deposit. The beds are horizontally stratified, which is in contrast to the underlying sediments. The deposits are overlain by deltaic sands, silts and gravels, deposited by the stream in Argo Gully. The deposits are indicative that the Wright Valley was formerly a shallow marine fjord, and have been dated as Middle Miocene. The full extent of the deposits below the overlying sediment is unknown, and the intermittent exposures along the channel change over time as a result of natural erosion.

Boundaries

The Restricted Zone extends from the first prominent raised beach (elevation 104 m) above, and ~140 meters from, the shore of Lake Vanda, for 175 meters up the stream channel to an elevation of ~135 m. The zone extends 25 meters either side of the stream channel (Map 19).

Impacts

Known Impacts

None.

Potential Impacts

- The deposit is within the permafrost but the surface continually slumps when the permafrost melts. The surface of the deposit if friable when touched.

Access requirements

Helicopter Access

Helicopters should land at the designated site at Lake Vanda Hut Facilities Zone ~1.2 km to the east at: 77° 31.361′ S, 161° 41.442′ E.

Surface Access

Access to and movement within the Restricted Zone should be on foot.

Special site guidance

- Avoid walking on the edges of the gully or above the exposed outcrops.
- Minimize disturbance to the sediments surrounding the deposits.
- Avoid touching the exposed outcrops unless conducting scientific research.

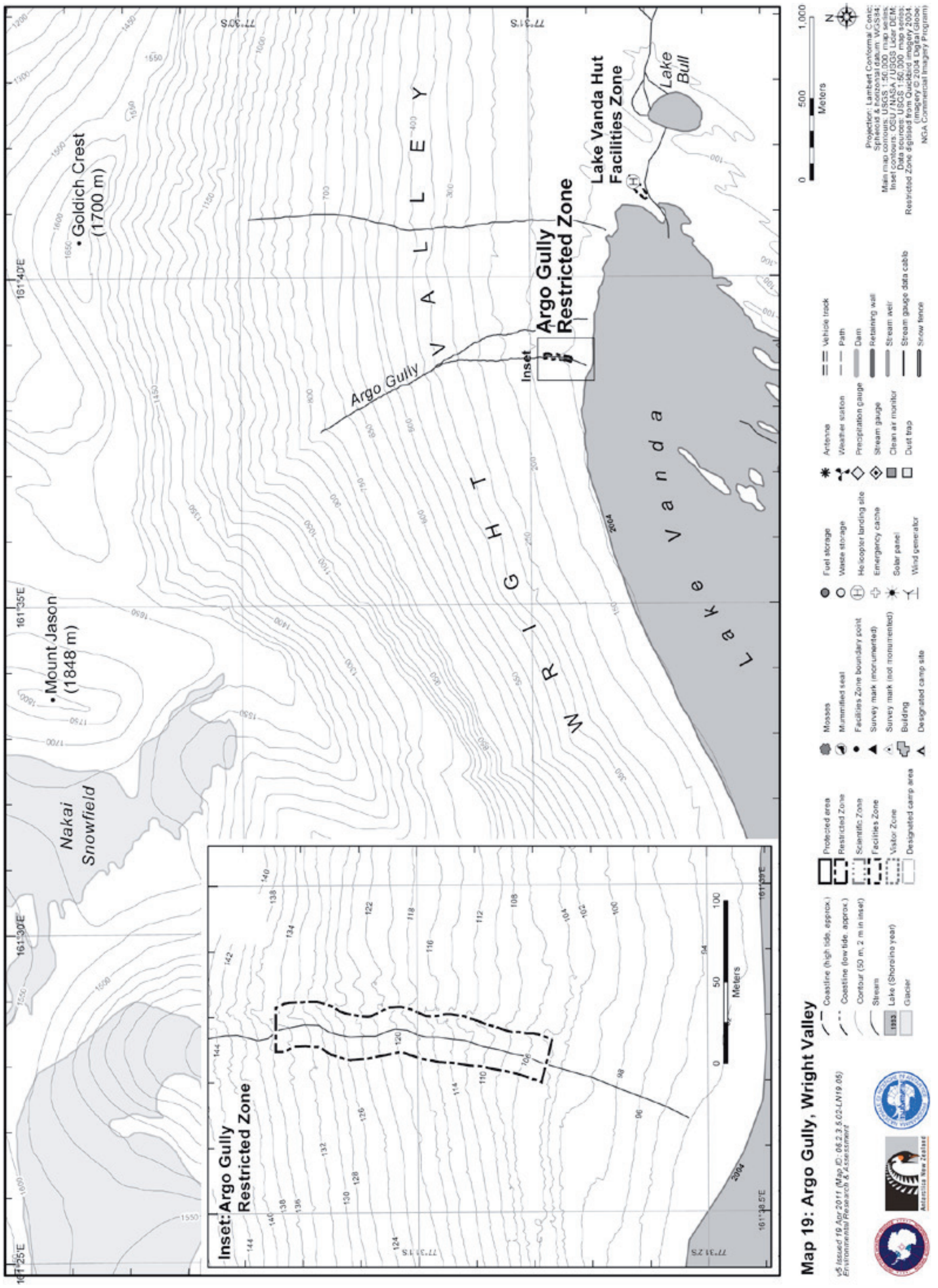
Key references

Brady, H.T. 1980. Palaeoenvironmental and biostratigraphic studies in the McMurdo and Ross Sea regions, Antarctica. Unpublished PhD thesis, Macquarie University, Australia.

Brady, H.T. 1979. A diatom report on DVDP cores 3, 4a, 12, 14, 15 and other related surface sections. In: Nagatta, T. (Ed) Proceedings of the Seminar III on Dry Valley Drilling Project, 1978. Memoirs of National Institute of Polar Research, Special Issue 13: 165-75.

Site Map

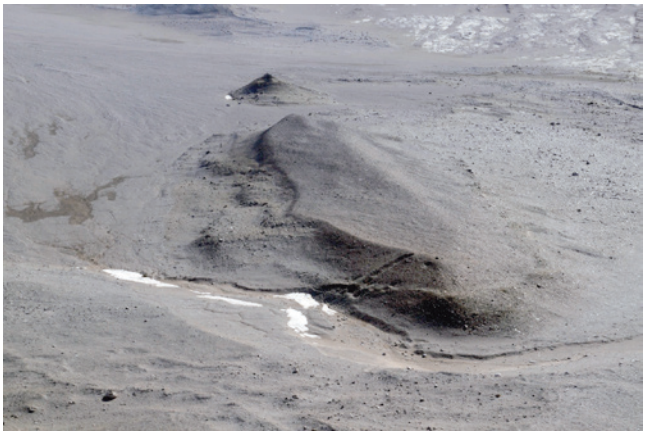
Map 19.


