Management Plan

for Antarctic Specially Managed Area No.5 AMUNDSEN-SCOTT SOUTH POLE STATION, SOUTH POLE

Introduction

The Amundsen-Scott South Pole Station (hereafter referred to as South Pole Station), operated by the United States, is located on the polar plateau at an elevation of 2835 m near the geographic South Pole at 90°S. An area of ~26,344 km^2 around the South Pole Station is designated as an Antarctic Specially Managed Area (hereafter referred to as 'the Area'). The Area has been designated in order to maximize the valuable scientific opportunities at the Pole, protect the near-pristine environment and ensure that all activities, including those to experience the extraordinary qualities of the South Pole, can be conducted safely, environmentally responsibly and without disruption to scientific programs. In order to help achieve the objectives of the Management Plan, the Area has been divided into Scientific, Operations, and Restricted zones. The Scientific Zone is further divided into four sectors: Clean Air, Quiet, Downwind and Dark. The management measures agreed for those areas help coordinate activities and protect the important values of the South Pole.

The Area was originally designated following a proposal by the United States of America and adopted through Measure 2 (2007). The current Management Plan has been comprehensively revised and updated as part of the review process required by the Protocol on Environmental Protection to the Antarctic Treaty (hereafter the Protocol).

The Area is situated within 'Environment Q – East Antarctic high interior ice sheet', as defined in the Environmental Domains Analysis for Antarctica (Resolution 3 (2008)). The Area is not classified under the Antarctic Conservation Biogeographic Regions classification (Resolution 6 (2012)).

1. Values to be protected and activities to be managed

Environmental and scientific values

The Area is located in a region of high scientific value and Amundsen-Scott South Pole Station facilitates exceptional scientific research with extensive international collaboration. The unique environmental conditions at the South Pole, including the extremely cold and dry climate, its isolated location high on an ice sheet and being the southern axis point of the Earth, provide ideal conditions to conduct a wide range of scientific observations:

- Astrophysics, atmospheric and geospace sciences – including near-Earth solar wind, magnetosphere, ionosphere, and astronomy and astrophysical studies including cosmic ray and solar physics. The South Pole's position on the Earth's axis, the Area's climatic conditions and remoteness from light pollution facilitate extended astronomical and astrophysical observations of specific stellar objects. Also, the Area's isolation from sound, vibration, and electromagnetic interference (EMI) is important for astrophysical research. The location is ideal for high-energy particle astrophysics experiments and detection of extreme energy events using instrument arrays installed into the ice sheet. The geophysically stable location of the Area and the operation of the South Pole Station year-round allow for continuous research of upper atmosphere physics, including solar processes, effects of short term geomagnetic phenomena (auroras, induced electrical currents, and radio wave communications interference), and long term events (relating to the ozone layer, ultraviolet radiation, atmospheric composition, stratospheric winds, weather, and climate). Located far from pollution sources and human influence, the air at the South Pole is considered to be the cleanest on Earth. The Area therefore serves as an important monitoring and research location for global background levels of natural and anthropogenic atmospheric constituents, and also for research into climate change.
- **Glaciology** – The thick ice sheet contains a natural record of atmospheric constituents, which is researched to understand past changes in the Earth's atmosphere and climate.
- **Seismology** – Due to its isolation from sound and vibration, one of Earth's most important seismic stations is situated in the Area.
- **Medical research** – The unique community of people living at South Pole Station allows for specialized medical research on small, isolated groups.

Historic values

The Area has significant historic value and two Historic Sites and Monuments (HSMs) have been designated at the South Pole:

- HSM No.1 was designated in 1972 at 90°S to recognise a flag mast erected at the South Pole by the First Argentine Overland Polar Expedition in December 1965. The flag mast is believed now to lie irretrievably buried deep beneath ice within ~500 m from the geographic South Pole, although its exact location is unknown.
- HSM No.80 was designated in 2005 in the vicinity of 90°S to recognise Amundsen's Tent, which was erected by the Norwegian expedition led by Roald Amundsen on their arrival at the South Pole on 14 December 1911. The Norwegian expedition was the first to reach the South Pole. The tent is believed now to lie irretrievably buried deep beneath ice within several km of the geographic South Pole, although its exact location is unknown.

The United States has established a 'Ceremonial South Pole' close to South Pole Station to commemorate the 1957/58 International Geophysical Year (IGY) and all expeditions that have achieved the South Pole.

Aesthetic and wilderness values

As unique points on the rotational axis of the Earth, the Poles have long captured the imagination of geographers, explorers and the general public. The South Pole has attracted exceptional interest because of its unique and challenging qualities, such as the ice-dominated landscape combined with remoteness, high altitude and extreme cold. The South Pole is one of the most challenging environments on Earth for human survival. Many continue to seek out that challenge for diverse reasons, including for adventure, excitement and for personal discovery and achievement. For many, whether making the journey overland or by air, attaining the Pole represents an extraordinary and highly rewarding experience.

In addition, unusual phenomena such as parhelion or sun dogs, sun pillars and mirages may occur with beautiful effects in polar clouds or in suspended ice crystals in the dry, clear atmosphere. The Aurora Australis may illuminate the sky with dramatic arcs and waves of multicolored light at times of darkness, making a most impressive display.

The extreme environmental conditions, the vast ice-bound landscape, the unusual and beautiful atmospheric phenomena, the deep sense of history of human endurance and perseverance, combined with intangible qualities in people's personal experience and relationship with the South Pole, characterize the site as one of exceptionally high aesthetic and wilderness value.

2. Aims and objectives

The aim of this Management Plan is to conserve and protect the environment surrounding the South Pole by managing and coordinating human activities in the Area such that the values of the South Pole are protected and sustained in the long term, especially the unique and outstanding scientific values.

