ANTARCTIC TREATY
AUSTRALIAN OBSERVER TEAM 2005
Scott Base and McMurdo Station

Report of an Inspection under Article VII of the Antarctic Treaty and Article 14 of the Protocol on Environmental Protection
JUNE 2005

Australian Government
Department of Foreign Affairs and Trade
Department of the Environment and Heritage

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SCOTT BASE and McMURDO STATION

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## Photography

<table>
<thead>
<tr>
<th>Photograph</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Building 63, the oldest building at McMurdo Station</td>
</tr>
<tr>
<td>2</td>
<td>Inside Scott’s Hut, Hut Point (HSM 18)</td>
</tr>
<tr>
<td>3</td>
<td>Waste separation at source, McMurdo Station</td>
</tr>
<tr>
<td>4</td>
<td>Presentation to Julian Tangaere, Scott Base Manager</td>
</tr>
<tr>
<td>5</td>
<td>Tourists landing on Ross Island, 25 January 2005</td>
</tr>
<tr>
<td>6</td>
<td>Footings of the new Hillary Field Centre, Scott Base</td>
</tr>
<tr>
<td>7</td>
<td>Overview of McMurdo Station, from Observation Hill</td>
</tr>
<tr>
<td>8</td>
<td>Mt Erebus dominates the view from Ross Island</td>
</tr>
<tr>
<td>9</td>
<td>Tourists at Scott Base, 25 January 2005</td>
</tr>
<tr>
<td>10</td>
<td>Double-walled diesel fuel tank and bunded vehicle fuelling point, Scott Base</td>
</tr>
<tr>
<td>11</td>
<td>Earth-bermed containment for fuel storage at McMurdo Station</td>
</tr>
<tr>
<td>12</td>
<td>RV Nathaniel B Palmer at the ice wharf, McMurdo Station</td>
</tr>
<tr>
<td>13</td>
<td>Crary Scientific Laboratory, McMurdo Station</td>
</tr>
<tr>
<td>14</td>
<td>Waste-water treatment plant, McMurdo Station</td>
</tr>
<tr>
<td>15</td>
<td>“Hut A” (HSM75) the oldest building at Scott Base</td>
</tr>
<tr>
<td>16</td>
<td>Double-walled diesel fuel day tank, McMurdo Station</td>
</tr>
<tr>
<td>17</td>
<td>Passenger transfer bus at Pegasus airfield, Ross Ice Shelf</td>
</tr>
<tr>
<td>18</td>
<td>Trailer-mounted petrol tank, parked on concrete containment, Scott Base</td>
</tr>
<tr>
<td>19</td>
<td>Overview of Scott Base, from Observation Hill (©C. O’Connell, DEH)</td>
</tr>
<tr>
<td>20</td>
<td>Day tank and drip tray on field camp facility, Scott Base</td>
</tr>
<tr>
<td>21</td>
<td>Part of the aircraft support facilities, Williams Field, Ross Ice Shelf</td>
</tr>
<tr>
<td>22</td>
<td>Waste-water treatment plant, Scott Base (©C. O’Connell, DEH)</td>
</tr>
<tr>
<td>23</td>
<td>Over-snow vehicle for US proof-of-concept traverse to South Pole</td>
</tr>
</tbody>
</table>

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REPORT OF AN INSPECTION UNDER ARTICLE VII OF THE ANTARCTIC TREATY
AND ARTICLE 14 OF THE PROTOCOL ON ENVIRONMENTAL PROTECTION

1. Introduction

2. Overview
   2.1 Conduct of the inspections
   2.2 Summary of observations

3. Scott Base (New Zealand)
   3.1 General information
   3.2 Observations - Antarctic Treaty
   3.3 Observations - Environmental Protocol
   3.4 Other observations

4. McMurdo Station (United States of America)
   4.1 General information
   4.2 Observations - Antarctic Treaty
   4.3 Observations - Environmental Protocol
   4.4 Other observations

5. Operations on the Ross Ice Shelf (United States and New Zealand)

6. RV Nathanial B Palmer (United States)

7. Protected areas on Ross Island
   7.1 Antarctic Specially Protected Area 122
   7.2 Antarctic Specially Protected Area 158
   7.3 Historic Sites and Monuments

8. Tourist activities on Ross Island

9. Acknowledgments

10. Appendixes
1. INTRODUCTION

Article VII of the Antarctic Treaty provides that each Consultative Party has the right to designate observers to undertake inspections in Antarctica. Observers have complete freedom of access at any time to any and all areas of Antarctica. Parties are obliged to have all areas of Antarctica, including stations, installations and equipment, open at all times to inspection by designated observers. This also applies to all ships and aircraft at points of discharging or embarking cargoes or personnel in Antarctica. The provision for inspection is a key element of the Treaty and is designed to promote the objectives of the Treaty and ensure observance of its provisions.

Article 14 of the Protocol on Environmental Protection to the Antarctic Treaty (the Protocol) also provides for the conduct of inspections, consistent with Article VII of the Treaty, to promote protection of the Antarctic environment and ensure compliance with the Protocol. The Protocol requires that reports of inspections are sent to the Parties whose facilities are subject to inspection and that, after those Parties have been given the opportunity to comment, the report and any comments on it are circulated to the Committee on Environmental Protection, considered at the next Treaty meeting and then made publicly available.

This was the fifth inspection mission undertaken by Australia since the entry into force of the Treaty in 1961, and the first by Australia since the entry into force of the Protocol in 1998.

2. OVERVIEW

2.1 CONDUCT OF THE INSPECTIONS

The Australian observer team conducted inspections in the Ross Sea region over a five-day period from 21 to 25 January 2005. The observer team comprised:

- Mr Christos Moraitis, Senior Legal Adviser, Department of Foreign Affairs and Trade
- Dr Conall O’Connell, Deputy Secretary, Department of the Environment and Heritage
- Mr Andrew Jackson, Manager, Antarctic and International Policy, Australian Antarctic Division

All inspections were conducted in accordance with Article VII of the Antarctic Treaty and Article 14 of the Protocol. In accordance with Article VII the names of the Australian observer team were notified by diplomatic note to all Parties to the Antarctic Treaty. This was done in advance of the observer team’s departure for Antarctica.

The activities of the observer team in Antarctica were subject to an authorisation in accordance with sections 12E and 12F of Australia’s Antarctic Treaty (Environment Protection) Act 1980 which implements the obligations of the Protocol in domestic law.

The Australian observer team looked at the following:

- Scott Base (New Zealand) 21 and 22 January 2005
- McMurdo Station (United States) 23, 24, 25 January 2005
- Logistic facilities on the Ross Ice Shelf (United States) 23 and 25 January 2005
- RV Nathaniel B Palmer (United States) 24 January 2005
- Protected areas on Ross Island 23 January 2005
- Tourist activities on Ross Island 25 January 2005

The Australian observer team entered the Antarctic Treaty area on 21 January 2005 and departed on 25 January. The observers were taken to Antarctica as guests of the New Zealand Antarctic Program. Transport between Christchurch and Antarctica was on a Lockheed C141 (Starlifter) operated by the US Air Force in support of the United States Antarctic Program. The observers were accommodated at Scott Base. Logistic support for movement around Ross Island was generously provided by both the New Zealand and United States programs.

In undertaking the inspections the observer team was guided by the inspection checklists adopted under Resolution 5 (1995) of the 19th Antarctic Treaty Consultative Meeting. The observers also looked at activities not subject to the checklist. The observers carried with them information exchanged and made publicly available by the New Zealand and United States governments in accordance with Article VII.5 of the Antarctic Treaty.

The inspections were greatly assisted by the quantity and quality of information provided by the operators of the stations inspected. This information, provided in the format of the inspection checklists, greatly facilitated the task of gathering volumes of critical data in a short time.
2.2 SUMMARY OF OBSERVATIONS

Australia last inspected Scott Base and McMurdo Station in 1964. It is believed that Scott Base was last inspected in 1989, and McMurdo Station in 1988. Accordingly, these were the first inspections of these stations for some 15 years, and the first since the entry into force of the Protocol in 1998.

The Australian observer team is pleased to report that it was welcomed cordially at each station visited. The level of support provided by both the New Zealand and United States Antarctic programs in facilitating the activities of the Australian observer team was an excellent example, on the ice, of the cooperation promoted by the Antarctic Treaty. The observers were provided with full access to all of the facilities and equipment they sought to inspect. The observers are pleased to report that there is full compliance with the provisions of the Antarctic Treaty at both stations inspected. No military manoeuvres were observed and any military personnel and equipment in Antarctica were unarmed and directed solely to the support of civilian scientific activities.

Both stations are directed at facilitating the conduct of sophisticated scientific research programs on Ross Island and elsewhere in Antarctica, and both stations demonstrate their Governments’ commitment to cooperation under the Antarctic Treaty by actively supporting the operations in Antarctica of other Parties.

Furthermore, there is a very high level of compliance with the provisions of the Protocol and active steps are being taken to address the minor compliance issues observed. The inspection revealed “state of the art” performance with respect to several aspects of the operation of these stations, demonstrating that there are areas of excellence at both stations where other operators in Antarctica can draw on the substantial achievements made - these relate in particular to the segregation and handling of solid wastes and hazardous wastes, the treatment of liquid wastes, cleaning up the sites of previous activities, and mechanisms to increase energy efficiency.

The remainder of this report of the inspection provides details on the stations and other places observed. The information is presented in the sequence of the obligations presented in the Treaty (article by article) and in the Protocol (by article, followed by the annexes). Some additional observations are also reported. The appendices contain information provided by the New Zealand and United States Antarctic Programs against the standard checklist for inspections.
3. SCOTT BASE (NEW ZEALAND)

3.1 GENERAL INFORMATION

The inspection of Scott Base was undertaken on 21 and 22 January 2005. Supplementary observations were made on 23, 24 and 25 January. No aerial observations of Scott Base were made.

Scott Base is on Ross Island at 77º51’S, 166º45’E. The base is operated by New Zealand. Scott base was established to support the Trans Antarctic Expedition and the International Geophysical Year, and has been continuously operated by New Zealand since its official in January 1957.