Map 19: Argo Gully, Wright Valley
Goldich Crest (1700 m)
Mount Jason (1848 m)
Nakai Snowfield
Argo Gully
Argo Gully Restricted Zone
Lake Vanda Hut Facilities Zone
Lake Bull
Lake Vanda
WRIGHT VALLEY
Inset
Inset: Argo Gully Restricted Zone
Meters

Restricted Zone: Prospect Mesa

Location

Below Bull Pass ~250 m north of the Onyx River, Wright Valley: 77° 31.33' S; 161° 54.58' E



Prospect Mesa: C. Harris, ERA / USAP (15 Dec 2009)

Purpose

To avoid damage to a fragile deposit of fossilized extinct marine pecten (scallop) shells of a single species.

Description

Zone area: 4.76 ha

Prospect Mesa is a deposit of fossiliferous gravels overlying till containing a high density of well-preserved extinct marine pecten (scallop) shells of a single species, Chlamys (Zygochlamys) tuftsensi, of the Family Pectinidae. This is the only known site where this species is found. A stratified layer of sand and gravel overlying till is exposed in a gully cut by a stream flowing from Bull Pass a few hundred meters from its junction with the Onyx River (Map 20). The precise age of the deposit is unknown, although the presence of articulated shells, the abundance of complete shells, the lack of abrasion, the similarity of internal and external matrix, the lack of good size segregation and a generally very poor sorting of the clasts suggest that the fossils were deposited in situ in a marine fjord. Sponge spicules, radiolarian and a few ostracod fragments are also present but foraminifera are the most abundant and diverse microfossil group present.

Boundaries

The Restricted Zone boundary is defined around two adjacent mesa features, the smaller of the two being ~100 m north of the main feature. The boundary follows the well-defined NE bank of the stream descending from Bull Pass in the SW of the zone, and then follows around the base of the slopes that define the two features (Map 20).

Impacts

Known Impacts

- An excavation from early research exists on the southwest slope of the mesa (see photo), which is marked by a pole at the base.

Potential Impacts

- Isolation of unbroken pecten fragments is extremely difficult. Disturbance or damage to
- the sediments may cause damage to the fossils.

Access requirements

Helicopter Access

Helicopters should not land within the Restricted Zone. Use the designated helicopter landing site at Bull Pass Hut Facility Zone: 77° 31.056'S, 161° 51.048'E

Surface Access

Access to and movement within the Restricted Zone should be on foot.

Special site guidance

- Avoid walking on top of the mesa.
- Pedestrians should walk carefully to minimize disturbance to fragile sedimentary structures, deposits and slopes.
- Camping is not permitted within the Restricted Zone.

Key references

Turner, R.D. 1967. A new species of fossil Chlamys from Wright Valley, McMurdo Sound, Antarctica. New Zealand Journal of Geology and Geophysics 10: 446-55.

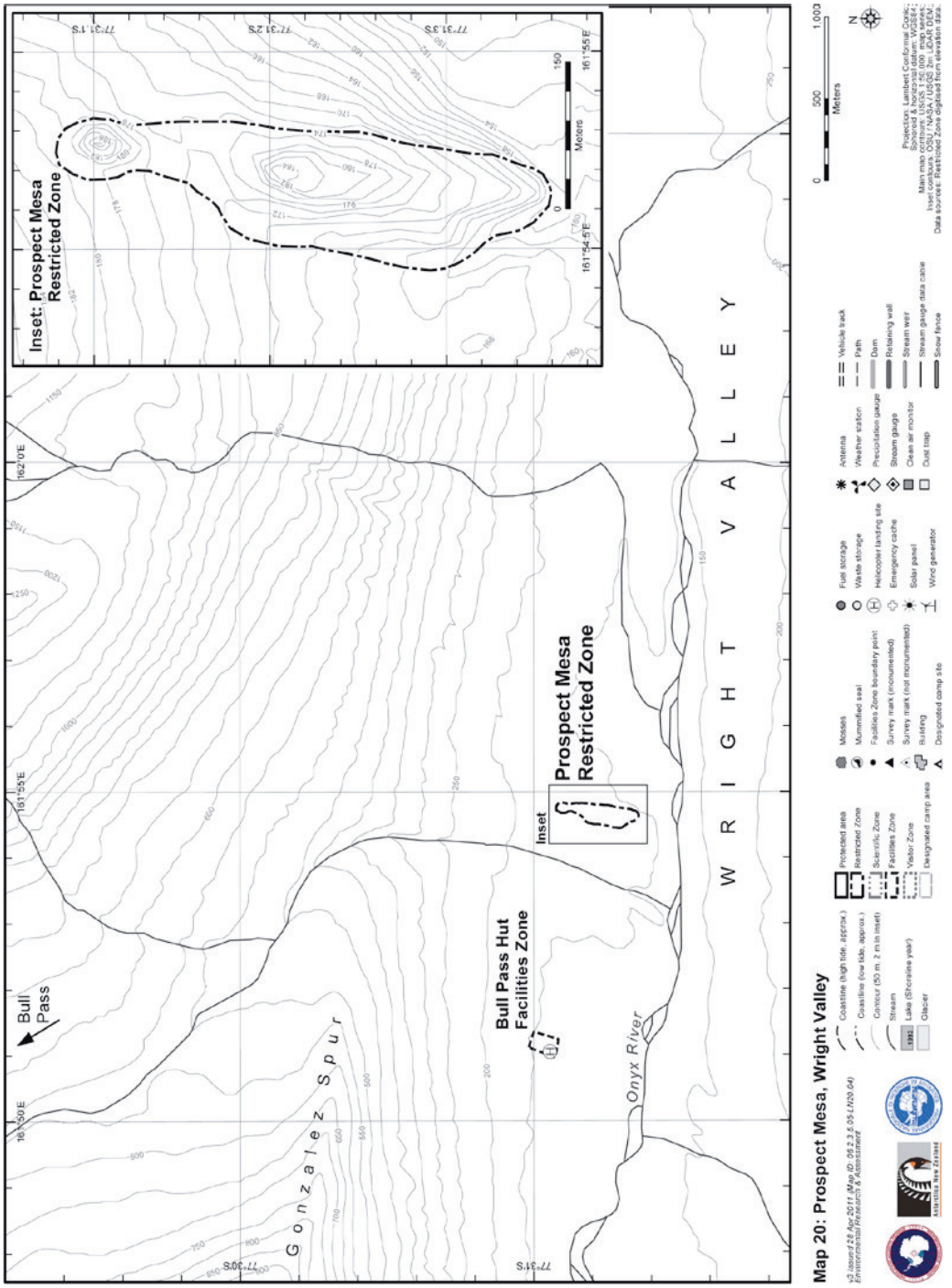
Vucetich, C.G. & Topping, W.W. 1972. A fjord origin for the pecten deposits, Wright Valley, Antarctica. New Zealand Journal of Geology and Geophysics 15(4): 660-73.