The specific objectives of management in the Area are to:

- Facilitate scientific research while maintaining stewardship of the environment;
- Promote and assist with the planning and coordination of human activities at South Pole to manage actual or potential conflicts among different values (including those of different scientific disciplines), activities and operators;
- Ensure the long-term protection of scientific, historic, aesthetic, wilderness and other values of the Area by minimizing disturbance to or degradation of these values, including disturbance to natural features, and by minimizing the cumulative environmental impacts of human activities;
- Minimize the footprint of all facilities and scientific experiments established in the Area, while allowing for necessary modifications and improvements to these in a manner consistent with the other objectives of the Management Plan;
- Minimize any physical disturbance, release of pollutants, contamination and wastes produced within the Area, and take all practical steps to contain, treat, remove or remediate these whether produced in the course of normal activities or by accident;
- Promote use of energy systems and modes of transport within the Area that have the least environmental impact, and minimize as far as practicable the use of fossil fuels for the conduct of activities within the Area;
- Improve the understanding of natural processes and human impacts both locally within the Area and globally, including through the conduct of monitoring programs; and
- Encourage communication and co-operation between users of the Area, in particular through dissemination of information on the Area and the provisions that apply.
- Prevent the unintended introduction of species not native to the Area, and minimize as far as practicable the unintended transfer of native species within the Area;

3. Management activities

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

- Parties with an active interest in the Area should convene as required, and preferably annually, a South Pole Management Group (hereafter the Management Group) to oversee coordination of activities in the Area, including to:
  - facilitate and ensure effective communication among those working in or visiting the Area;
  - provide a forum to anticipate, identify and resolve any actual or potential conflicts in use;
  - help minimize duplication of activities;
  - maintain a record of activities and, where practical, impacts in the Area;
  - develop strategies to detect and address cumulative impacts;
  - disseminate information on the Area, in particular on the activities occurring and the management measures that apply within the Area, including through maintaining this information electronically at http://www.southpole.aq/;
  - review past, existing, and future activities and evaluate the effectiveness of management measures; and
  - make recommendations on the implementation of this Management Plan.
- National Programs operating within the Area shall maintain copies of the current version of the management plan and supporting documentation in appropriate station and research facilities and make these available to all persons in the Area, as well as electronically at http://www.southpole.aq/;
- National Programs operating within the Area and tour operators visiting should ensure that their personnel (including staff, crew, passengers, scientists and any other visitors) are briefed on, and are aware of, the requirements of this Management Plan, and in particular the General Environmental Guidelines (Appendix A), the Guidelines for the Scientific Zone (Appendix B) and Restricted Zones (Appendix C), and the Guidelines for Non-Governmental Visitors (Appendices D and E) that apply within the Area;
- National Programs operating within the Area and tour operators visiting should ensure that their personnel are briefed on, and are aware of, the risks and requirements for safety in the extreme environment at the South Pole, including in aircraft operations and in medical emergencies;
- Tour operators and any other group or person responsible for planning and / or conducting non- governmental activities within the Area should coordinate their activities with National Programs operating in the Area in advance to ensure they do not pose risks to the values of the Area and that they comply with the requirements of the Management Plan. In particular, advance coordination should be undertaken with the United States Antarctic Program as operator of Amundsen-Scott South Pole Station;
- National Programs operating within the Area should seek to develop best practices with a view to achieving the objectives of the Management Plan, and to exchange freely such knowledge and information;
- Signs and / or markers should be erected where necessary and appropriate to show the location or boundaries of zones, research sites, landing sites or campsites within the Area. Signs and markers shall be secured and maintained in good condition, and removed when no longer necessary;
- Visits shall be made as necessary (no less than once every five years) to evaluate whether the Management Plan is effective and to ensure management measures are adequate. The Management Plan, Code of Conduct and Guidelines shall be revised and updated as necessary; and
- National Programs operating within the Area shall take such steps as are necessary and practical to ensure the requirements of the Management Plan are observed.

4. Period of designation

Designated for an indefinite period.

5. Maps and Photographs

Map 1 – ASMA No.5 South Pole: Location, topography, ASMA boundary, Scientific Zone and Clean Air Sector.

Map 2 – ASMA No.5 South Pole: Management Zones and Sectors.

Map 3 – ASMA No.5 Amundsen-Scott South Pole Station: Operations Zone. Map 4 – ASMA No.5 Amundsen-Scott South Pole Station.

Map 5 – South Pole Non-Governmental Visitor approach guidelines overview. Map 6 – South Pole Non-Governmental Visitor approach guidelines detail.

Important notes on South Pole maps

The ice sheet and facilities at the South Pole move at a rate of ~10 m per year. As a result, the true positions of features shown on maps and their GPS coordinates change over time. Therefore a Local Grid is used to define all ASMA, Zone and Sector boundaries, which all move with the Local Grid. Local Grid bearings thus remain consistent relative to permanently installed facilities, which move with the ice.

Facility positions remain consistent relative to each other and to the ASMA boundaries, although their true positions shift relative to the geographic South Pole. Local Grid north aligns with the Greenwich Meridian (0 Degrees Longitude). ASMA maps are updated on a regular basis and the most current maps are made available at http://www.southpole.aq/.

6. Description of the Area

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

General description

The landscape at the South Pole comprises an extensive, gently sloping and featureless ice sheet rising to ~2835 m in elevation. The bedrock of the underlying continental landmass has an elevation of ~135 m above sea level, making the ice sheet at this location approximately 2700 m in thickness. The ice sheet over the Pole extending out to 89°S slopes in a Grid NW direction towards the Weddell Sea, ranging from ~3000 m to ~2650 m. The surface near the pole generally comprises windblown snow or sastrugi, and is otherwise featureless and not crevassed.

Boundaries and coordinates

The boundary of the Area is defined as two semi-circles extending with a radius of 20 km and 150 km respectively around the South Pole Station (Map 1). The larger semi-circle extends 150 km from a point of origin defined as the Grid SW corner of the Atmospheric Research Observatory (ARO) building (~365 m from the geographic South Pole (2017)) and is bounded by the Grid 110° and 340° lines from the ARO building. This large semi-circle comprises the Clean Air Sector (CAS) of the Scientific Zone, which shares the outer boundary of the ASMA.