Progressive replacement of the original base with more permanent structures commenced in 1976, and completion of the rebuilding will be achieved in 2005 with the commissioning of the new Hillary Field Centre. Two old buildings survive. The station now provides approximately 3000 m² of heated accommodation and work space. Ancillary structures provide a further 400 m² and the Hillary Field Centre will provide an additional 900 m² when commissioned.

Scott Base supports scientific research at the station itself and in the immediate vicinity of Ross Island. In addition, the base acts as a major logistics hub for scientific activities further afield throughout the Ross Sea region. These programmes include the international ANDRILL project, as well as smaller studies of the atmosphere, the Antarctic ecosystem, geophysics, glaciology, climate, physiology, sea ice and oceanography. Scott Base also supports visits by heritage conservation experts, media and artists.

There are several scientific facilities at Scott Base including the Hatherton Geosciences Laboratory; wet laboratory; dry laboratory; magnetic variometer hut and magnetic absolute hut. Some of the scientific instrumentation has been making continuous readings of geophysical observations for many decades. As for all the Scott Base buildings, the scientific facilities are well maintained. There are approximately 200 metres of gravel road at Scott Base to provide access between buildings. These connect to the road that links McMurdo station with ice shelf airfields.

At the time of the inspection Scott Base was under the command of Mr Julian Tangaere, Base Manager. Up to 85 people can be accommodated at the base and approximately 70 people were on base at the time of our visit. Of these, around half were domestic, engineering and logistic staff employed to run the base and support people working on the base itself and the scientists and other personnel in transit to field locations. A high proportion of visitors to the base are in transit to field locations or are short term visitors to undertake specific scientific or engineering projects. An 8-person contract construction crew was present throughout summer to erect the new Hillary Field Centre. 10 people will maintain Scott Base and year-round scientific projects over the 2005 winter.

3.2 OBSERVATIONS - ANTARCTIC TREATY

Use of Antarctica for peaceful purposes (Article I)

Antarctica New Zealand operates a civilian scientific program. No military activities or armaments were observed at Scott Base. The New Zealand Defence Force assists with the provision of personnel at Scott Base, including the Base Services Manager, communications staff, cargo handlers and canteen management. The Royal New Zealand Air Force provides aircraft and personnel to support flights between New Zealand and Ross Island as a contribution to a logistics pool arrangement also involving the United States and Italian Antarctic programs. Military personnel in support of these activities are accommodated and managed out of McMurdo Station. No military personnel are at Scott Base during the winter period.

Freedom of scientific investigation (Article II)

There are multiple examples of New Zealand’s commitment to freedom of scientific investigation. Scott Base has been occupied continuously since the International Geophysical Year.

Exchange of scientific information and personnel (Article III)

Information about New Zealand’s scientific programs in Antarctica is publicly available and readily accessible in printed form and through the internet. Scientists from Australia, Italy and South Africa were present at Scott Base during the visit of the observer team. During 2004/05 scientists from seven other Antarctic Treaty Parties participated in the New Zealand programme, as well as scientists from Malaysia.

The results of New Zealand’s Antarctic scientific observations are published in a range of scientific journals and copies of many past scientific publications were seen at Scott Base. The forward science program is described in *New Zealand Science in Antarctica and the Southern Ocean* (2004-2009) which is publicly available and promotes international cooperation in pursuit of the strategic research objectives.
Sovereignty (Article IV)
A sign on the northern approach to Scott Base announces that it is in the Ross Dependency. Scott Base flew the New Zealand flag during the visit of the Australian observer team. Ross Dependency postal stamps produced over a number of years are on display at Scott Base and current stamps are sold at the Scott Base shop. No other evidence of territorial interests was observed.

Nuclear explosions and radioactive waste (Article V)
Spent and surplus radioactive chemicals (such as $^{14}$C tracers) used for scientific research are returned to New Zealand for disposal. No other radioactive materials are present.

High seas rights (Article VI)
Although not observed, we were advised that a New Zealand registered tourist vessel Spirit of Enderby was operating in the southern part of the Ross Sea during our visit.

Conduct of inspections (Article VII)
The Australian observer team enjoyed complete freedom of access to all parts of Scott Base. All of our questions were answered without hesitation. New Zealand personnel had a good understanding of the role of Treaty inspections and cooperated with the observer team at all times.

Before departing for Antarctica the Australian observer team had access, via the internet, to detailed information about the New Zealand Antarctic Programme. This information was available in accordance with the agreed format for exchange information. The New Zealand Antarctic Programme greatly facilitated the inspection by also providing information in the format of the Inspection Checklists recommended by Resolution 5 (1995) - copy at Appendix A.

Exercise of jurisdiction (Article VIII)
At that time of the inspection the Australian observer team was subject to an authorisation under sections 12E and 12F of Australia’s Antarctic Treaty (Environment Protection) Act 1980. The personnel of Scott Base recognised that the members of the Australian observer team were subject to Australian jurisdiction while exercising their functions as observers.

3.3 OBSERVATIONS - ENVIRONMENTAL PROTOCOL

Environmental principles (Article 3)
The Australian observer team noted considerable evidence that protection of the Antarctic environment and its value as an area for the conduct of scientific research are fundamental considerations in the planning and conduct of the New Zealand Antarctic programme. All New Zealand activities are planned on the basis of informed judgments about their possible impacts on the Antarctic environment. In accordance with the Protocol, priority is given to scientific research.

Cooperation (Article 6)
New Zealand cooperates closely with other Parties to the Protocol in the planning and conduct of its Antarctic activities, particularly with the United States and Italy with whom it contributes to a shared logistics pool for intercontinental air transport and intra-continental helicopter support. As noted above, scientists from 8 other nations participated in the New Zealand programme during 2004/05. The programme also supports several media, artistic and related educational activities.

Prohibition of mineral resource activities (Article 7)
No mineral resource activities, other than scientific research, were observed at Scott Base. Local volcanic gravels and scoria are from time to time collected from the immediately adjacent area to maintain access tracks in support of Scott Base as a hub for scientific research.

Environmental impact assessment (Article 8)
Activities at Scott Base are subject to prior evaluation of their environmental impacts in accordance with New Zealand’s Antarctica (Environmental Protection) Act 1994 which implements the Protocol’s obligations. Activities are subject to a Preliminary Environmental Evaluation (PEE), Initial Environmental Evaluation (IEE) or Comprehensive Environmental Evaluation (CEE) depending on the nature and scale of the activity. Further information on assessed activities at Scott Base is provided later in this report.
Compliance with the Protocol (Article 13)
Scott Base carries copies of the relevant New Zealand legislation. Base staff and visitors are provided with numerous publications detailing environmental requirements. The Australian observer team was provided with copies of Antarctica New Zealand 2004/05 Handbook; Environmental Code of Conduct; Field Manual 2004/05; Environmental Guidelines for Helicopter Operations in the Ronne Sea Region, Antarctica; Antarctica New Zealand Waste Management Handbook; McMurdo Dry Valleys ASMA Manual 2004-2005; and a welcome booklet for Scott Base.

There are numerous prominent signs throughout Scott Base instructing visitors on environmental procedures such as waste handling, use of protected areas, and approaches to wildlife.

Antarctica New Zealand has developed policies on a range of matters relating to base management, environmental protection and safety. These policies are regularly reviewed and copies are readily available to staff at Scott Base including in the dining room and station library.

Antarctica New Zealand seeks to conduct an audit of 20% of supported events each year. The Australian observer team was provided with a copy of a Field Event Audit form which is used to document compliance with an approved PEE and the Code of Conduct. The audit report we saw provided a frank assessment of compliance and noted actions where improvements can be built into future activities. Antarctica New Zealand’s Environmental Performance Report 2002/03 and 2003/04 indicates that 14 audits were conducted over those two seasons and assesses compliance with a range of other activities subject to PEEs and IEEs.

We were also provided with two copies of the Antarctic New Zealand Environmental Management System Corrective Action Form - in one case dealing with interference with historic artefacts and, in the other case, inadvertent entry to a protected area. In both cases the incident and recommended future preventive measures were documented.

We were advised that compliance with environmental requirements is made a condition of employment with Antarctica New Zealand.

Emergency response action (Article 15)
Scott Base has in place contingency plans for responses to emergencies. These plans relate to search and rescue, medical emergencies, fire fighting, fuel spills and chemical spills. Quantities of equipment are held on base for fuel spill response and supplies are readily accessible to major fuel handling equipment. Designated staff are trained in use of the equipment.

Fuel for the Scott Base diesel generators is stored in a double skinned tank. The fuel storage and handling system is fitted with sensors to trigger overfill alarms and to shut off pumps to minimise spills. The risk of impact from emergencies is reduced by minimising the volume and variety of fuels stored on the base. Further information appears at Section 3.4 below.

Annual report by Parties (Article 17)
New Zealand reports annually (by way of an ATCM Information Paper) to all Parties to the Protocol, to the Committee for Environmental Protection, and to the ATCM. The Australian observer team was provided with a copy of the Antarctica New Zealand Environmental Performance Report 2002/03 and 2003/04 which is also available to interested Parties.

Signature, ratification and entry into force (Articles 21 to 23)

Environmental impact assessment (Annex I)

Preliminary stage (Article 1)
Scott Base supported over 70 separate “events” in the 2004/05 season. The majority of activities inspected by the Australian observer team had been evaluated at the PEE level on the basis that they would have a less than minor or transitory impact.

We were provided with copies of PEEs for the following activities: Cape Roberts Tide Gauge (K042); The Physiography, Flow Characteristics and Vulnerability of the Southern McMurdo Ice Shelf, Antarctica (K065); Media Programme, Radio New Zealand (K314); Antarctica New Zealand Support to the Annual Antarctic Programme 2004/2005 (K401, K402 and K406); and 50th Anniversary Visit by Edmund and June Hillary (K430).
**Initial environmental evaluation (Article 2)**

One activity inspected by the Australian observer team was subject to a current IEE - this was the construction of the new Hillary Field Centre. A copy of the IEE for this activity was provided to us. In inspecting the construction site an IEE appeared to be an appropriate level of evaluation given that the building is on ground that has been impacted previously by the storage of vehicles and containers over many years. It was noted that the building is constructed in a way which will allow its complete removal at some future time and leave little or no evidence of its presence. The IEE included effective analysis of the alternatives. The activity was being undertaken in accordance with the evaluation.