Webb, P.N. 1972. Wright fjord, Pliocene marine invasion of an Antarctic Dry Valley. Antarctic Journal of the United States 7: 227-34.

Prentice, M.L., Bockheim, J.G., Wilson, S.C., Burckle, L.H., Jodell, D.A., Schluchter, C. & Kellogg, D.E. 1993. Late Neogene Antarctic glacial history: evidence from central Wright Valley. Antarctic Research Series 60: 207-50.

Site Map

Map 20


Map 20: Prospect Mesa, Wright Valley
Inset: Prospect Mesa Restricted Zone
Prospect Mesa Restricted Zone
Bull Pass Hut Facilities Zone
Bull Pass
Onyx River
Gonzalez Spur
W R I G H T V A L L E Y
Inset
Meters
0
500
1,000
N

Restricted Zone: Hart Ash Deposit

Location

On a relatively featureless slope between the Goodspeed and Hart Glaciers, Wright Valley, at an elevation of ~400 m: 77° 29.76′ S, 162° 22.35′ E

Purpose

To avoid damage to an in situ deposit of volcanic ash airfall tephra that is of high scientific value.

Description

Zone area: 1.8 ha

The Hart Ash deposit is an in situ preserved deposit of volcanic ash airfall tephra protected by a surface layer of gravel. The surface gravel protecting the ash layer has a wide spatial extent and the Hart Ash is not immediately visible unless the surface gravel is removed, making field identification difficult. The full extent of the Hart Ash deposit is thus unknown, although its maximum extent has been estimated as ~100 x 100 m (Map 21). The Hart Ash deposit, dated 3.9 ± 0.3 million years old, is of high scientific importance for interpreting the paleoclimate of the McMurdo Dry Valleys.

Hart Ash deposit: J. Aislabie Antarctica NZ Pictorial Collection (2005)

Boundaries

Owing to a lack of prominent surface landmarks, the boundary of the Restricted Zone is defined as an area of 150 m x 120 m following lines of latitude and longitude (Map 21) extending from the coordinates: Upper Left: 77°29.72′ S, 162°22.2′ E; Lower Right: 77°29.8′ S, 162° 22.5′ E

Impacts

Known Impacts

None.

Potential Impacts

- The deposit is covered by a thin gravel desert pavement which is easily disturbed by walking. Wind erosion of the ash deposits would be rapid if the desert pavement is disturbed.

Access requirements

Helicopter Access

Helicopters should avoid landings and overflight below 50 m above ground level within the

Restricted Zone. Helicopter landings should be made at least 100 m from the boundary.

Surface Access

Access to and movement within the Restricted Zone should be on foot.

Special site guidance

- Avoid walking on the desert pavement overlying the ash deposits unless necessary for essential scientific or management purposes, and then walk carefully to minimize disturbance.
- Should the desert pavement be removed for essential scientific purposes, ensure the material is replaced to protect the feature.
- Camping is not permitted within the Restricted Zone.

Key references

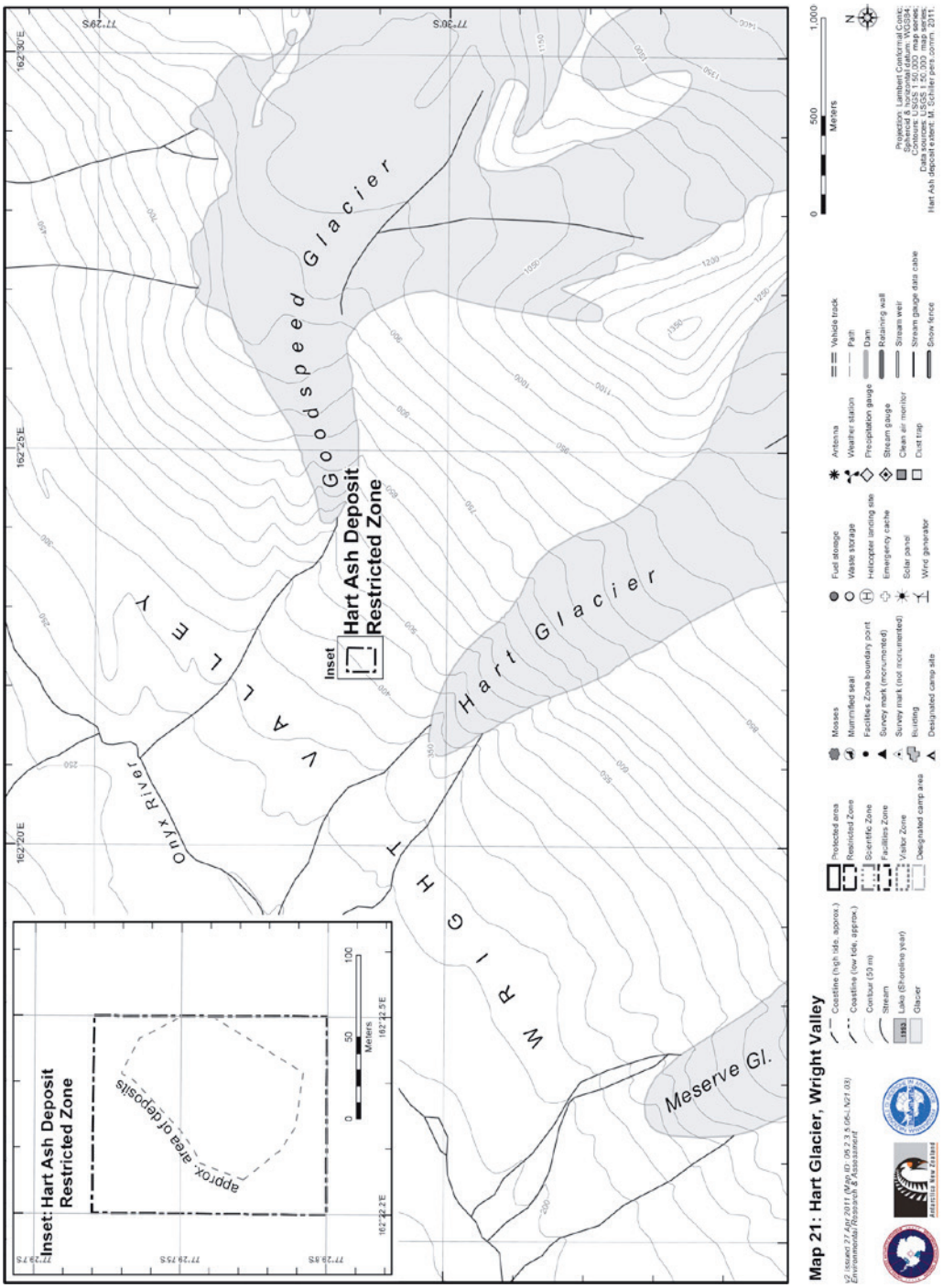
Hall, B.L., Denton, G.H., Lux, D.R. & Bockheim, J. 1993. Late tertiary Antarctic paleoclimate and ice-sheet dynamicsinferred from surficial deposits in Wright Valley. Geografiska Annaler 75A(4): 239-67.