The smaller semi-circle extends 20 km from a point of origin defined as the center of the circular aluminum tower staircase on the main elevated building of South Pole Station (hereafter the elevated station). The center of this staircase is the common origin of three other management sectors (Quiet, Downwind and Dark) which, together with the CAS, comprise the Scientific Zone within the ASMA. The circular aluminum tower staircase is a readily recognizable feature on the maps and on the ground, and the elevated station is expected to be present in the Area longer than any other structure or landmark.

The boundary of the Area comprises all structures and areas of current and planned research at South Pole Station and an area of sufficient size to meet the objectives of the Scientific Zone. The geographic location of the ASMA shifts by ~10 m per year along with all of the facilities as the ice sheet moves.

Climate

The climate at the South Pole Station is extremely cold, windy and arid. The average annual temperature at the South Pole is -49.4°C (-56°F). The highest temperature recorded at South Pole Station is -12.3°C (9.9°F) (on 25 Dec 2011), and the lowest is −82.8°C (−117.0°F) (June 1982).

The sun reaches a maximum elevation of 23.5° above the horizon at midsummer. Snow reflects much of the sunlight reaching the surface of the Polar Plateau.

Air humidity at the South Pole is close to zero, making the environment an extreme polar desert. Snowfall at the South Pole is minimal, with average annual precipitation being only 86 mm liquid equivalent.

Winds are persistent and average between 5-15 knots, mainly originating from a Grid northeast / east direction. Wind-blown snow tends to accumulate around structures, causing deep drifts and burying structures even though actual snowfall is low.

An analysis of surface climatology by Lazzara *et al*. (2012) found no statistically significant change in temperature or pressure at the South Pole over the period 1957–2010, although a significant downward trend was observed for wind speeds, decreasing by 0.28 m / s per decade, as well as for average snow accumulation (1983-2010), decreasing by -2.9 mm / year.

Atmospheric sciences

Pollutants from aircraft and other sources in polar regions can travel hundreds of kilometers, affecting measurements of boundary layer air, measurements of gasses and aerosols in the air column, and measurements of contaminants in the snow, thus requiring an extensive area be kept vacant to maintain a site for research on clean air. The Atmospheric Research Observatory (ARO) is situated upwind ~450 m Grid NE of the elevated station, and lies at the Grid SW corner of the Clean Air Sector (CAS). The CAS extends in a semi-circle from ARO 150 km to the outer boundary of the Scientific Zone and the ASMA, which provides the necessary buffer for ensuring accurate measurements. Most of the atmospheric research is conducted within the CAS, which is situated upwind from the station to help to ensure that the air remains as pristine as possible. The research at ARO is carried out by the United States National

Oceanic and Atmospheric Administration's Global Monitoring Division (NOAA/ESRL). Measurements are undertaken to determine long-term trends of important trace gases, aerosols, and solar radiation and to investigate the influence of these gases and aerosols on the Earth's climate (Sheridan *et al*. 2016).

Stratospheric ozone depletion is also investigated using balloon-borne instrumentation, and both scientific and operational balloon launches are made from the Balloon Inflation Facility located in the Operations Zone.

Astrophysics and Geospace sciences

Most research projects related to astrophysics and geospace sciences are conducted within the Dark Sector, an area which has been set aside with the aim to reduce light and EMI as far as possible within this area.

The Dark Sector Laboratory is home to the South Pole Telescope (SPT). The SPT can detect Cosmic Microwave Background (CMB) Radiation and one of its main aims is to develop understanding of the expansion of the Universe from the time of the 'Big Bang' by identifying galaxy clusters where CMB radiation has been altered by concentrations of dark matter (Carlstrom *et al*. 2011; Reichardt, de Haan & Bleem 2016). The SPT will form part of the Event Horizon Telescope, an array of telescopes distributed worldwide which will synthesise together an earth-sized telescope. The Dark Sector Laboratory also houses the BICEP detectors, which have been operational since 2006. These experiments aim to detect B- mode polarization, with each generation of BICEP increasing the number of detectors and thus the sensitivity to B-mode polarization (Ade *et al*. 2015).

The Martin A. Pomerantz Observatory (MAPO) is also situated inside the Dark Sector. It houses equipment for several research projects, one being the Small Polarimeter Upgrade for DASI (SPUD), which is also designed to measure B-mode polarization.

The IceCube Laboratory, a neutrino detector, is also located in the Dark Sector. IceCube is a form of telescope comprising over 5100 spherical sensors buried in one cubic kilometre of ice. The experiment was built to investigate neutrino properties and the nature of dark matter. Since operation commenced in 2010, IceCube has observed for the first time the astrophysical high-energy neutrino flux, it has measured the cosmic-ray anisotropy for the first time in the southern hemisphere, it has produced the world's best limits on the spin-dependent cross section for weakly interacting dark matter particles, and it has made the most detailed measurements of the properties of light propagation in Antarctic ice (Aartsen *et al*. 2016, 2017).

The Askaryan Radio Array (ARA) is a novel detector under construction in the Dark Sector which aims to discover extreme energy events using sub-surface radio antenna arrays (Allison *et al*. 2015, 2016).

South Pole is part of the Antarctic Gravity Wave Imaging Network (ANGWIN). The aim of ANGWIN is to collect continent-wide gravity wave measurements. At South Pole, measurements are focused on quantifying the temperature signatures of gravity waves deep within the polar vortex (Mehta *et al*. 2017).

A SuperDARN (Dual Auroral Radar Network) array was established at South Pole in the Operations Zone in 2013, and the array helps fill a gap in studies of auroral physics over the Antarctic (Makarevich, Forsythe & Kellerman 2015).