We were also provided with a copy of the IEE for the clean up of Cape Hallett Station, Victoria Land, but this activity was not inspected.

**Comprehensive Environmental Evaluation (Article 3)**

The Australian observer team did not inspect any activities subject to a CEE.

We examined equipment previously used for the Cape Roberts Drilling Program, which had been subject to a CEE in 1995. This equipment was in good order and ready to be redeployed for the ANDRILL project, but we could not assess its use in the field.

**Monitoring (Article 5)**

The Australian observer team did not inspect any monitoring activities. However, we were advised that there is frequent monitoring of the quality of effluent from the waste water treatment plant. The outcomes of this monitoring are addressed in Antarctica New Zealand’s Environmental Performance Report 2002/03 and 2003/04. The Environmental Performance Report also includes information on photographic monitoring of the Scott Base site and fuel use over a ten year period.

New Zealand has also published the *Ross Sea Region 2001: a State of the Environment Report for the Ross Sea Region of Antarctica* which identifies cumulative impacts, disturbance to wildlife and contamination of water, air and ice-free areas as key environmental issues in the region.

**Circulation of information (Article 6)**

Information on the environmental evaluation procedures are publicly available and has been provided to other Parties and forwarded to the CEP. IEEs are available on request.

**Conservation of Antarctic Fauna and Flora (Annex II)**

**Protection of native fauna and flora (Article 3)**

In the absence of suitable activities in the immediate vicinity of Scott Base the Australian observer team was not able to inspect any activities subject to a permit authorising disturbance to or interference with native birds or seals. We were advised that several projects in the 2004/05 season had received permits for the sampling of various organisms in the Ross Sea region and we were provided with a list of samples obtained in 2003/04. Antarctica New Zealand’s Environmental Performance Report 2002/03 and 2003/04 lists permits granted over those two seasons and assesses compliance with them.

The *Environmental Guidelines for Helicopter Operations in the Ross Sea Region, Antarctica* provide detailed instruction on the use of helicopters near concentrations of birds. It provides no specific information with respect to interactions with seals. The Australian observer team noted the proximity of seals hauled out on to the sea ice some 200 metres downwind of the helicopter landing pad. While no helicopters were observed to directly overfly the seals, there were occasions when the aircraft’s horizontal separation may have been reduced by using alternative approach paths. That said, there appeared to be no reaction by the seals to the presence of helicopter operations and the number of seals hauled out continued to increase during our visit.

With respect to native flora, it was noted that there are a few isolated occurrences of moss species growing on the slopes directly above Scott Base. Some of these are adjacent to the foot track to McMurdo Station and adjacent to the road to the ice shelf. These patches of moss, while not necessarily rare, are not marked and are vulnerable given their proximity to the base, frequently used routes and areas that have been subject to past disturbance.
Introduction of non-native species, parasites and diseases (Article 4)
No non-indigenous plants or animals were observed at Scott Base. The base has a well-equipped hydroponics facility that is currently out of use pending determination of the power demand to run the facility after commissioning of the Hillary Field Centre.

Information (Article 5)
Antarctica New Zealand provides good information to programme participants on protected species, protected areas and requirements for permits. This includes poster information displayed in Scott Base on protected areas in the region and approach distances for wildlife.

Waste disposal and waste management (Annex III)

General obligations (Article 1)
Waste management policy and procedures for Scott Base are detailed in Antarctica New Zealand's Waste Management Handbook 2004/2005, a copy of which was provided to the Australian observer team. It demonstrates that waste minimisation, storage and disposal are fundamental considerations in the planning and conduct of New Zealand Antarctic activities. Other than sewage and domestic waste water, all waste items are removed from the Antarctic Treaty area and returned to New Zealand for recycling or disposal as appropriate.

The Australian observer team was impressed by how little surface litter was present at Scott Base. This was all the more remarkable given that 2004/2005 experienced a significantly higher level of melt than previous seasons and some bare ground was exposed for the first time in many years.

The site of the original Scott Base has been rehabilitated so that it is not visible unless pointed out. The only remaining evidence is “Hut A”, the first to be built in 1956. It is now retained as a museum and is a designated historic monument (HSM 75). Removal of the other buildings without residual evidence was made possible by the fact that the buildings sat on timber bearers laid directly on the ground and anchored with steel cables.

Waste disposal by removal from the Antarctic Treaty Area (Article 2)
The following materials are removed from Antarctica in accordance with Annex III of the Protocol: radio-active materials; electrical batteries (segregated into types); fuels and lubricants (segregated into types); plastics (also segregated); timber offcuts; fuel drums (for recycling or disposal); other solid wastes are sorted before return. Organic wastes such as food and food contaminated wastes are returned frozen to New Zealand for disposal. Hazardous wastes are separately packed for return to New Zealand. The Base Manager reported that there are occasional problems when programme participants do not declare the nature of their hazardous wastes. Wastes containing heavy metals, acutely toxic or harmful persistent compounds are seldom generated at Scott Base. The Australian observer team was impressed by the degree of segregation achieved on the relatively small volumes of waste produced.

Waste disposal by incineration (Article 3)
There is no evidence of open burning being conducted at Scott Base. The incinerator was de-commissioned in 1999 and the incinerator building is now used for sorting, storing and packing solid waste materials prior to return to New Zealand.

Other waste disposal on land (Article 4)
There was no evidence of waste disposal on land or into freshwater systems at Ross Island.

Disposal of waste in the sea (Article 5)
Sewage and domestic liquid wastes are discharged through a waste water treatment plant installed in 2002. The system has a design capacity of 120 persons. Scott Base personnel advised that adjustments to the operating procedure need to be made to satisfactorily handle the transition between the low loading of the system in winter and the much higher loading over the summer months. Problems occur when the system receives insufficient aeration and goes anaerobic and produces H²S. It was reported that when operating at its optimum the system generates little or no odour and the discharge at the outfall pipe is biologically very clean. The treated sewage was observed to discharge directly into the sea through an insulated outfall pipe suspended on a cantilevered gantry. If the biological treatment breaks down, Scott Base has a permit to by-pass the treatment plant, in which case the sewage is passed through a macerator before discharge to the sea. An assessment of the system’s performance up to April 2004 appears in the Environmental Performance Report including monitoring to New Zealand health standards at the nearby sea water intake pipe for the reverse osmosis desalination plant.
Storage of waste (Article 6)

All wastes to be removed from the Antarctic Treaty area are stored in the waste handling facility (previously the incinerator building) or externally in sealed and labelled containers awaiting shipping.

Prohibited products (Article 7)

There was no evidence at Scott Base of PCBs, polystyrene chips and other materials prohibited by Annex III of the Protocol.

Although vermiculite is not a prohibited material, the Waste Management Handbook states that it is discouraged at Scott Base except where no practicable alternative exists. Several bags of vermiculite, which is used as a soil substitute, are stored in the hydroponics facility which is not currently in use. Antarctica New Zealand subsequently advised the Australian observer team that vermiculite is sometimes used as packaging material for retrograding hazardous chemicals.

Article 8: Waste management planning

The Waste Management Handbook sets out in detail the procedures for the handling of all categories of waste, including waste generated in the field. All solid wastes from the field are returned to Scott Base for handling, with the exception of solid and liquid human waste in a few specified circumstances.

The Australian observer team was provided with an inventory of the locations of past activities and their status with respect to clean up and removal. Considerable effort has been made in removing materials from abandoned sites. A particularly significant effort has been made on removing the old Cape Hallett station, a facility jointly operated by New Zealand and the United States until 1973. We were provided with a copy of the IEE for the clean up of the station. Progress in 2004/05 was reported to have reached the stage where only fuel tanks remain to be removed in 2005/06. It is understood that Italy assisted with removal of materials on their resupply vessel Italica.

Prevention of Marine Pollution (Annex IV)

New Zealand does not operate ships in support of its activities at Scott Base. Cargo transport by ship is provided by the United States Antarctic Program using its dry cargo vessel MV American Tern and its bulk fuel tanker USNS Paul Buck.

Area protection and management (Annex V)

Antarctic Specially Protected Areas (Article 3)

There are several ASPAs on Ross Island and in the Ross Sea region which are frequently visited by the New Zealand program. Two ASPAs in the vicinity of Scott Base - ASPA 122, Arrival Heights; and ASPA 158, historic hut, Hut Point. The inspection of activities undertaken by New Zealand in these protected areas is discussed in part 7 of this report.

Antarctic Specially Managed Areas (Article 4)

There are no ASMAs in the immediate vicinity of Scott Base.

Management plans (Article 5)

Copies of management plans for ASPAs visited by New Zealand personnel are held at Scott Base.

Permits (Article 7)

The Australian observer team did not witness any New Zealand personnel undertaking activities within protected areas without a permit. The Scott Base Manager carried copies of his permit for entry to the protected areas when escorting us into the protected areas.
**Historic Sites and Monuments (Article 8)**

Historic sites and monuments in the vicinity of Scott Base are:

- **HSM 18** Hut at Hut Point erected by R F Scott in 1902, adjacent to McMurdo Station.
- **HSM 19** Vince’s memorial cross at Hut Point, overlooking Winter Quarters Bay and adjacent to Scott’s hut.
- **HSM 20** the memorial cross erected in memory of R F Scott overlooks Scott Base from Observation Hill.
- **HSM 54** the monument to Richard Byrd, erected at nearby McMurdo Station in 1965.
- **HSM 75** “Hut A” is the oldest building at Scott Base and was constructed in 1956 for the Tran-Antarctic Expedition and formed part of the original station. It originally served as the kitchen and mess and included the office occupied by Edmund Hillary as base leader. The building is well maintained as a museum and emergency shelter.