Morgan, D.J., Putkonen, J., Balco, G. & Stone, J. 2008. Colluvium erosion rates in the McMurdo Dry Valleys, Antarctica. Proceedings of the American Geophysical Union, Fall Meeting, 2008.

Schiller, M., Dickinson, W., Ditchburn, R.G., Graham, I.J. & Zondervan, A. 2009. Atmospheric 10Be in an Antarctic soil: implications for climate change. Journal of Geophysical Research 114, F01033.

Site Map

Map 21


Map 21: Hart Glacier, Wright Valley
Inset: Hart Ash Deposit Restricted Zone
approx. area of deposits
Inset
Hart Ash Deposit Restricted Zone
Goodspeed Glacier
Onyx River
Wright Valley
Hart Glacier
Meserve Gl.
Meters
Projection: Lambert Conformal Conic; Datum: WGS 1984
Contours: USGS 1:50,000 map series.
Data sources: USGS 1:50,000 map series.
Hart Ash deposit extent: M. Schiller pers comm. 2011.

Restricted Zone: Victoria Valley Sand Dunes

Location

In two main groups between Lake Vida and Victoria Lower Glacier, ~ 1 km south from the Packard Glacier terminus, Victoria Valley: 77° 22.19' S, 162° 12.45' E

Victoria Valley sand dunes (eastern group below Packard Glacier) H. McGowan, Antarctica NZ Pictorial Collection (Dec 2004).

Purpose

To avoid damage to the sand dune system, which is fragile and of high scientific value.

Description

Zone area: 3.16 km²

The extensive Victoria Valley sand dune system is comprised of two distinctive areas made up of crescent-, transverse- and whaleback-shaped dunes and numerous sand mounds (Map 22). The largest group of dunes in the west extends over ~6 km and ranges between 200 to 800 m wide, with a total area of ~1.9 km^2. The smaller group of dunes in the east, which is bisected by Packard Stream and bounded to the south by Kite Stream, extends over ~3 km and ranges between 300 to 600 m wide with a total area of ~1.3 km^2. The source of sediment is from the surface and margins of the Victoria Lower Glacier and from ground moraine, which are transported west toward Lake Vida by the dominant easterly wind and meltwater streams. It is the only area where major eolian sand depositional forms occur in Antarctica. The dunes differ from the usual desert and coastal formations because the sand in the dunes is interbedded with compacted snow and contains permafrost.

Boundaries

The Restricted Zone boundary is defined by the outer extent of the main sand dune system in Victoria Valley, which extends in two groups for a distance of ~9 km with a width from varying from 200 to 800 m (Map 22).

Impacts

Known Impacts

None

Potential Impacts

- A thin surface layer of the sand dunes is mobile and dynamic. Damage or disruption to the
- internal permafrost of the dunes, can affect the integrity of the sand dune structure.

Access requirements

Helicopter Access

Helicopters should avoid landing within the Restricted Zone and avoid overflight below 50 m above ground level.

Surface Access

Access to and movement within the Restricted Zone should be on foot.

Special site guidance

- Avoid walking through the dunes unless necessary for scientific or management purposes.
- Walk carefully to minimize disturbance to the sensitive dune surfaces and slopes. Avoid disturbing the internal permafrost and structure of the sand dunes.
- Camping is not permitted within the Restricted Zone.

Key references

Lindsay, J.F. 1973. Reversing barchans dunes in Lower Victoria Valley, Antarctica. Geological Society of America Bulletin 84: 1799-1806.