Glaciology

Snow accumulation has been monitored intermittently at the South Pole since the 1957/58 International Geophysical Year (IGY). An extensive network of measurement locations to monitor long-term snow accumulation around the South Pole was established in 1992 (Mosley-Thompson *et al*. 1999). The network of measurement stakes extends out 20 km in all directions from the Pole; it is essential for the research being conducted on snow accumulation that the stakes and the area around the stakes are not disturbed. Data collected between 1958-97 showed net annual accumulation rates increased over this period (Mosley-Thompson *et al*. 1999), which is in contrast to the more recent results reported by Lazzara *et al*. (2012) for the period 1982-2010 showing a decrease.

Ice core drilling is also conducted at South Pole. SPICECORE, which was drilled during the 2014/15 and 2015/16 seasons, will provide records of stable isotopes, aerosols and atmospheric gases dating back ~40,000 years.

Seismology

Seismological data have been collected at the South Pole since the 1957/58 IGY. Conditions at the South Pole are ideal for investigating earthquakes and the structure of the Earth. The energy levels of vibrations from seismic events travelling through the Earth and the polar ice sheet are recorded by seismometers at the South Pole. Because of its position at the Earth's axis of rotation, measurements at the Pole of the energy generated by major earthquakes are not affected by the rotational forces which influence recordings elsewhere on Earth. The South Pole Remote Earth Science and Seismological Observatory (SPRESSO) is situated ~7.5 km from South Pole Station inside the Quiet Sector. The instruments are buried ~300 m deep in the ice recording vibrations of the Earth. Due to the lack of other vibrations in the area which can generate seismic 'noise', the instruments at South Pole can detect vibrations up to four times quieter than other observatories on earth.

Medical research

Due to its isolated environment South Pole Station is ideal for medical research focusing on evaluations of social behaviour and human physiology. Research at the South Pole on sleep patterns has examined the role of total darkness on sleep quality and mood characteristics. Studies have also been undertaken at the South Pole on the effects of isolation and confinement on depression, fatigue, vigor, and anxiety. This research is important for determining the performance capabilities of people working in isolated environments. Research has also been conducted on high altitude illness (Anderson *et al*. 2011).

Historic features

Two Historic Sites and Monuments (HSM) have been formally designated within the Area (HSM No.1 and HSM No.80), and these are described in Section 6(iv).

A marker surrounded by the flags of the original twelve signatory nations of the Antarctic Treaty, known as the Ceremonial South Pole, has been erected by the United States ~150 m grid north of South Pole Station and lies ~200 m from the geographic South Pole. The Ceremonial South Pole commemorates the 1957/58 IGY as well as all expeditions that have reached the South Pole.

Human activities / impacts

Following attainment of the South Pole by the Amundsen and Scott expeditions in 1911/12, no further visits were made to the South Pole until the 1957/58 IGY when a permanent station was established there by the United States. Amundsen-Scott South Pole Station has had several major upgrades, the most recent being the opening of the elevated station in 2008. The main activity at the South Pole is science. The remoteness, scale and types of science being conducted require significant logistical support, including a major ski-way for large transport aircraft, substantial fuel storage and power generation facilities, and accommodation and scientific laboratories. Further information about structures at the South Pole is provided in Section 6(iii).

Non-Governmental Visitors (NGVs) on expeditions or as tourists comprise the other main activity at the South Pole. Over the five-year period between 2006-11 an average of approximately 190 people per season visited the South Pole on private expeditions. The highest number to date was recorded in 2011/12 with 495 visitors, which is almost double the previous high of 266 recorded in 2010/11. This peak was driven by a surge of interest in the South Pole surrounding the centennial years of Amundsen's and Scott's expeditions. Around 230 NGVs were recorded in 2015/16, close to the level seen immediately prior to the centennials.

Approximately 750,000 liters (198,000 gallons) of diesel fuel is stored in tanks at the South Pole, the volume necessary to maintain safe operations at South Pole Station, which is used for power, aircraft, vehicles and heavy machinery. In the winter of 1989 150,000 liters (40,000 gallons) of this fuel leaked into snow at South Pole and was unrecoverable (Wilkniss 1990), which represents the most substantial single contamination event at South Pole to date. Emissions from diesel generators and engines probably account for the majority of contaminants on a continuous basis, although these are dispersed and diluted by persistent winds generally towards the area Grid SW from the station.

6(ii) Restricted and managed zones within the area

This management plan establishes three types of zones within the Area: Operations, Scientific, and Restricted. The management objectives of the different types of zone are set out in Table 1. Maps 1 and 2 show the extent of the Scientific Zone, while Map 3 shows the extent of the Operations Zone and the Restricted Zones.

A new zone or zone type may be considered by the Management Group as the need arises, and those no longer needed may be delisted. Zoning updates should be given particular consideration at the time of Management Plan reviews.

Table 1: Management Zones designated within the Area and their specific objectives.

Management Zones	Specific Zone Objectives	Plan Appendix
Operations Zone	To ensure that science support facilities and related human activities within the Area are contained and managed within a designated area.	-
Scientific Zone	To ensure those planning science or logistics within the Area, and all visitors to the Area, are aware of sites of current or long-term scientific investigation that may be sensitive to disturbance or have sensitive scientific equipment installed, so these may be taken into account during the planning and conduct of activities within the Area. A particular objective of the Scientific Zone is to minimize conflicts between different types of use.	B
Restricted Zone	To restrict access into a particular part of the Area and/or activities within it for a range of reasons, e.g. owing to special scientific values, because of sensitivity, presence of hazards, or to restrict emissions or constructions at a particular site. Access into Restricted Zones should normally be for compelling reasons that cannot be served elsewhere within the Area.	C

The overall policies applying within the zones are outlined in the sections below, while detailed guidelines for the conduct of activities within the Scientific Zone are found in Appendix B and within the Restricted Zones in Appendix C.

Operations Zone

The Operations Zone (Maps 3 and 4) has been established to contain primary human activity in the Area, including science support activities, main station services (e.g. living facilities), ski-way operations, and on-ground support facilities for Non-Governmental Visitors (NGVs).