**Information and publicity (Article 9)**

Detailed information on the location and values of protected areas on Ross Island and the Ross Sea region are provided on posters at Scott Base as well as in printed material provided to base visitors.

The events list for the 2004/05 New Zealand Antarctic Program includes a number of media and artist visitors who visit the historic huts to publicise their importance.

**Exchange of information (Article 10)**

The Australian observer team was provided with a copy of Antarctica New Zealand’s *Environmental Performance Report 2002/03 and 2003/04* which includes a detailed list of visits to protected areas by New Zealand programme participants.

### 3.4 OTHER OBSERVATIONS

**Station operation**

Scott Base operates as much as a logistic hub to support activities in other parts of the Ross Sea region as it does to support science on Ross Island. Accordingly, many of its facilities and its infrastructure are designed to operate as a high throughput accommodation facility for visitors in transit to field locations. In addition, the intercontinental air link with Christchurch allows many transient visitors to come for time-limited engineering projects, media events and so on. The close logistic cooperation with the United States Antarctic Program also allows Scott Base to operate largely as a staging post for people rather than for heavy equipment - the logistic support coming from McMurdo means that Scott Base does not have to provide for much of the otherwise complicated infrastructure (such as high volume fuel storage, facilities to support intercontinental air transport, and advanced medical support).

**Station construction and design**

Although the construction techniques employed at Scott Base have evolved over time the uniform colour and appearance of the buildings gives it a cohesive look. All buildings are connected by a corridor and the footprint of the base is contained in a relatively small area. The older buildings are well maintained. The most recently occupied facilities are the ablutions building and the waste water treatment plant. The integrated appearance of Scott Base is enhanced by having dealt successfully with the legacy of previous occupation of the site - removal of unnecessary structure, equipment and stores.

The newest building is the Hillary Field Centre which is waiting fit-out during 2005. The building has been designed to be demountable with pre-cast concrete footings and floor panels, and pre-formed steel framing. In 2003/04 the site was cleared of loose boulders, followed by some blasting and excavation before the site was graded and footings positioned. The building itself was assembled in 2004/05 by 8 persons over 3 months. The construction site is remarkably clean with all waste materials containerised. Older Scott Base buildings also stand above ground, mainly on timber piers, and it would be equally simple to remove the buildings with little residual evidence.
Science undertaken at Scott Base

The Hatherton Laboratory supports ionosonde soundings which have been taken continuously for 25 years; fluxgate magnetometers; meteorological observations which have been continuous at the site since 1957; seismic observations on behalf of the USGO; upper atmosphere winds; polarimeter observations; and a chlorine oxide experiment with 9 years continuous measurements. The laboratory also supports Malaysian programs include a Trimble reference station for GPS monitoring; an all-sky camera used in winter for web-based education programs; and a grid of four automatic weather stations on the ice shelf for detecting atmospheric turbulence and gravity waves.

Power generation

Three 225 kVA generators supply Scott Base of which two are in the main power house and a separate one is for emergency use. There is one power control system.

Fuel storage and handling

The main fuel used at Scott Base is AN8 diesel fuel. Over 450,000 litres are consumed annually. The fuel is purchased from McMurdo Station and 56,000 litres (enough for about 6 weeks) can be stored in a double-walled tank at Scott Base. Fuel is transported from McMurdo in a 7,000 litre trailer-mounted tank. AN8 is distributed around the station by pipe - welded stainless steel above ground, and underground in flexible fuel hose protected by galvanised steel pipe. The main storage tank and day tanks (all of which are also double-walled) are protected by high and low level alarms. Vehicles are refuelled from a bowser installed on a concrete pan with a closed catchment to allow complete recovery of any spills. In the unlikely event of catastrophic failure of the main storage tank and containment, escaping fuel would be absorbed into the ground or discharge to the sea 50 metres from the tank.

Spill response materials are readily available within the station and in a container alongside the main storage tank. However, the quantity of material seemed of limited capacity for anything other than a minor spill. The risk of fuel spills is minimised by standardising on AN8 fuel with its well developed storage and transfer systems. We were advised that the weakest link in the fuel handling system is the risk of accident during overland transport of fuel from McMurdo Station.

The helipads at Scott Base are within 50 metres of the main fuel storage tank.

Mogas (petrol) is transported and stored in a 2,000 litre trailer-mounted tank. This tank trailer is parked on its own concrete pan with a closed catchment sump to allow recovery of any spills.

Smaller amounts of fuels are stored and transported in various containers and drums of up to 200 litres. Day tanks at the base are double-walled, and day tanks on sled-mounted vans have drip trays.

Energy efficiency audit

We were advised that at Scott Base the most energy intensive activities are heating and production of water through reverse osmosis. Antarctica New Zealand is currently looking at the potential for fuel savings by improving energy efficiency within the buildings. The Hillary Field Centre has been designed to maximise energy efficiency which is important given that it represents one third of the station’s heated air space. Strict water conservation practices reduce the energy demand for water production and toilets are flushed with sea water. The kitchen has been converted to gas cooking to flatten the peaks in the power demand.

Vehicles

There are few vehicles at Scott Base and they are modest in size. The fleet appears to be in good working order and there was no evidence of unserviceable vehicles or machinery lying around.

Permafrost issues

The high melt experienced in the 2004/05 summer appears to have caused some movement in facilities anchored in the permafrost. This was evident in the movement of stanchions supporting the waste water treatment outfall pipe where it circumnavigates “Hut A” in an area prone to pooling, and in the anchors to one of the magnetometer huts. These issues are probably short lived and not of immediate environmental significance but were promptly attended to by the engineer.
**Dust**
The road between the ice shelf and McMurdo passes to the north and east of Scott Base and upwind. During the
time of our visit it was clear that considerable amounts of dust are generated by passing vehicles. This dust may
affect the albedo of snow around Scott Base.

**Road gravel**
Gravel and fines for maintaining the roads at Scott Base and for levelling the ground around buildings is won by
simple excavation of the naturally loose surface material which is composed of volcanic scoria. There is ample
evidence of earth moving in the immediate vicinity (within 100 metres) of Scott Base over the years to collect
gravel or to level areas suitable for container and equipment storage. The unaffected areas are characterised by
the presence of erratic boulders.

**Sea ice debris**
Approval for sea ice travel had been removed before the observer team arrived because of the increasing instability
of the sea ice during summer. Several canes and flags marking the sea ice routes remain alienated on the sea ice
and will eventually be dispersed at sea.

**Hazardous goods audit**
During the visit of the Australian observer team an expert was present to conduct an audit of hazardous materials
at Scott Base.

**Cooperation with McMurdo**
The close cooperation between Scott Base and McMurdo is manifested in a weekly coordination meeting held
on Mondays. The Australian observer team was privileged to be invited to the coordination meeting on 24
January 2005.

**Future development of Scott Base**
We were advised that completion of the Hillary Field Centre will bring to a close the current development of
Scott Base and that there are no immediate plans to modify or expand the facilities. However, we were advised
that in future there may be interest in increasing the amount of space allocated to visitors during the summer
period when up to 4 people occupy each bunk room - this would result in further building work.

**Consistency with Treaty exchange information**
The Australian observer team noted that activities at Scott Base are consistent with the information provided in
New Zealand’s advance exchange of information circulated in accordance with Article VII.5 of the Antarctic
Treaty.
4. MCMURDO STATION (UNITED STATES OF AMERICA)

4.1 GENERAL INFORMATION

The inspection of McMurdo Station was undertaken on 23, 24 and 25 January 2005. No aerial observations of McMurdo Station were made.

McMurdo Station is on Ross Island at 77°55'S, 166°39'E. The base acts as the hub of the United States Antarctic Program and was established to support the International Geophysical Year. The site has been continuously operated by the United States since the official opening of the base in 1958.

Buildings have been erected over time as required and indicate a range of construction techniques. Some of the most recent buildings are the new scientific laboratories and the waste-water treatment plant. Several old buildings survive and there are now over 100 buildings. No buildings are currently under construction. The total area occupied by the station is some 400,000 m² and McMurdo Station is the largest permanent facility on the Antarctic continent.

McMurdo Station supports scientific research at the station itself and in the immediate vicinity of Ross Island. In addition, a prime role of the station is to provide the prime entry point for United States activities in Antarctica and to serve as a logistics hub to support scientific activities further afield throughout the Ross Sea region, the South Pole and other remote sites on the high plateau.

Major research projects supported by the station include marine and terrestrial biology, biomedicine, geology, geophysics, glaciology, meteorology, aeronomy and atmospheric physics. McMurdo Station also supports visits by media representatives and artists.

There are several scientific facilities at McMurdo Station. The primary facility is the Crary Science Centre. Other facilities include an aquarium, ice core building, cosmic ray building, infrasound sensor station, seismic facilities, and gravity station.

The station buildings are served by several formed roads which connect to the main feeder route to the nearby Scott Base (New Zealand) and the ice shelf runways. An annual sea ice road connects to the sea ice runway in early summer.

In its role as a logistics hub the station supports three airfields: the annual sea ice runway, Williams Field ski way (South Pole flights and deep field sites), and Pegasus glacier ice runway (intercontinental flights from New Zealand). There is an emergency landing area at Odell Glacier. Several helipads at McMurdo Station support local aviation.

At the time of the inspection, overall responsibility for McMurdo Station fell to Mr Brian Stone, National Science Foundation (NSF) representative, and Mr Terry Melton, NSF Station Manager. Operation of the station is contracted by the NSF to Raytheon Polar Services Company. Up to 1,100 people can be accommodated at the station and 1,062 people were on station at the time of our visit. The majority of these people were Raytheon employees, or military personnel engaged in logistic support for the scientific activities. A number of scientists from United States and overseas institutions were on station at the time of our visit to conduct research or in transit to field sites. Around 200 people winter over at McMurdo station.