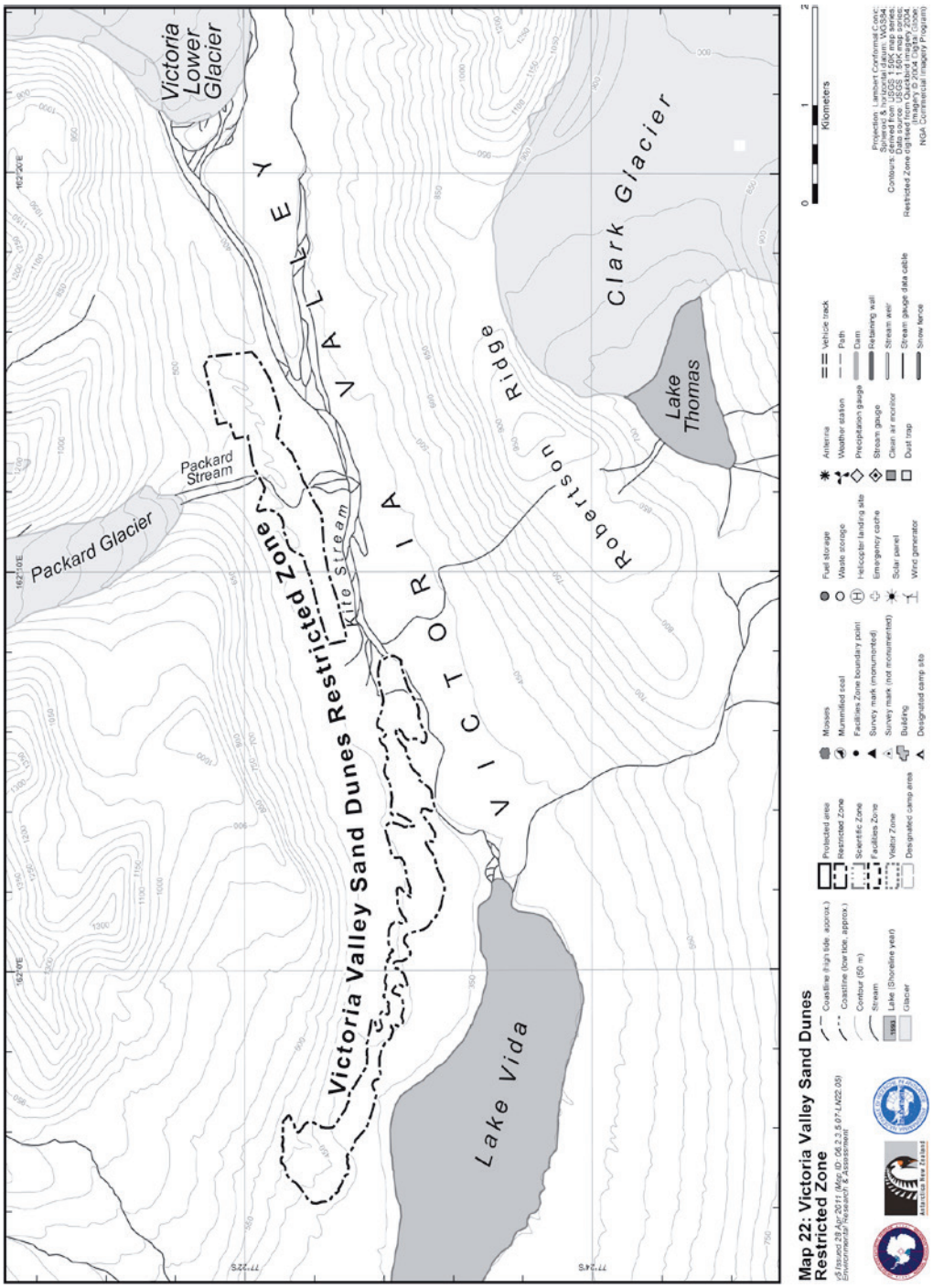
Calkin, P.E. & Rutford, R.H. 1974. The sand dunes of Victoria Valley, Antarctica. The Geographical Review 64(2): 189- 216.

Selby, M.J., Rains, R.B. & Palmer, R.W.P. 1974. Eolian deposits of the ice-free Victoria Valley, Southern Victoria Land, Antarctica. New Zealand Journal of Geology and Geophysics 17(3): 543-62.

Speirs, H.C., McGowan, J.A. & Neil, D.T. 2008. Meteorological controls on sand transport and dune morphology in a polar-desert: Victoria Valley, Antarctica. Earth Surface Processes and Landforms 33: 1875-91.

Site Map

Map 22



Restricted Zone: Battleship Promontory

Location

Southwest Alatna Valley, Convoy Range, ~1 km west of Benson Glacier: 76° 55.17′ S, 161° 02.77′ E

a) Aerial from Alatna Valley. b) from Cargo Pond. C. Harris, ERA / USAP (16 Dec 2009)

Purpose

To avoid damage to the fragile sandstone rock formations that host microbial communities, and to ensure aesthetic and wilderness values of the site are maintained.

Description

Zone area: 4.31 km²

Battleship Promontory is an area of dramatic Beacon Sandstone outcrops rising from the southwestern floor of Alatna Valley, near Cargo Pond (Map 23). The cliff formation is ~5 km in length, and extends over an area of between 0.4 – 1.2 km in width. The promontory stands ~300 m in height at an elevation of between ~900-1200 m in the west and ~1050- 1350 m in the east. The russet and white sandstone outcrops are deeply weathered into striking spires, ledges and eroded gully formations, into which dark boulders and sediments have accumulated from the overlying dolerite as it weathers from above. The environment hosts rich microbial communities, including lichens, cyanobacteria, non-photosynthetic bacteria, and fungi, with the highest microbial biodiversity yet recorded in the Dry Valleys. Cryptoendolithic microbial communities live in pore spaces within the sandstone rock, and comprise lichens and cyanobacteria growing to depths of up to 10 mm beneath the surface. These communities are extremely slow-growing, and the rocks in which they live are susceptible to breakage.

Boundaries

The Restricted Zone boundaries encompass the main area of sandstone outcrops at Battleship Promontory, extending from and including several small lakes present the foot of the formation, to its maximum upper extent (Map 23).

Impacts

Known Impacts

- Small instruments have previously been installed in rocks for in situ measurements, and a small quantity of rock samples collected. The designated helicopter landing site is marked by cloth flags weighed down by rocks, some of which were selected to ensure they were not used by subsequent scientists because they were modified by an early experiment (E. Friedmann, pers. comm. 1994). Air safety smoke canisters have been released at the site, causing localized contamination, a practice discontinued in the 1990s.

Potential Impacts

- Breakage of fragile rock formations, over-sampling, introduction of non-native species.

Access requirements

Helicopter Access

Helicopters should land at the designated site at: 76o 55.35′ S, 161o 04.80′ E (1296 m). If access is required to the base of the cliffs, or parts of the zone that are impractical to reach on foot, helicopters should avoid landing on sandstone surfaces or on lakes / ponds.

Surface Access

Movement within the Restricted Zone should be on foot.

Special site guidance

- Walk carefully to minimize disturbance, avoid moving rocks and boulders, and do not break the fragile sandstone rock formations.
- Camping within the Restricted Zone should be at the site previously used, which is adjacent to the designated helicopter landing site at 76o 55.31′ S, 161o 04.80′ E (1294 m).