The boundary of the Operations Zone (Map 3), described clockwise from ARO, extends ~1.85 km Grid SE 110° from ARO, following the southern boundary of the Clean Air Sector. Thence the Operations Zone boundary extends ~3.75 km Grid 243° SW, sharing the boundaries of the Quiet Sector and Downwind Sector. Thence the Operations Zone boundary extends ~1.3 km Grid 202° SSW, following the boundary of the Aircraft Operations Restricted Zone around the Grid southern end of the ski-way. The boundary thence extends ~3.6 km Grid 158° NNE along the Grid western boundary of the Aircraft Operations Restricted Zone, parallel to the ski-way and to its Grid northern end. The Operations Zone boundary continues in the same direction a further ~1.3 km beyond the Grid northern end of the ski-way to the Clear Air Sector boundary. Thence the Operations Zone boundary follows the Clean Air Sector boundary back to ARO ~1.15 km Grid SE (following the Grid 340° line from ARO). The Operations Zone is ~430 ha in area.

The following provisions should be observed within the Operations Zone:

- Waste minimization and management should be considered in the planning, maintenance and decommissioning of facilities within the Operations Zone;
- Alternative energy sources and energy efficiency should be considered in the planning and maintenance of facilities within the Operations Zone;
- Contingency plans for emergencies in the Operations Zone should be developed as appropriate by the National Program(s) operating in the Area;
- The installation of any new structures or modernization of existing structures in the Operations Zone may from time to time be necessary. The National Program(s) operating in the area should review and coordinate any plans for construction or installations to ensure that any impacts on scientific activities and values are minimized. Any change is subject to environmental assessment as required by Article 8 of the Protocol.
- Specific guidelines for Non-Governmental Visitors (NGVs) within the Operations Zone are described in Appendix D of this management plan.

Scientific Zone

The Scientific Zone has been established to avoid mutual interference and / or conflicts between multiple activities, and in particular to protect scientific research from disturbance that could affect results. The Scientific Zone encompasses the majority of the ASMA, with the outer boundary defined by and coincident with the ASMA boundary (Map 1). The inner boundary of the Scientific Zone is defined by, and coincident with, the boundary of the Operations Zone (Maps 2 and 3).

The Scientific Zone is divided into four Sectors – Clean Air, Quiet, Downwind and Dark – to ensure that scientific activities with particular sensitivity are strategically located so the potential for interference is minimized. Of particular concern are interference from sound, light, vibration, contamination from local sources of pollutants, and visual obstruction. Entry to and activities within the Sectors should not interfere with scientific research.

The boundaries of the Sectors and the specific guidelines and operational policies applying within them are defined in Appendix B.

Restricted Zones

Restricted Zones have been designated at sites where access and / or activities need to be restricted to ensure scientific values are maintained, or for reasons of safety. Access to Restricted Zones is prohibited except by authorized personnel for essential scientific, operational or management purposes. There are six Restricted Zones in the ASMA, all located within or near the Operations Zone (Maps 3 and 4): details of the boundaries and restrictions applying within the Restricted Zones are provided in Appendix C.

The National Program(s) operating in the Area or expedition leaders from other groups should ensure that all visitors to the Area are informed of the boundaries and purposes of the Restricted Zones and the entry restrictions that apply.

6(iii) Structures within and near the Area

The first station at the South Pole was established by the United States in the 1956/57 austral summer for the 1957/58 International Geophysical Year (IGY). A permanent research facility named Amundsen-Scott South Pole Station has been operated at the South Pole continuously by the United States since, although with several major facility replacements and additions. Wind-blown snow accumulation is a perennial problem and without clearance structures can become buried. The first station, now referred to as 'Old Pole', was crushed by the weight of snow and ice and had to be abandoned deep under the surface. More recently, the geodesic dome that replaced 'Old Pole' was removed before it became submerged by ice.

The replacement main building (Map 4), dedicated in 2008, is elevated above ground level in order to minimize snow accumulation, and is referred to as the elevated station. In addition to dining and sleeping accommodation for up to ~150 people, the facilities include a computer laboratory, meeting rooms, lounges, a gym, medical surgery, emergency power plant, and a hydroponic greenhouse. The elevated station has a floor area of ~6000 m^2 (65,000 ft^2). Fuel storage and power generators to support station operations are located in the nearby sub-surface fuel arches.

In the summer South Pole Station accommodates up to a maximum of ~150 scientists and support personnel, while during winter this reduces to ~45 to maintain the station and run experiments. If required, up to ~18 additional personnel can be housed in the nearby 'hypertats' (Map 4). The station is completely isolated between mid-February and late-October, when air and overland support to the Pole are generally not undertaken because conditions are so extreme.

Other structures at the South Pole include the Atmospheric Research Observatory (ARO), located ~450 m Grid NE from the elevated station, air operations facilities and passenger terminal, fuel tanks, antennae, 'Summer camp' buildings, and maintenance offices. Three principal science buildings are located in the Dark Sector, including the IceCube Neutrino Observatory, the Dark Sector Laboratory which houses the South Pole Telescope (SPT), and the Martin A. Pomerantz Observatory (MAPO) where a range of astrophysics and geospace science projects are undertaken.

Two Automatic Weather Stations (AWS) are situated in the Clean Air Sector ~110 km from ARO. AWS 'Henry' is located at Grid north (-89.001° S, -0.391° W) and AWS 'Nico' is located Grid east (-89.0° S, 90.024° E). The AWS were installed in 1993; maintenance access is made by small aircraft, with the most recent in January 2015 when tower heights were increased to account for snow accumulation.

All permanent facilities at the South Pole have been constructed by the United States Antarctic Program. Temporary camp facilities are erected in the summer by Non-Governmental Visitors (NGVs) to the South Pole, and these are located ~1 km Grid north from the elevated station in an area that does not conflict with science or support operations. A second NGV camp typically used by vehicle expeditions is located outside of the Area just over 20 km Grid NW of the South Pole. Each summer, a small temporary building is usually placed by USAP near the aircraft parking area close to the Ceremonial South Pole for use by NGVs as a shelter and for science interpretation.