4.2 OBSERVATIONS - ANTARCTIC TREATY

Use of Antarctica for peaceful purposes (Article I)

The National Science Foundation operates a civilian scientific program. No military activities or armaments were observed at McMurdo Station. Various parts of the United States Department of Defense provide logistics support to the United States Antarctic Program. This includes the provision of air transport between New Zealand and Ross Island (using Lockheed C141, C17 and C130 aircraft) and airlift to the South Pole and other deep field sites using LC130 aircraft. Military support is also provided for marine transport of dry cargo and fuel, cargo handling, navigational support and weather forecasting. The United States Antarctic Program participates in a logistics pool arrangement with the New Zealand and Italian programs which also use military personnel in the logistic support operations.

Freedom of scientific investigation (Article II)

There are multiple examples of the United States’ commitment to freedom of scientific investigation. McMurdo Station Base has been occupied continuously since the International Geophysical Year.
Exchange of scientific information and personnel (Article III)

Information about the United States Antarctic Program is publicly available and readily accessible in printed form and through the internet. Scientists from nine Treaty States (Australia, Canada, France, Italy, Japan, New Zealand, Poland, Switzerland and the United Kingdom) were reported to be present at McMurdo during the 2004/05 summer. In addition, there were scientists from Mexico and Portugal.

The results of scientific observations resulting from the United States Antarctic Program are published in a range of scientific journals.

Sovereignty (Article IV)

No evidence of territorial activities were observed. The flags of the twelve original signatories to the Antarctic Treaty were flying at the National Science Foundation chalet during the visit of the Australian observer team.

Nuclear explosions and radioactive waste (Article V)

Spent and surplus radioactive chemicals used for scientific research are returned to the United States for disposal. No other radioactive materials are present.

High seas rights (Article VI)

Four vessels associated with the United States Antarctic Program were in the vicinity of Ross Island during the presence of the Australian observer team. These were the icebreaker USCG Polar Star, the icebreaker Krasin on charter from FESCO, oceanographic ship RV Nathaniel B Palmer, and the bulk fuel tanker USNS Paul Buck. We were advised that the bulk dry cargo ship MV American Tern was en route from New Zealand.

Conduct of inspections (Article VII)

The Australian observer team enjoyed complete freedom of access to all parts of McMurdo Station. All of our questions were answered without hesitation. United States personnel had a good understanding of the role of Treaty inspections and cooperated with the observer team at all times.

Before departing for Antarctica the Australian observer team had access, via the internet, to detailed information about the United States Antarctic Program. This information was available in accordance with the agreed format for exchange of information. The National Science Foundation greatly facilitated the inspection by also providing information in the format of the Inspection Checklists recommended by Resolution 5 (1995) - copy of this information is at Appendix B.

Exercise of jurisdiction (Article VIII)

At the time of the inspection the Australian observer team was subject to an authorisation under sections 12E and 12F of Australia’s Antarctic Treaty (Environment Protection) Act 1980. The personnel of McMurdo Station recognised that the members of the Australian observer team were subject to Australian jurisdiction while exercising their functions as observers.

4.3 OBSERVATIONS - ENVIRONMENTAL PROTOCOL

Environmental principles (Article 3)

The Australian observer team noted considerable evidence that protection of the Antarctic environment and its value as an area for the conduct of scientific research are fundamental considerations in the planning and conduct of the United States Antarctic Program. All activities at McMurdo Station are planned on the basis of informed judgments about their possible impacts on the Antarctic environment. In accordance with the Protocol, priority is given to scientific research - and the major role of McMurdo Station is facilitating scientific research on Ross Island, in the Ross Sea region and elsewhere in Antarctica. In this regard, McMurdo operates as the major entry point into Antarctica for research supported by the United States at the South Pole and other deep field sites on the high Antarctic plateau.

Cooperation (Article 6)

The United States cooperates closely with other Parties to the Protocol in the planning and conduct of its Antarctic activities, particularly with New Zealand and Italy with whom it contributes to a shared logistics pool for inter-continental air transport and intra-continental helicopter support. These are longstanding arrangements which generate considerable efficiencies and avoid duplication of support infrastructure. As noted above, scientists from 11 other nations participated in the research at McMurdo Station during 2004/05.
Prohibition of mineral resource activities (Article 7)

No mineral resource activities, other than scientific research, were observed at McMurdo Station. There is evidence that local volcanic gravels and scoria are from time to time collected from the valleys immediately adjacent to the Station area to maintain roads in support of McMurdo Station as a hub for scientific research.

Environmental impact assessment (Article 8)

Activities supported by McMurdo Station are subject to prior environmental evaluation in accordance with the United States Antarctic Conservation Act of 1978 as amended by the Antarctic Science, Tourism and Conservation Act of 1996 which implements the Protocol's obligations. Activities having less than a minor or transitory impact on the environment may proceed. Otherwise an Initial or Comprehensive Environmental Evaluation is prepared depending on the nature and scale of the activity. Activities having a less than minor or transitory impact may, however, be subject to a Record of Environmental Review to verify the level of impact.

Compliance with the Protocol (Article 13)

McMurdo Station carries copies of the relevant United States legislation. Station staff and visitors are provided with the United States Antarctic Program Participant Guide 2004-2006 which, among other things, provides information on environmental requirements. The Australian observer team was also provided with copies of McMurdo Station Guide; Power, Water and Wastewater Treatment at McMurdo Station and copies of The Antarctic Sun, a station newsletter that includes environmental stories. Environmental guidelines are also covered in the Field Manual for the United States Antarctic Program. There are numerous prominent signs throughout McMurdo Station instructing visitors on environmental procedures such as waste handling.

The Participant Guide describes a range of policies relating to station management, environmental protection and safety and indicates where to find further information. All program participants are given orientation training before departure for the ice and an orientation briefing on arrival - both of these include environmental requirements.

McMurdo Station has staff designated as Antarctic Conservation Act Enforcement Officers who are federal officials responsible for ensuring compliance with the Act.

Emergency response action (Article 15)

McMurdo Station has in place contingency plans for responses to emergencies. These plans relate to search and rescue, medical emergencies, fire fighting, fuel spills and chemical spills. The spill response plan complies with United States Environmental Protection Agency requirements. Quantities of equipment are held on base for fuel spill response and there is also a mobile spill response vehicle. Four groups of personnel trained in use of the equipment are designated as spill response teams and one team must be available at all times. The training includes fuel spills and hazardous materials, as well as regular team exercises.

To minimise the impact of spills, aviation fuels and fuel for the McMurdo Station diesel generators is mostly stored in single-walled tanks contained in large earth bermed compounds.

Annual report by Parties (Article 17)

The Australian observer team has not seen a report provided by the United States pursuant to Article 17 of the Protocol.

Signature, ratification and entry into force (Articles 21 to 23)


Environmental impact assessment (Annex I)

Preliminary stage (Article 1)

Under the Antarctic Conservation Act activities having less than a minor or transitory impact on the environment may proceed. Otherwise an Initial or Comprehensive Environmental Evaluation is prepared depending on the nature and scale of the activity. The majority of activities inspected by the Australian observer team at McMurdo proceed on the basis that they have a less than minor or transitory impact or were ongoing at the time of the entry into force of the Protocol. Activities having a less than minor or transitory impact may, however, be subject to a Record of Environmental Review to verify the level of impact. The entire United States Antarctic Program is subject to a 5-year master permit under the Act.
**Initial environmental evaluation (Article 2)**

The Australia observer team was advised that several activities underway at McMurdo were subject to an IEE. These included construction of replacement gasoline bulk storage tanks, diesel engine generator set replacement for continued power generation and establishment of redundant power and water generation capacity, continued use of assisted take off units, use of an emergency landing area at Odell Glacier, and adoption of standard operating procedures for the renovation or decommissioning of United States Antarctic Program facilities.

**Comprehensive Environmental Evaluation (Article 3)**

The Australian observer team examined the equipment used for the development of the proof of concept traverse from McMurdo Station to the geographic South Pole, an activity which was subject to a CEE in 2003. This equipment comprises living vans and fuel sleds towed behind a variety of heavy over-snow tracked vehicles.

**Monitoring (Article 5)**

The United States Antarctic Program is also undertaking a local environmental monitoring program commenced in 2003/04 to study anthropogenic disturbance to the terrestrial and marine environment in the immediate vicinity of McMurdo Station.

The Australian observer team observed the monitoring of the outfall of the waste-water treatment plant in a laboratory specially set up for this purpose. This monitoring is undertaken daily and the outcomes used to adjust variables such as aeration in the digester system. The system has been running since 2003 and is consistently producing biologically sterile effluent for discharge into McMurdo Sound.

**Circulation of information (Article 6)**

Information on the environmental evaluation procedures is publicly available and has been provided to other Parties and forwarded to the CEP. The United States 2004/05 exchange information lists all the IEEs for the program in the current season. IEEs are available on request.

**Conservation of Antarctic Fauna and Flora (Annex II)**

**Protection of native fauna and flora (Article 3)**

In the absence of suitable activities in the immediate vicinity of McMurdo Station the Australian observer team was not able to inspect any activities subject to a permit authorising disturbance to or interference with native birds or seals. We were advised that several projects in the 2004/05 season had received permits for the sampling of various organisms in the Ross Sea region.

We saw no evidence of native flora within the boundaries of McMurdo Station. Small patches of moss were seen between the road to the ice shelf and the solid pipeline carrying fuel to Williams Field. These patches of moss, while not necessarily rare, are not marked and are vulnerable given their proximity to the road, permanent infrastructure and previously disturbed areas.

**Introduction of non-native species, parasites and diseases (Article 4)**

No non-indigenous species were observed at McMurdo Station.

**Information (Article 5)**

The United States Antarctic Program provides good information to participants on protected species, protected areas and requirements for permits. The United States Antarctic Program Participant Guide 2004-2006 specifies permit requirements and procedures and where to go for further information.

**Waste disposal and waste management (Annex III)**

**General obligations (Article 1)**

Waste management policy and procedures for McMurdo Station are detailed in the station’s waste management plan which provides that waste minimisation, storage and disposal are fundamental considerations in the planning and conduct of the United States Antarctic Program. Other than sewage and domestic waste water, all waste items are removed from the Antarctic Treaty area and returned to the United States for recycling or disposal as appropriate.
Raytheon Polar Services Company employs a dedicated team of waste handlers experienced in the range of waste management issues. Six employees remain on station during winter to handle waste management. A weekly and annual waste management report is prepared by Raytheon.