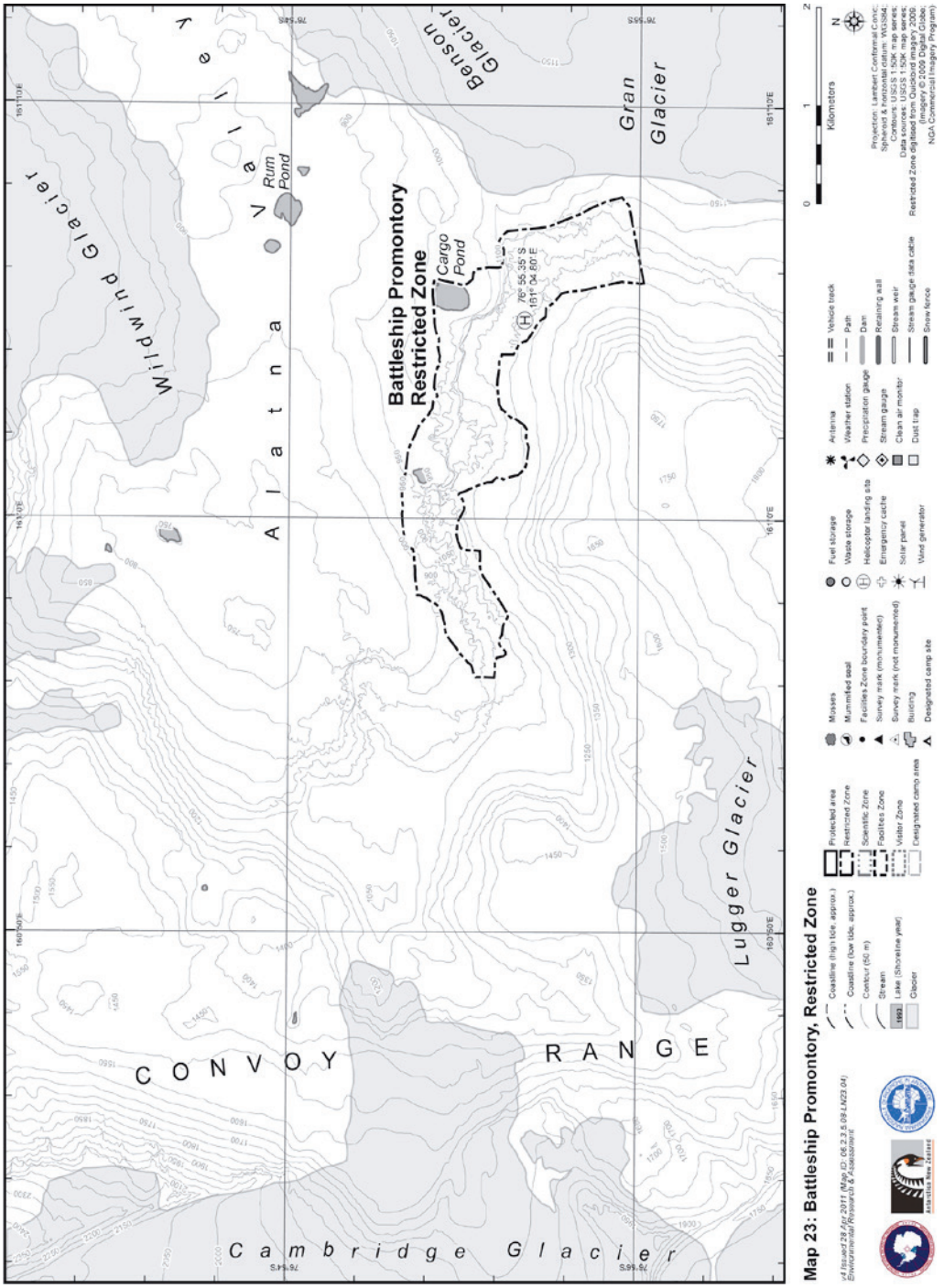
Key references

Friedmann, E.I., Hua, M.S., Ocampo-Friedmann, R. 1988. Cryptoendolithic lichen and cyanobacterial communities of the Ross Desert, Antarctica. Polarforschung 58: 251-59.

Johnston, C.G. & Vestal, J.R. 1991. Photosynthetic carbon incorporation and turnover in Antarctic cryptoendolithic microbial communities: are they the slowest-growing communities on Earth? Applied & Environmental Microbiology 57(8): 2308-11.

Site Map

Map 23


Map 23: Battleship Promontory, Restricted Zone
Battleship Promontory
Restricted Zone
Cargo Pond
Rum Pond
Wildwind Glacier
Benson Glacier
Gran Glacier
Lugger Glacier
Cambridge Glacier
CONVOY
RANGE
Alatna Valley
76° 55.35' S
151° 04.60' E
Kilometers
Projection: Lambert Conformal Conic
Spheroid & horizontal datum: WGS84
Contours: USGS 1:50K map series
Data sources: USGS, this project
Restricted Zone digitized from QuickBird imagery 2009
(Imagery © 2009 DigitalGlobe,
NGA Commercial Imagery Program)

APPENDIX F: Guidelines for Visitor Zones

The following site within the Area is designated a Visitor Zone:

- Taylor Valley

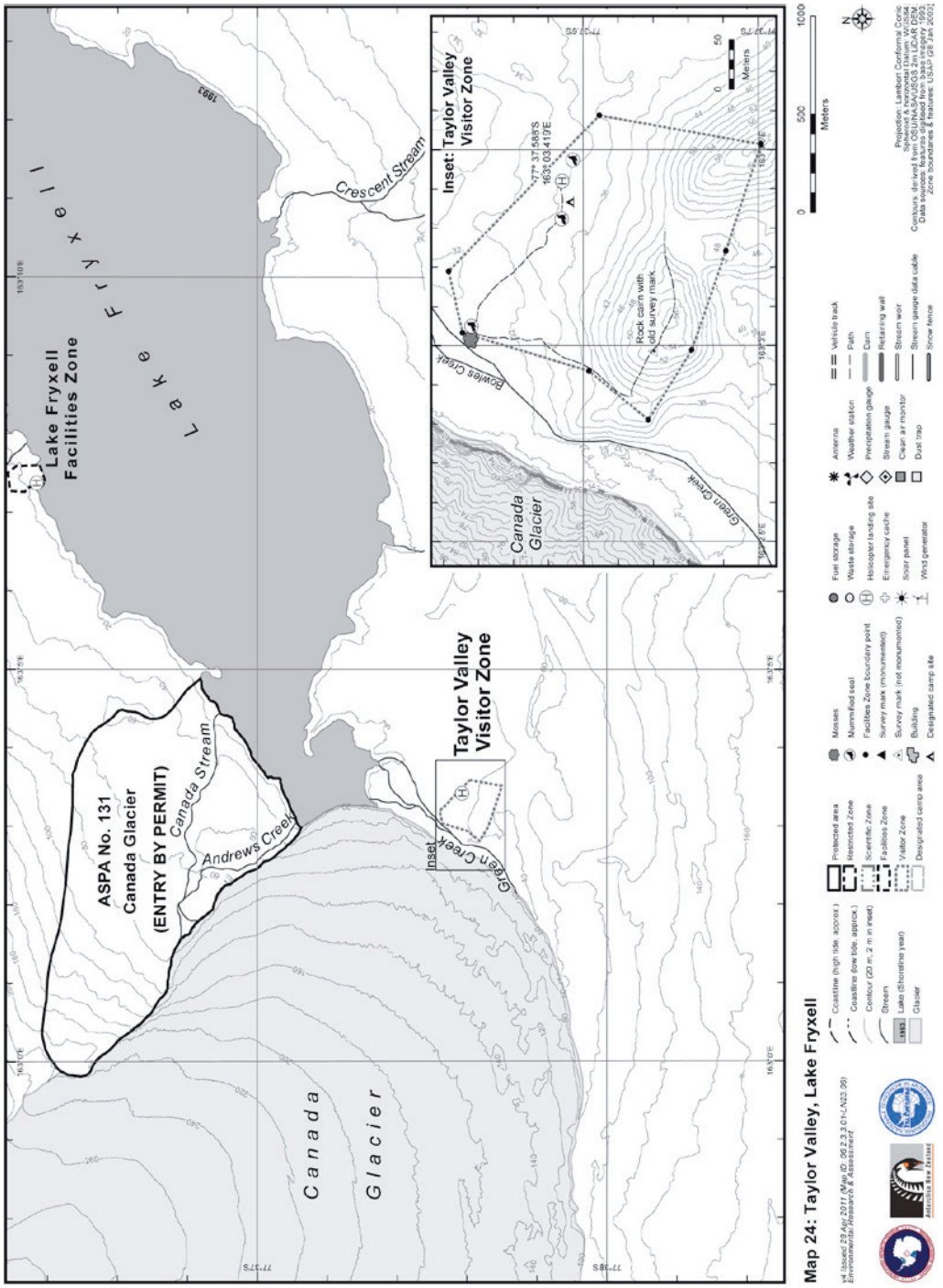
The Visitor Zone is located in the lower Taylor Valley near Canada Glacier. The location, boundaries, helicopter landing site, and features at the Visitor Zone are shown in Map 24.