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

There are no Antarctic Specially Protected Areas within or near the ASMA. Two Historic Sites and Monuments have been designated within the Area:

Historic Site and Monument No. 1 (HSM No. 1), located at the South Pole 90°S: Flag mast erected in December 1965 at the South Geographical Pole by the First Argentine Overland Polar Expedition. The precise location or continued existence of the flag mast is not known.

Historic Site and Monument No. 80 (HSM No. 80), located in the vicinity of the South Pole 90°S: Amundsen's tent. The tent was erected at 90°S by the Norwegian group of explorers led by Roald Amundsen on their arrival at the South Pole on 14 December 1911. The tent is assumed to have become buried deep under ice in the vicinity of the South Pole, although the precise location is not known.

7. General Code of Conduct

7(i) Access to and movement within the Area

Air access to the Area is usually made by ski-equipped fixed-wing aircraft, and visits made by helicopter are rare. Overland access to the Area is made by vehicle, on ski or on foot. For safety reasons, all visitors to the Area should give prior notification of their visit to the National Program(s) operating in the Area. In particular, prior permission is required from the United States Antarctic Program for use of the ski-way.

Additional requirements are detailed below for access to the Area by aircraft. Coordination with National Program(s) operating in the Area does not imply any liability of those National Program(s) for any accident or injury incurred at any time during the expedition.

Access to the Area both by air and overland should avoid the Clean Air Sector of the Scientific Zone (Map 1). Access to the Restricted Zones within the Area is generally prohibited except by authorized personnel as detailed below and in Appendix C.

Aircraft access and overflight

The ski-way and associated infrastructure have been established and are maintained by the National Program(s) operating in the Area and are essential to the operations and safety of personnel in the Area. Use of the ski-way and associated infrastructure is therefore restricted to the National Program(s) operating in the Area unless prior permission has been granted by those National Program(s) for aircraft access by other visitors. The entire ski-way and associated aircraft taxi, fuelling and parking areas lie within the Aircraft Operations Restricted Zone (Appendix C), where access is restricted according to the provisions set out below.

Use of wheeled aircraft on the ski-way is prohibited.

All pilots visiting the Area should refer to the latest version of the Antarctic Flight Information Manual (AFIM) for specific details regarding access to the area via aircraft and requirements for prior approval for ski-way use.

Specific restrictions on aircraft access to and overflight within the Clean Air Sector are detailed in the Guidelines for the Scientific Zone (Appendix B).

Aircraft access and overflight by National Programs

- National Program(s) intending to access the Area by aircraft, including for overflight, should coordinate with the National Program(s) operating in the area to ensure there will be no conflicts with ongoing activities.
- Advance planning and communication, consistent with the Antarctic Treaty's Information Exchange requirements, with confirmation at least 24 hours prior to arrival, is necessary to avoid conflicts.
- Pilots approaching the ski-way should notify Amundsen-Scott South Pole Station Communications Center (COMMs) at least 30 minutes prior to landing at the South Pole to allow time to clear the ski- way, and should confirm again their approach 10 minutes before landing.

Aircraft access and overflight by other expeditions

- Approval of ski-way use for an activity not associated with a National Program does not need to include a full safety review of an expedition or its flight plan, and does not imply any liability of those National Program(s) responsible for operating the ski-way for any accident or injury incurred at any time during the expedition.
- Non-Governmental Visitors (NGVs) seeking prior approval to access the Area by aircraft or use the ski-way should refer to the requirements and procedures for approval in the AFIM and contact the appropriate National Authorities.

Ski-way access and crossing

- The ski-way and associated aircraft taxi, refuelling and parking areas are located entirely within the Aircraft Operations Restricted Zone (Appendix C and Map 3) where access is prohibited except by authorized personnel;
- Pilots, logistics personnel, and passengers on aircraft are authorized to move to and from aircraft as necessary and in accordance with operational procedures within the Aircraft Operations Restricted Zone;
- Station personnel and Non-Governmental Visitors are authorized to cross the aircraft taxi area at the Grid northern end of the ski-way at the designated crossing point, located where red beacon lights are installed on the road between the elevated station and Dark Sector science buildings (Map 4);
- Crossing the aircraft taxi area is prohibited when the red beacon lights are flashing, warning that aircraft movements in the vicinity are imminent;
- The ski-way should only be crossed in other areas as absolutely necessary, or as authorized, or in an emergency.

Vehicle access and use

- Vehicles should stay on marked trails to the maximum extent practicable and observe the requirements of the ARO 'No Vehicle' and ARO 'Meteorological Tower' Restricted Zones (Appendix C);
- Vehicles should not be driven within 50 m of the geographic South Pole;
- Vehicles should avoid the Clean Air and Quiet Sectors except as required for essential scientific, operational and management purposes and observe the Guidelines for the Scientific Zone (Appendix B).

Pedestrian access and movement within the Area

- Pedestrians should stay on marked trails to the maximum extent practicable;
- Pedestrians should avoid the Clean Air and Quiet Sectors except as required for essential scientific, operational and management purposes and observe the Guidelines for the Scientific Zone (Appendix B).

Access to buildings and facilities

Access to buildings and facilities in the Area operated by National Program(s) should be made only with permission from the responsible Program. For restrictions on access to specific structures and their surrounding areas, see the Guidelines for the Scientific Zone (Appendix B) and for Restricted Zones (Appendix C).

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

All activities in the Area should be conducted in a manner that is in accordance with the requirements of this Management Plan and will preserve the values of the Area to the greatest extent practicable.

Parachute operations from aircraft over or near the ski-way or other infrastructure in the Area should not be conducted unless specific written authorization is provided in advance by the United States Antarctic Program, which operates South Pole Station and the ski-way.