There is little surface litter present at McMurdo Station. Large areas of the station precinct are used to store equipment and materials. Some of the items are obviously stored for use in the immediate future, such as components of South Pole station which is being rebuilt. Other materials appeared to be have been there for some years and it was not immediately obvious whether any of the items could be regarded as surplus and could be removed. We were advised that considerable efforts have been made to remove redundant materials and to make an inventory of remaining items.

**Waste disposal by removal from the Antarctic Treaty Area (Article 2)**

The following materials are removed from McMurdo Station in accordance with Annex III of the Protocol: radioactive materials; electrical batteries (segregated into types); fuels and lubricants, plastics (also segregated); off-cuts of chemically treated timber; fuel drums no longer required; and other solid wastes which are sorted before return. Organic wastes such as food and food contaminated wastes are returned frozen to the United States for disposal. Hazardous wastes and wastes containing heavy metals, acutely toxic or harmful persistent compounds are sorted, stored and packed separately for return to the United States for recycling or disposal. A large grinder is used to shred untreated timbers and surplus pallets before being baled for return to the United States. Cardboard cartons are flattened and baled for recycling.

Some wastes are recycled for use at McMurdo. This includes waste lubricants that are used to feed the boiler that heats the waste management facility. A large volume of surplus clothes, boots, domestic appliances and household goods are made available to other station personnel through an exchange facility called “Skua Central”. The hazardous waste building has a drum washer to clean fuel drums to enable them to be reused on station rather than take up valuable shipping space.

Apart from the waste management building, there is a large fenced compound for the sorting, packing and storage of wastes. Other areas around the station are used for bulk storage of packed wastes, such as strapped triwall containers of frozen food wastes awaiting removal by ship.

The Australian observer team was impressed by the degree of segregation achieved at McMurdo Station and the amount of effort put into recycling of waste. We were advised that because of the volumes produced and the discipline achieved in segregation, this is cost-effective because of the financial return for recyclable wastes. Up to 65% of returned waste is recycled.

**Waste disposal by incineration (Article 3)**

There is no evidence of open burning being conducted at McMurdo Station. No waste is destroyed by incineration. The station has a unit capable of burning oils from contaminated soils. However this unit has never been commissioned pending evaluation of its efficiency, effectiveness and the environmental impacts of operating the unit itself.

**Other waste disposal on land (Article 4)**

There was no evidence of waste disposal on land or into freshwater systems at Ross Island.

**Disposal of waste in the sea (Article 5)**

Sewage and domestic liquid wastes are discharged through a waste water treatment plant commissioned in 2003. The system consists of three parallel “trains”, two of which are required to treat the liquid waste of the station at its maximum capacity of 1,100 people. The operation of three trains enables optimum operation of the system to produce clean effluent into the sea. As noted above, there is detailed monitoring of the operation of the system to ensure a clean product. The sewage outfall is directly into the sea adjacent to the station and within a few hundred metres of the scawater intake for the reverse osmosis water production system. The system treats approximately 35 millions litres per year, and produces about 30 tonnes of compressed dried solids that are returned to the United States for incineration.

**Storage of waste (Article 6)**

All wastes to be removed from the Antarctic Treaty area are stored at the waste handling facility, mostly externally, in sealed and labelled containers awaiting shipping.
**Prohibited products (Article 7)**

A container of mixed wastes inside the waste handling building contained polystyrene chips. The Australian observer team was advised that these prohibited items appear to turn up from time to time in parcels sent through the mail system. The National Science Foundation subsequently advised that prior to deployment, all USAP participants are informed that polystyrene chips are banned in Antarctica, so that they will provide this information to those who might send packages. During the on-site mandatory waste management training, personnel are given specific instructions on the collection and disposal of polystyrene chips should these arrive via the mail system.

**Article 8: Waste management planning**

Compliance with the waste management plan is a condition of the program’s master permit under the *Antarctic Conservation Act*. All solid wastes from the field are returned to McMurdo for handling, with the exception of solid and liquid human waste in a few specified circumstances.

The Australian observer team was advised that most abandoned sites have been cleaned up or are preserved because of their historic significance. There is considerable evidence of effort over many years to clean up the McMurdo Station precinct and the immediately adjacent environs. Sites of previous waste disposal at McMurdo have been remediated. The site once occupied by the nuclear power plant has been rehabilitated and is not visible unless pointed out.

**Prevention of Marine Pollution (Annex IV)**

The United States Antarctic Program operates several ships in support of its activities at McMurdo Station. Cargo transport by ship is provided by the vessel *MV American Tern* and bulk fuel by the tanker *Paul Buck*. Other vessels supporting the program in 2004/05 are the icebreakers *USCGC Polar Star* and the chartered Russian vessel *Krasin*. The oceanographic vessel *R V Nathaniel B Palmer* visited the ice wharf at Winter Quarters Bay during the visit of the Australian observer team.

We were advised that shortly before our arrival at McMurdo Station repairs had been completed to the *Polar Star* which had been leaking hydraulic fluids through a failure of seals on one of the controllable pitch propellers. The vessel was tied up at the ice wharf while awaiting the arrival of the repair crew and the hydraulic fluid recovered using absorbent materials. Satisfactory on-site repairs were made by divers over a period of several days.

**Area protection and management (Annex V)**

**Antarctic Specially Protected Areas (Article 3)**

There are several ASPAs on Ross Island and in the Ross Sea region which are frequently visited by the United States Antarctic Program scientists. There are two ASPAs in the vicinity of McMurdo Station - ASPA 122, Arrival Heights; and ASPA 158, historic hut, Hut Point. Inspection of activities undertaken by United States personnel in these protected areas is discussed in part 7 of this report.

**Antarctic Specially Managed Areas (Article 4)**

There are no ASMAs in the immediate vicinity of McMurdo Station.

**Management plans (Article 5)**

Copies of management plans for ASPAs visited by United States Antarctic Program personnel are held at McMurdo Station.

**Permits (Article 7)**

The Australian observer team did not witness any United States personnel undertaking activities within protected areas without a permit. The McMurdo Station National Science Foundation Representative carried copies of his permit for entry to the protected areas when escorting us into the protected areas.
Historic Sites and Monuments (Article 8)

Historic sites and monuments in the vicinity of McMurdo Station are:

- **HSM 18** Hut at Hut Point erected by R F Scott in 1902, adjacent to McMurdo Station.
- **HSM 19** Vince’s memorial cross at Hut Point, overlooking Winter Quarters Bay and adjacent to Scott’s hut.
- **HSM 20** the memorial cross erected in memory of Scott overlooks McMurdo Station from Observation Hill.
- **HSM 54** the monument to Richard Byrd, erected at McMurdo Station in 1965 and currently adjacent to the National Science Foundation chalet.
- **HSM 75** “Hut A” which was constructed in 1956 for the Tran-Antarctic Expedition and is located within the boundaries of nearby Scott Base.

Other sites having historic importance for the United States Antarctic Program, but not listed under the provisions of the Protocol, are a shrine in memory of Navy employees who died in service to the program in 1956 and 1982. The oldest structure at McMurdo Station is Building 63 which is currently used for recreation.

Information and publicity (Article 9)

Information on the protected areas and historic sites on Ross Island is provided in the United States Antarctic Program Participant Guide 2004-2006.

4.4 OTHER OBSERVATIONS

Station operation

McMurdo Station is the largest facility of any national program in Antarctica. It operates as the main entry point for United States activities in Antarctica. The station supports research at Ross Island and in the Ross Sea region, but it is equally significant as the staging point for personnel, equipment and fuels to be carried onwards to the South Pole. This logistic role is also critical to the operations of the New Zealand program, and to the Italian program, both of which contribute to the logistic pool arrangement but whose demands are substantially less than the United States program. The logistic capacity of the United States Antarctic Program was evident in other ways, which also demonstrated the commitment of the United States to cooperation in Antarctica. For example, shortly before the visit of the Australian observer team the United States Antarctic Program successfully evacuated a seriously ill member of the Chinese Dome A from high on the Antarctic plateau and repatriated him through McMurdo Station to New Zealand. United States support also enabled the retrieval of a Russian aircraft that had been stranded at South Pole.

The logistic role of McMurdo Station requires supporting the nearby airfield facilities at Williams Field and Pegasus runway each of which comprises sophisticated infrastructure to support complex air operations (over 100 inter-continental and over 400 intra-continental heavy lift flights per year). The facilities at the runways are as big as the winter bases of many national programs. Accordingly, many of McMurdo Station’s facilities and its infrastructure are designed to support a high population of visitors in support of local operations, in transit to field sites, and for the handling of cargo and fuel. This requires capacity to store and handle high volumes of materials and large quantities of fuel. The level of support necessary for this extends to activities not found at other Antarctic stations, such as a scheduled shuttle bus, provision of an automated teller machine and many other services that are typical of similar sized settlements elsewhere in the world.

Station construction and design

The construction techniques employed at McMurdo Station have varied significantly over time and there is no consistent design appearance. Older buildings are prefabricated of timber and other materials and are enclosed to the ground; the newer buildings are elevated and have much greater attention to the requirements of minimising drift accumulation and achieving energy efficiency. The buildings are generally not interconnected and overall occupy a large area. The most significant recent buildings are the Crary Scientific Laboratory and the waste-water treatment plant. The backdrop of the station is a large area used for exterior storage but, that said, the whole is contained within a natural catchment sloping down to Winter Quarters Bay and once out of this valley the station is not visible. Several roads traverse the station area, link the buildings, and connect to the road that goes via nearby Scott Base to Williams Field and Pegasus runway.
**Science undertaken at McMurdo Station**

Research undertaken at McMurdo Station includes astronomy and astrophysics, biology and medicine, geology and geophysics, glaciology, ocean and climate systems. During 2004/05 these projects involved a total of around 500 scientists from multiple research institutions across the United States and well as visiting scientists from overseas organisations.