The boundary of the Visitor Zone is defined as follows: proceeding in a clockwise direction from the northern limit of the zone on a low hill at 77° 37.523′ S, 163° 03.189′ E, the boundary extends 225 m southeast, past the designated helicopter landing site, to a point in moraine soils at 77° 37.609′ S, 163° 03.585′ E, thence extends 175 m southward ascending the summit of a small hill (elevation 60 m) at 77° 37.702′ S, 163° 03.512′ E. From this small hill, the boundary extends northwest 305 m towards and beyond a second small hill (summit elevation 56 m, marked nearby with a rock cairn and old survey marker), following a line ~30 m south of the main ridge joining the two hills, directly to a point on the western ridge of this second small hill at 77° 37.637′ S, 163° 02.808′ E. From this ridge, the boundary extends northeast 80 m directly to the western face of a prominent boulder located at 77° 37.603′ S, 163° 02.933′ E, which is ~70 m northwest from the cairn on the hill. The boundary thence extends northeast 130 m, descending parallel with the designated walking track (which follows a low moraine ridge) to a point near Bowles Creek at 77° 37.531′ S, 163° 03.031′ E. A mummified (dessicated seal) is located here, adjacent to a small area of mosses. The boundary thence extends eastward 65 m to return to the northern limit of the zone at 77° 37.523′ S, 163° 03.189′ E.

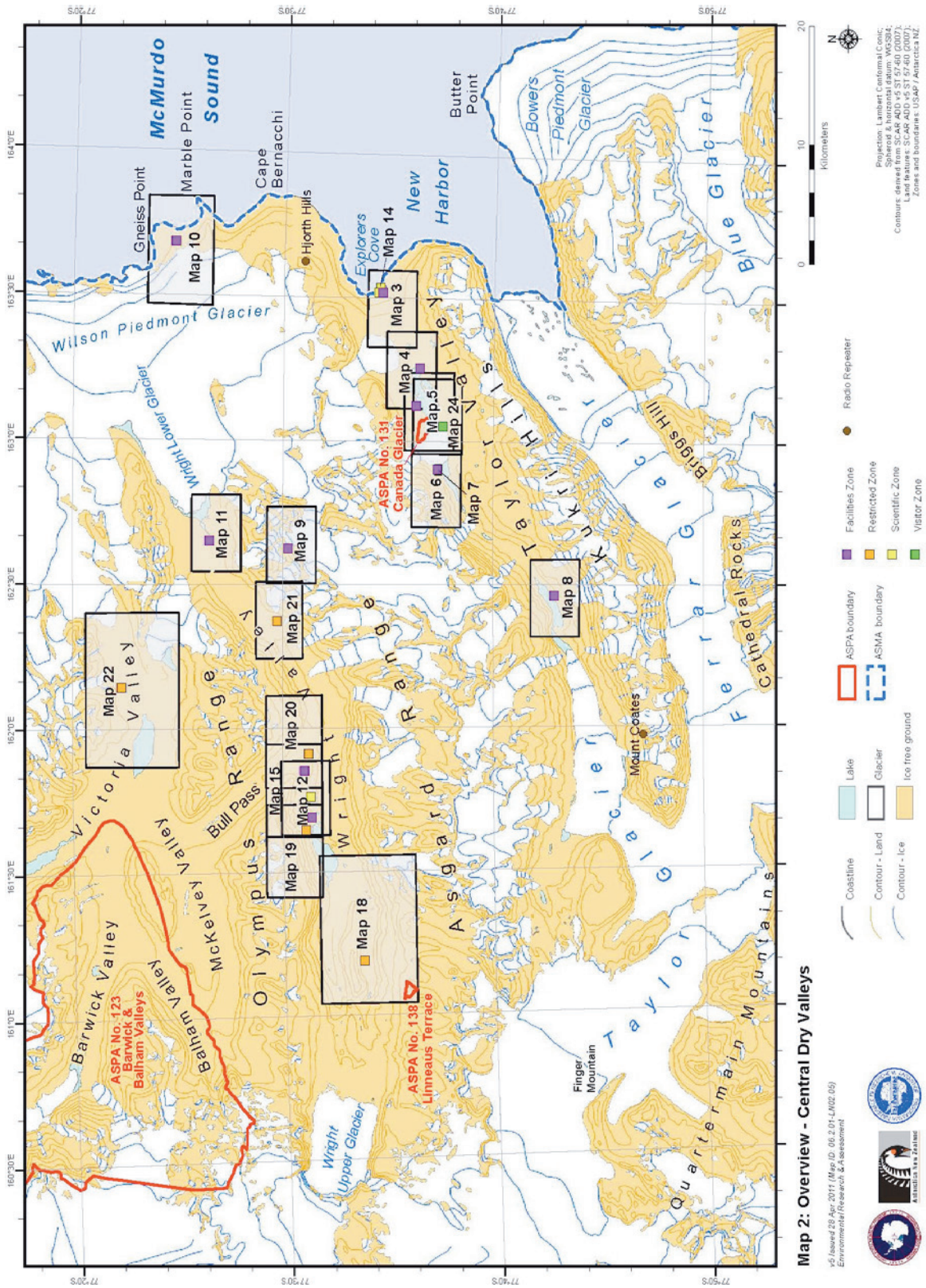
Special guidelines for activities within the Visitor Zone include that:

- Tour operators should ensure that all visitors to the Visitor Zone for which they are responsible have clean boots and equipment before visiting the site;
- Tour expedition helicopter landings should be made at the designated landing site at 77° 37.588′ S, 163° 03.419′ E (elevation 34 m);
- Tour operators should ensure that foot tracks within the Visitor Zone are clearly marked and that visitors stay on those routes. Markers used to mark tourist routes and sites of interest should be installed securely and removed at the end of each visit;
- Tents should only be erected at the designated tent site for health and safety reasons, and tour groups should not camp in the Visitor Zone except for reasons of safety;
- Tourist movement within the Visitor Zone should be conducted in small, guided groups;
- Stream and pond beds should be avoided; and
- Activities planned for and conducted within the Visitor Zone should be in accordance with ATCM Recommendation XVIII-1.

Further site-specific guidelines for the conduct of activities within the Visitor Zone are attached as the Antarctic Treaty Visitor Site Guide: Taylor Valley, Southern Victoria Land, Ross Sea (submitted as ATCM XXXIV WPXX).


Lake Fryxell
Facilities Zone
Lake Fryxell
Crescent Stream
Taylor Valley
Visitor Zone
ASPA No. 131
Canada Glacier
(ENTRY BY PERMIT)
Canada Stream
Andrews Creek
Green Creek
Canada
Glacier
Inset: Taylor Valley
Visitor Zone
Bowles Creek
Rock cairn with
old survey mark
77° 37.585'S
163° 03.419'E
Meters
Map 24: Taylor Valley, Lake Fryxell


159°0'E
160°0'E
161°0'E
162°0'E
163°0'E
164°0'E
165°0'E
76°30'S
77°0'S
77°30'S
78°0'S
Battlements Nunatak (2128 m)
Mt. Douglas (1750m)
Mt. Endeavour (1870m)
Fry Glacier
Tripp Island
ROSS SEA
Allan Hills
Odell Glacier
Convoy Range
Flagship Mtn. (1720 m)
Mt. Davidson (1560 m)
Mt. Whitcombe (1426 m)
Coombs Hills
Mt. Brooke (2675 m)
Cambridge Glacier
Benson Glacier
Cape Archer
Granite Harbor
Carapace Nunatak (2321 m)
Map 23
Mt. Gran (2233 m)
Geteway Nunatak
Mackay Glacier
ASPA No.154
Cape Roberts
Map 13
McMurdo Sound
Clare Range
Wilson Piedmont Glacier
Skew Peak (2534 m)
St Johns Range
Mt. DeWitt (2190 m)
Dunlop Island
Mt. Bastion (2530 m)
Barwick Valley
ASPA No. 123
Balham Valley
McKelvey Valley
Victoria Valley
Spike Cape
Map 2
Gneiss Point
Marble Point
Olympus Range
Wright Valley
Mt. Newall (1920 m)
Cape Bernacchi
Horseshoe Mountain
ASPA No. 138
ASPA No. 131
New Harbor
Round Mtn. (2308 m)
Asgard Range
Butter Point
Taylor Valley
Depot Nunatak (1980 m)
Taylor Glacier
Kukri Hills
Bettle Peak (1490 m)
Ferrar Glacier
Mt. Koger (2450 m)
Map 17
Quartermain Mountains
Mt. Crean (2550 m)
Mt. Feather (2985 m)
Table Mtn. (2170 m)
Mt. Kowalczyk (1690 m)
Cape Chocolate
Mt. Wisneski (2320 m)
Royal Society Range
Blue Glacier
The Portal
Mt. Lister (4025 m)
DeMaster Point
Portal Mtn. (2556 m)
Brown Peninsula
Skelton Névé
Map 16
Heald Island
Koettlitz Glacier
Mt. Metschel (1843 m)
Névé Nunatak
Mt. Kempe (3004 m)
The Pyramid (854 m)
Halfway Nunatak
Shark Fin (2242 m)
Mt. Discovery (2681 m)
Highway Ridge
0 10 20
Kilometers
N
Map 1: Overview
ASMA No. 2 McMurdo Dry Valleys: boundary & zones
v8 Issued 28 Apr 2011 (Map ID: 06.2.01-LN01.08)
Environmental Research & Assessment
Coastline
Lake
Glacier
Ice free ground
Mountain peak
ASMA boundary point
ASMA boundary
ASPA boundary
Facilities Zone
Restricted Zone
Scientific Zone
Visitor Zone
Projection: Lambert Conformal Conic
Spheroid & horizontal datum: WGS84
Contours: derived from SCAR ADD v5 ST 57-60 (2007)
Land features: SCAR ADD v5 ST 57-60 (2007)
Boundaries & zones: USAP / Antarctica NZ


Map 2: Overview - Central Dry Valleys
v5 Issued 28 Apr 2011 (Map ID: 05.2.01-LM02.05)
Environmental Research & Assessment
McMurdo Sound
New Harbor
Marble Point
Gneiss Point
Cape Bernacchi
Butter Point
Hjorth Hills
Explorers Cove
Bowers Piedmont Glacier
Blue Glacier
Wilson Piedmont Glacier
Wright Lower Glacier
Victoria Valley
Barwick Valley
Balham Valley
McKelvey Valley
Bull Pass
Olympus Range
Wright Valley
Asgard Range
Taylor Valley
Hjorth Hills
Ferrar Glacier
Cathedral Rocks
Briggs Hill
Mount Coates
Finger Mountain
Taylor Glacier
Quartermain Mountains
Wright Upper Glacier
ASPA No. 123 Barwick & Balham Valleys
ASPA No. 131 Canada Glacier
ASPA No. 138 Linnaeus Terrace
Map 3
Map 4
Map 5
Map 6
Map 7
Map 8
Map 9
Map 10
Map 11
Map 12
Map 14
Map 15
Map 18
Map 19
Map 20
Map 21
Map 22
Map 24
Coastline
Lake
Contour - Land
Glacier
Contour - Ice
Ice free ground
ASPA boundary
ASMA boundary
Radio Repeater
Facilities Zone
Restricted Zone
Scientific Zone
Visitor Zone
Kilometers
N