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

Care should be exercised when locating and establishing installations to minimize the risk of mutual interference between different scientific activities, or between science and operations activities, and of their impact on the environment. In particular, installation, modification or removal of structures within the Area should be planned taking into account the different objectives of the Scientific Zone Sectors to help ensure that the potential for conflicts is minimized.

Consideration should be given to maximizing the use of existing facilities before new facilities are constructed, and the footprint of all installations should be kept to the minimum practicable. In general, permanent or semi-permanent structures primarily needed for station logistics and operations should be installed within the Operations Zone, unless they are small in size and pose no significant threat to the values of the Area (e.g. an Automatic Weather Station (AWS) or a small radio repeater with minimal associated infrastructure).

All installations should be maintained while operational and removed when no longer necessary. Installations should be identified by the National Program responsible, name of the principal investigator and year of installation. The types of installations and their coordinates should be recorded by the responsible National Program in a facilities database, with this information made available as necessary.

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

7(iv) Field camps

Non-Governmental Visitors (NGVs) to the South Pole should camp at the designated field camp site located within the Operations Zone ~1 km Grid north from the elevated station (Maps 3 and 4).

A small field camp is occasionally established to support NGVs travelling to the South Pole by vehicle, which is located ~300-400 m outside of the boundary of the ASMA, just over 20 km Grid NW from the South Pole.

Field camps shall be maintained while operational and removed when no longer necessary.

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

Not applicable.

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

Long-term research to establish global baselines and trends for atmospheric trace gases and pollutants is being carried out using highly sensitive instruments at ARO. It is important that air sampled remains as pristine as possible. For this reason, those chemicals listed in Table B.1 of the guidelines for the Clean Air Sector (Appendix B), or products and equipment that contain or emit them, are prohibited within the CAS and at ARO. All visitors to the South Pole should, to the maximum extent practicable, seek to avoid bringing those chemicals listed in Table B.1 into the Area.

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

Collection and use of snow and ice for water supplies essential to support National Programs or Non- Governmental Visitor (NGV) expeditionary activities is permitted. It is prohibited to damage, remove or destroy any historic artifacts listed as Historic Sites and Monuments under Article 8.4 of Annex V to the Protocol (see Section 6(iv) for a list of designated sites within the Area). All other material found within the Area should only be collected or removed for essential scientific, educational or management purposes and should be limited to the minimum necessary for those needs. Any meteorites taken are to be collected and curated according to accepted scientific standards, and made available for scientific purposes. Material of human origin likely to compromise the values of the Area should be removed unless the impact of removal is likely to be greater than leaving the material in place. If this is the case the appropriate authority should be notified.

7(viii) Waste management

- For the National Program(s) operating in the Area:
  - All waste shall be removed from the Area except human and domestic liquid wastes which may be deposited into deep sewer bulbs beneath the ice surface, or disposed of by other methods in accordance with Annex III of the Protocol;
- For other expeditions to the Area:
  - All wastes, including all human and domestic liquid wastes, shall be removed from the Area.

7(ix) Requirements for reports

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

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

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

8. Provisions for the Exchange of Information in Advance of Proposed Activities

In addition to the normal exchange of information by means of the annual national reports to the Parties of the Antarctic Treaty, Scientific Committee on Antarctic Research (SCAR), and Council of Managers of National Antarctic Programs (COMNAP), Parties operating in the Area should exchange information in advance through the Management Group. All National Programs intending to visit or conduct research in the ASMA should contact the National Program(s) operating in the Area sufficiently in advance of the activity to allow for coordination of planned activities with ongoing activities in the Area.

All visitors intending to use the skiway are required to provide advance notification to the United States Antarctic Program, as detailed in Section 7(i) of this Management Plan.

Tour operators and other Non-Governmental Visitors to the Area shall provide advance notification of their visit schedules to National Program(s) operating in the Area.

9. Supporting Documentation

Electronic information

The Management Group has established a website (http://www.southpole.aq) for the purpose of providing additional information and supporting documentation on the environment, science and activities at South Pole, including up-to-date management documents, maps, descriptions and policies.

Because of the steady ice movement at the South Pole there is a need for regular map updates, and the most recent versions are made available at www.southpole.aq/maps.

References

Aartsen, M.G. *et al.* 2016. Search for annihilating dark matter in the Sun with 3 years of IceCube data. *arXiv*: 1612.05949 [astro-ph. HE].

Aartsen, M.G. *et al.* 2017. Neutrinos and Cosmic Rays Observed by IceCube. *arXiv*: 1701.03731 [astro- ph.HE].

Ade, P.A.R. *et al.*2015.BICEP2 / Keck Array V: Measurements of B-mode polarization at degree angular scales and 150GHZ by the Keck Array. *arXiv:*1502.00643v2 [astro-ph.HE].

Allison, P. *et al*. 2015. First Constraints on the Ultra-High Energy Neutrino Flux from a Prototype Station of the Askaryan Radio Array. *arXiv*: 1404.5285v3 [astro-ph.HE].

Allison, P. *et al*. 2016. Performance of two Askaryan Radio Array stations and first results in the search for ultra-high energy neutrinos. *arXiv*: 1507.08991v3 [astro-ph.HE].

Anderson, P.J., Miller, A.D., O'Malley, K.A., Ceridon, M.L., Beck, K.C., Wood, C.M., Wiste, H.J., Mueller, J.J., Johnson, J.B., & Johnson, B.D. 2011. Incidence and Symptoms of High Altitude Illness in South Pole Workers: Antarctic Study of Altitude Physiology (ASAP). *Clinical Medicine Insights: Circulatory, Respiratory and Pulmonary Medicine* **5**: 27–35.

Carlstrom, J.E. *et al*. 2011. The 10 Meter South Pole Telescope. *Publications of the Astronomical Society of the Pacific* **123**: 568-81.