**Power generation**

The current McMurdo Station power plant was commissioned in 1981. Normally the station load is served by three of the six generators, capable of meeting the peak demand of 2300kW. Although there is no emergency power house as such, several standby generators around McMurdo Station can service critical areas during a power failure. Several station buildings are heated by waste heat recovered from the generators. The generators are currently scheduled to be replaced over the coming year with higher efficiency units expected to save over 3 millions litres of fuel per annum.

We were also shown an experimental unit for testing alternative energy generation for field use.

**Water production**

McMurdo Station produces water by reverse osmosis. Three units are on line but normally only two are required to meet peak station demand which is around 300,000 litres per day. One unit operates in winter. Waste heat recovered from the reverse osmosis system saves about 1.6 million litres of fuel that would otherwise be required for heating buildings.

**Fuel storage and handling**

The main fuels used at McMurdo Station are AN8 aviation fuel, JP5 diesel for the generators and vehicles, and mogas (unleaded petrol) for light vehicles and equipment. Around 13 million litres of AN8 are consumed annually (this includes flights throughout Antarctica), about 7.5 million litres of JP5, and about 500,000 litres of mogas. A large amount of the fuel carried at McMurdo Station is subsequently flown to South Pole. We were advised that around one litre of fuel is burned in order to deliver one litre of fuel to the South Pole - this is one of the prime motivators for investigating an overland traverse system to support South Pole station.

Bulk AN8 and JP5 are stored in four single-walled tanks standing within earth-bermed bunding. The earth berms are lined with a heavy rubberised fabric to provide a fuel tight seal. The Australian observer team noted that the liner of the containment area holding tank J7 has failed in one corner with several square metres of lining missing, but the earth berm itself intact. The National Science Foundation subsequently advised that the repair of the liner is scheduled for the 2005/06 season.

In the unlikely event of catastrophic failure of one of the main AN8 storage tanks and containment, there is a fifth tank that remains empty at all times so that fuel can be transferred in emergency situations. If more than one tank experienced a catastrophic failure at the same time, escaping fuel would be absorbed within the volcanic gravel around the fuel farm or flow through the main McMurdo station area and discharge to the sea.

Mogas is currently stored in single-walled steel tanks without containment. During our visit we observed the construction of new tanks to hold mogas within the bunded fuel farm. The decommissioned mogas tanks are being converted for use as warehouses.

Several day tanks are scattered around McMurdo Station to store fuel for individual boilers. Many of these are double-walled or mounted in steel bunds, and un-contained tanks are being progressively replaced by prefabricated 500, 1000 and 5000 gallon units. We were also advised that by next season the refuelling point for vehicles will also be mounted within a bunded containment area. Day tanks are filled from a truck-mounted tank.

Fuel is pumped ashore from the bulk tanker in a flexible hose which connects to the rigid fuel pipe system above the ice wharf. Spill containment materials are stored in a container on the ice wharf. The pipes distribute the fuel to the main diesel fuel farm and the mogas storage tanks.

AN8 is fed from the fuel farm to Williams Field by continuously welded pipe supported above ground on steel stanchions. This replaces a previously flange-jointed system which we were advised was prone to leakage at stress points. At one point, where the fuel line descends steep ground to the transition zone between Ross Island and the ice shelf, summer melting of the permafrost has resulted in some of the steel stanchions no longer providing full support to the fuel line at one of the expansion loops.
From the transition zone the fuel is carried in flexible fuel lines rolled out according to the distance and route required. Many kilometres of flexible fuel line are held on station to allow this and currently the Williams Field line is approximately 10 kilometres in length. The flexible fuel line is supported by flotation bags where it crosses open water, and rests on the snow surface of the ice shelf. The flexible fuel line is subject to weekly inspection during summer, and is rolled up and removed following the completion of the annual aviation program. The flexible and rigid fuel lines are pigged for winterisation.

All pumps and tanks are monitored during fuel transfer operations and accounting for fuel is done at each end of the delivery system by the fuel handlers. Another group is responsible for maintaining the integrity of the infrastructure such as the tanks, fuel lines, pumps and valves. Spill response is the responsibility of a further group.

**Vehicles**

Because of the complexity of the logistic support activities at McMurdo Station and the distances involved between facilities to be supported, there is a very large fleet of vehicles. There is also a large quantity of heavy earthmoving and cargo handling vehicles. Standardisation only appears to have occurred with the newer personnel transport vehicles. On the whole, the fleet of vehicles and mobile plant and equipment appears to be in good working order. At a parking area on the flanks of Observation Hill there is a large collection of old prime movers and trucks which, while possibly serviceable, appear to have had little recent use. The National Science Foundation subsequently advised that these special vehicles are required only during vessel unloading operations, which occur annually in early February.

**Road gravel**

Gravel and fines for maintaining the roads at McMurdo Station and for levelling the ground around buildings appears to be collected by simple excavation of the naturally loose surface material which is composed of volcanic scoria. There is ample evidence of earth moving in the valleys and flanks of the small hills around the station. The unaffected areas are characterised by the presence of erratic boulders.

We were advised that dust control on the McMurdo Station road network no longer involves spraying the road surfaces with oil.

**Ice wharf at Winter Quarters Bay**

The ice wharf is used to allow vessels to tie up to a secure mooring and to discharge onto a level surface directly onto cargo handling vehicles. Construction of the ice wharf is achieved by a matrix of ice and gravels tied together with steel cables. Bollards and other equipment are embedded into the ice wharf during construction. We were advised that when the ice wharf reaches the end of its safe life it is cut loose and allowed to drift away as part of the pack ice field of McMurdo Sound and eventually disappear at sea, taking with it the embedded cables. The permit for this activity requires that before being released the ice wharf must be fitted with a satellite-tracking device.

**Civilian contractor**

The great majority of personnel at McMurdo Station are employees of Raytheon Polar Services Company, a civilian contractor operating the bulk of the United States Antarctic Program on behalf of the National Science Foundation. Many of the key contractor staff have been associated with the United States Antarctic Program over a number of years and have served under previous contractors. This approach has provided benefits in maintaining a highly skilled and experienced workforce, essential in a specialised and complex operation. The Australian observer team was impressed by the high proportion of women in the McMurdo Station workforce, including in occupations that elsewhere in the world are not traditionally attractive to women. This provides a normality to the station population not often enjoyed at other Antarctic stations.

**Cooperation with Scott Base**

There is close cooperation between McMurdo Station and Scott Base. The Australian observer team was privileged to be invited to the weekly coordination meeting on 24 January 2005.

**Future development of McMurdo Station**

There are no immediate plans for large scale upgrading of the buildings at McMurdo Station. However, effort is continuing on a program of modernising the infrastructure to improve reliability and environmental performance. This is evident, for example, in the effort being put into upgrading the fuel handling systems and improvements to the efficiency of the power generation system.

**Consistency with Treaty exchange information**

The Australian observer team noted that activities at McMurdo Station are consistent with the information provided in the United States’ advance exchange of information circulated in accordance with Article VII.5 of the Antarctic Treaty.
5. OPERATIONS ON THE ROSS ICE SHELF (UNITED STATES)

The United States Antarctic Program operates two airfields on the ice shelf adjacent to Ross Island during summer. Williams Field is used for ski-equipped C130 operations to Amundsen-Scott South Pole Station and other deep field research sites. Pegasus ice runway is used for inter-continental flights between Christchurch and Antarctica. Another landing zone, known as Odell Glacier, is some 170 kilometres from Ross Island and is used only in cases of emergency when weather conditions preclude the use of the regular airfields.

In the early part of the summer the sea ice runway is used for all flights as it is substantially closer to McMurdo Station, but is decommissioned each year around mid-December as the sea ice becomes less stable. Operations then move onto the ice shelf.

The airfields are operated by the United States, with assistance from New Zealand personnel for ground services for aircraft and cargo handling.

The Australian observer team visited Williams Field on 23 January 2005 and Pegasus ice runway on 25 January. At the time of our visit Williams Field was some 10 kilometres from Ross Island, and Pegasus runway about 25 kilometres away. Connection to Ross Island is via a flagged over-snow route passable by light vehicles. However, much heavier vehicles (for example, Deltas) are used for passenger and cargo movements.

The airfields support a combined total of over 400 intra-continental flights and over 100 inter-continental flights. Considerable infrastructure is required to support the aviation operations. Apart from the runway maintenance and navigation equipment, the Williams Field facility also comprises several structures. These include communications, fire fighting and emergency services, power generation, messing and basic accommodation. The number of buildings resembles a modest Antarctic winter station. However, the entire complex is sled-mounted and can be repositioned very quickly, which occurs when the move from the sea ice runway occurs. This move takes place over a period of two days when the entire “station” is dragged up onto the shelf.

Fuel is stored in stainless steel tanks supplied by the over-ice flexible fuel line from Ross Island. Catering is provided by McMurdo Station and food is trucked out to the airfield. Sewage disposal at Williams Field is into deep holes drilled into the ice shelf.

During the visit of the Australian observer team the Williams Field site was also used as a depot for the equipment employed in the proof of concept traverse to the South Pole. The launch equipment for the very high altitude balloons was also located there.

Facilities at Pegasus runway were more limited. Apart from the runway and aircraft maintenance equipment, there are some emergency vehicles and shelters, a small generator and a modest passenger terminal. Toilet wastes are drummed and returned to McMurdo.

At the time of the visit by the Australian observer team the aircraft on the ground were United States Air Force aircraft (C17s and C130s) and New York Air National Guard aircraft (C130s). The airfields also support flights by C130s operated by the New Zealand and Italian Antarctic programmes. There were no private non-government aircraft present.

We were advised that in future seasons New Zealand intends to operate a Boeing 757 between Christchurch and Pegasus.
6. **RV NATHANIAL B PALMER (UNITED STATES)**

The Australian observer team inspected RV *Nathaniel B Palmer* on 24 January 2005 while it was tied up at the ice wharf in Winter Quarters Bay and engaged in embarking and disembarking passengers and equipment.

*Palmer* is a civilian oceanographic and marine research vessel/ice breaker flagged to the United States of America and operated by Edison Chouest Offshore Inc on behalf of the National Science Foundation. The marine superintendent at the time of our visit was Ms Alice Doyle of Raytheon Polar Services Company who showed us around the vessel.

The vessel had just completed a marine research cruise involving 39 days of research within the Antarctic Treaty area. The cruise involved 38 scientists undertaking work in oceanography, marine microbiology and geophysics. The vessel was taking a break at McMurdo Station before embarking on a further research cruise to undertake bathymetric and marine magnetic surveys between the Ross Sea and New Zealand as part of a plate tectonics research project.

The 6,172 tonne vessel is 94 metres long and has a draught of 18 metres. It was built in 1992 and is designed and equipped for navigation in ice. It is diesel powered and has a maximum speed of 14 knots. The vessel has 70 days endurance and can be refuelled at sea. The vessel has a hangar suitable for small helicopters, although none were carried at the time of our inspection.

The vessel is well equipped for marine science and has spacious wet and dry laboratories. It is equipped for CTD sampling and has an A-frame gantry for instrument towing.

No armaments were observed on the vessel and no military personnel were on board.

*Palmer* has an incinerator for at-sea waste disposal. The Australian observer team noted the presence of a current copy of the vessel’s SOPEP (shipboard marine pollution emergency plan) manual on the bridge.
7. PROTECTED AREAS ON ROSS ISLAND

7.1 ANTARCTIC SPECIALLY PROTECTED AREA 122

ASPA 122 was nominated by the United States and originally designated in 1975 as SSSI No 2. This area, which occupies approximately 1.1km², seeks to protect a natural and electromagnetically quiet site which offers ideal conditions for the installation of sensitive instruments for recording data associated with upper atmosphere research programmes. A revised management plan for the area was adopted by the ATCM in 2004. The Australian observer team visited ASPA 122 on 23 January 2005 in the company of the Scott Base Manager (New Zealand) and the National Science Foundation Representative (United States). Both carried appropriate permits from their governments for entry to the protected area.

The road to ASPA 122 from Scott Base and McMurdo has a prominent sign announcing the presence of the protected area. Otherwise, the boundaries of the area are not indicated. There is no evidence that the road to ASPA 122 is used other than by the occasional authorised visitors.

ASPA 122 contains separate laboratories and instrumentation for both the New Zealand and United States Antarctic programs.

The New Zealand laboratory at Arrival Heights contains a number of geophysical instruments. These include a Dobson spectrophotometer, a Fourier transform, an auroral all-sky camera operated on behalf of an Australian program, and induction magnetometers. During the visit of the Australian observer team a number of scientists and technicians were present for their annual maintenance visit for equipment that otherwise operates with minimal intervention during the year. These personnel were subject to a permit under New Zealand’s Antarctica (Environmental Protection) Act 1994. The New Zealand scientists advised that there are plans to upgrade the laboratory facilities to overcome overcrowding.

The United States laboratory was occupied at the time of our visit by one technician, a Raytheon Polar Services Company employee retained to maintain the equipment on behalf of scientists from several research institutions. Among the instruments in the United States laboratory at Arrival Heights are a Fabry-Perot interferometer, ELF and VLF frequency monitors and continuous UV recorders.

It was acknowledged that there is some overlap with the research between the New Zealand and United States laboratories.

The Australian observer team concluded that the use of the protected area is consistent with the purposes for which the area was designated and that activities there comply with the site’s management plan.

7.2 ANTARCTIC SPECIALLY PROTECTED AREA 158

ASPA 158 was nominated by New Zealand in 1972 and is also designated as Historic Site No 18. This area, which occupies approximately 132m², seeks to protect the structure of the hut built in February 1902 by the British National Antarctic (Discovery) Expedition of 1901-04, led by Robert Falcon Scott, and which represents one of the principal sites of the heroic age of Antarctic exploration.

The Australian observer team visited ASPA 158 on 23 January 2005 in the company of the Scott Base Manager (New Zealand) and the National Science Foundation Representative (United States). Both carried appropriate permits from their governments for entry to the protected area. The site is very close to McMurdo Station, between Hut Point and the ice wharf in Winter Quarters Bay at the end of a road that at times is subject to heavy traffic. The ASPA is jointly managed between the New Zealand and United States programs with a view to limiting total visitor numbers to 2000 people entering the historic hut in any one year. We were advised that this target is achieved.

The historic hut has been subject to considerable conservation efforts over many years involving both New Zealand and United States personnel. The structure appears sound. Internally, the hut accommodates many artefacts of the various heroic era expeditions that occupied the site. These are stacked in various positions within the hut so that they are on display. Instructions to visitors on behaviour in the hut are prominently displayed.

There are no signs to indicate the boundaries of ASPA 158 and the chains that previously surrounded the hut have been removed because they detracted from the authenticity of the hut. There is a sign in the four languages of the Treaty identifying the historic hut and its significance. This sign is on the opposite side of the hut from the direction of approach of most visitors. The hut is locked to prevent unauthorised entry.
During the visit to Scott Base the Australian observer team witnessed the briefing of a staff member wishing to visit the historic hut. Before being given the hut key the visitor was provided with an appropriate short instructional brief.

The Australian observer team concluded that activities within the protected area are consistent with the purposes for which the area was designated and that activities there comply with the site’s management plan.

### 7.3 HISTORIC SITES AND MONUMENTS

The Australian observer team inspected the following historic sites and monuments listed under Article 8 of the Protocol:

- **HSM 18** Hut at Hut Point erected by R F Scott in 1902, adjacent to McMurdo Station. As noted above, this site is also designated as Antarctic Specially Protected Area 158.
- **HSM 19** Vince’s memorial cross at Hut Point, overlooking Winter Quarters Bay and adjacent to Scott’s hut.
- **HSM 20** the memorial cross erected in memory of Scott overlooks McMurdo Station from Observation Hill.
- **HSM 54** the monument to Richard Byrd, erected at McMurdo Station in 1965.
- **HSM 75** “Hut A” which was constructed in 1956 for the Trans-Antarctic Expedition and is located within the boundaries of nearby Scott Base.

Each of these historic sites and monuments appear to be well maintained and respected by visitors to them.
8. **TOURIST ACTIVITIES ON ROSS ISLAND**

The presence of the Australian observer team at Ross Island coincided with a visit to McMurdo Station and Scott Base by passengers from the tourist vessel *Kapitan Khlebnikov*. This vessel was operated by Quark Expeditions of the United States.

The Quark Expeditions visit took place on 25 January 2005 as part of a voyage which had taken in Cape Adare, Cape Royds, and the dry valleys. The tourist expedition was carrying 98 passengers from the United States, Australia, France, Germany and Italy. The largest contingent (27 passengers) was from Australia. The passenger group comprised people from teenage to elderly. One passenger with a disability was observed to require assistance in moving about the station.

Before tourists were landed at the stations the Australian observer team was privileged to be included in a planning meeting at McMurdo Station between representatives of Quark Expeditions (including the company representative and expedition leader), personnel from McMurdo Station (including representatives of the National Science Foundation) and representatives of Scott Base (including the base manager).

It was agreed that the passengers would be flown into the station by the ship’s helicopter from the tour ship and landed at McMurdo Station. At the commencement of operations the *Kapitan Khlebnikov* was stationary in the turning basin at the southern end of the icebreaker channel. After landing and being marshalled on the foreshore below the station the passengers were taken in groups of 16 to visit the Crary Science Laboratories, the National Science Foundation headquarters, the station store, the chapel, Observation Hill and Hut Point. Refreshments were provided by the station. Each group was escorted by two volunteer McMurdo guides and one Quark staff member.

After completion of the visit to McMurdo Station the tourists were driven to Scott Base where similar tours were provided by New Zealand Antarctic Programme volunteers. The visitors were escorted through Scott Base, provided with refreshments and taken to the base shop to purchase souvenirs. On completion of the visit the tourists were returned in the ship’s helicopters to *Kapitan Khlebnikov* which by then had moved further north in the channel towards open water.

The total time ashore at the stations was about 6 hours. The tourists appeared to be made welcome by both stations and their presence did not appear to be significantly disruptive to station operations. The tourists were observed to comply with instructions given to them.

One of the passengers raised with the Australian observer team a concern about the expedition’s compliance with quarantine procedures for passengers landing ashore from the vessel after coming from New Zealand. The obligations imposed on tour operators were subsequently explained and the passenger was satisfied that those requirements had been satisfied.
9. ACKNOWLEDGMENTS

The Australian observer team gratefully acknowledges the assistance provided by Antarctic program staff on and off the ice in supporting the inspection at a time of considerable activity at the stations. That we were able to achieve so much in four days on the ice is due to their generosity in making available to us themselves and their staff to patiently answer our questions, and their logistic resources to take us where we needed to go. In particular we had essential support from:

**McMurdo Station**
- Brian Stone, NSF Representative
- Dr Julie Palais
- Dr Vladimir Papitashvili
- Nadene Kennedy
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- Alice Doyle
- Jordan Dickens
- Grace Logston
- Mark Furnish
- Dave Weber
- Glen Grant

**Scott Base**
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- Glenn Powell
- Peter de Joux
- Emile Bomer
- Robert Turner

**US National Science Foundation**
- Dr Karl Erb, Director
- Erick Chiang
- Arthur Brown

**Antarctica New Zealand**
- Mr Lou Sanson, Chief Executive Officer
- Michelle Jones
- Dr Neil Gilbert
- Paul Woodgate
- Kevin Leech
10. APPENDIXES

<table>
<thead>
<tr>
<th>Appendix A</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Zealand Antarctic Program</td>
</tr>
<tr>
<td>Antarctic Treaty Inspection Checklist</td>
</tr>
<tr>
<td>Scott Base</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Appendix B</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States Antarctic Program</td>
</tr>
<tr>
<td>Antarctic Treaty Inspection Checklist</td>
</tr>
<tr>
<td>McMurdo Station</td>
</tr>
</tbody>
</table>