Lazzara, M.A., Keller, L.M., Markle, T. & Gallagher, J. 2012. Fifty-year Amundsen-Scott South Pole station surface climatology. *Atmospheric Research* **118**: 240-59.

Makarevich, R.A., Forsythe, V.V. & Kellerman, A.C. 2015. Electric field control of E region coherent echoes: Evidence from radar observations at the South Pole. *Journal of Geophysical Research: Space Physics* **120**: 2148-65.

Mehta, D., Gerrard, A.J., Ebihara, Y., Weatherwax, A.T. & Lanzerotti, L.J. 2017. Short-period mesospheric gravity waves and their sources at the South Pole. *Atmospheric Chemistry and Physics* **17**: 9141-19.

Mosley-Thompson, E., Paskievitch, J.F., Gow, A.J. & L.G. Thompson. 1990. Late 20th century increase in South Pole snow accumulation. *Journal of Geophysical Research* **104**(D4):3877-86.

Reichardt, C.L., de Haan, T. & Bleem, L.E. 2016. The South Pole Telescope: Unravelling the Mystery of Dark Energy. *International Journal of Modern Physics: Conference Series* **43**: 1-9.

Sheridan, P., Andrews, E., Schmeisser, L., Vasel, B. & Ogren, J. 2016. Aerosol Measurements at South Pole: Climatology and Impact of Local Contamination. *Aerosol and Air Quality Research* **16**: 855-72.

Standing Committee on Antarctic Logistics and Operations (SCALOP) and the Council of Managers of National Antarctic Programs (COMNAP). *Antarctic Flight Information Manual: A Handbook of Antarctic Aeronautical Information*. (See most recent update).

Wilkniss, P. 1990. Fuel spill cleanup in the Antarctic. *Antarctic Journal of the United States* **25**(4): 3-10.

APPENDIX A

General Environmental Guidelines for the South Pole

The South Pole has unique properties that make it an ideal location for certain types of scientific research. For example, its position remote from human influence makes it ideal for monitoring global background levels of atmospheric constituents. Isolation from light pollution, electromagnetic interference (EMI), sound and vibration, is important for astrophysical research, with the latter two being especially valuable for seismological observations. The thick ice sheet contains a natural record of atmospheric constituents that can be analysed to interpret past climate, and is also an ideal medium for installation of sensitive instruments to detect sub-atomic particles. The position on the Earth's axis of rotation is advantageous for many atmospheric and space science studies. It is important that guidelines are followed so that these qualities may be protected to the fullest extent practicable so that the productivity of the research can be maximized.

Before you travel to the Area:

- Ensure that your planned activities follow the requirements of the Code of Conduct in the Management Plan, the Environmental Guidelines in Appendix A, the specific guidelines that apply within the Scientific Zone (Appendix B), guidelines for Restricted Zones (Appendix C), and the guidelines for Non-Governmental Visitors in Appendices D and E.
- Plan all activities such as scientific experiments, installation of equipment, travel, camps, fuel handling, and waste management, with the aim of minimizing environmental impacts.
- Ensure that all equipment, supplies and packaging are planned so as to avoid to the maximum extent practicable those compounds listed in Table B.1, Appendix B, as prohibited within the Clean Air Sector (CAS) and at the Atmospheric Research Observatory (ARO).
- Ensure that all equipment, supplies and packaging are planned so as to minimize the amount of waste generated when at South Pole.

Travel and activities within the Area:

- Where practicable, keep to designated or established tracks, and be aware of the site-specific guidelines in Appendices B and C, and in particular avoid the Clean Air and Quiet Sectors and the Restricted Zones, where prior authorization is required for access.
- Vehicles should avoid the ARO 'No Vehicles' and ARO 'Meteorological Tower' Restricted Zones (Appendix C).
- Observe the designated crossing point and beacon warnings on the road between the elevated station and the Dark Sector science buildings.
- Where practicable, vehicles should be parked over a secondary containment unit or a drip tray.
- The ski-way should be marked so it is clearly visible from the air and markers used should be well-secured and durable.

Field camps: location and set up

- Non-Governmental Visitors should use the designated campsite within the Operations Zone when camping within the Area.
- The footprint of the designated campsite should be the minimum size practicable.
- Ensure that equipment and supplies are properly secured at all times to avoid dispersion by wind.

Use of materials and energy:

- Everything taken into the Area should generally be removed to the maximum extent practicable.
- Activities that could result in the dispersal of foreign materials should be avoided (e.g. use of flares) or should be conducted inside a building or tent (e.g. when cutting, sawing or unpacking materials).
- Explosives should not be used within the Area, unless approved by a National Program for use in support of essential scientific or management purposes.
- Where possible, ensure that nothing is left frozen into snow or ice that may ablate out and cause later contamination.
- Use energy systems and modes of travel within the Area that have the least environmental impact as far as practicable, and minimize the use of fossil fuels.

Fuel and chemicals:

- Steps should be taken to prevent the accidental release of fuel or chemicals. For example, regular checks should be made to ensure all fuel valve positions are correctly set, and fuel line couplings are sealed and secure.
- Ensure that spill kits and secondary containment units appropriate to the volume of the substance are available when using chemicals or fuels. Those working with chemicals and fuels should be familiar with their use and with appropriate spill response procedures.
- Chemical and fuel containers should be securely positioned and sealed, particularly when stored outside.
- All fuel drums should be stored with secondary containment.
- Fuel cans with spouts should be used when refuelling generators or vehicles.
- Vehicle oil changes should be carried out with adequate provision for containment and preferably inside.
- Generators and vehicles should be refuelled over drip trays with absorbent spill pads when outside.

Waste and spills:

- Clean up any spills and / or releases to the maximum extent possible and report the location(s) including coordinates, to the appropriate National Program.

APPENDIX B

Guidelines for the Scientific Zone

The Scientific Zone encompasses the majority of the ASMA and is divided into four Sectors – Clean Air, Quiet, Downwind and Dark (Maps 1-4). The Clean Air Sector (CAS) ensures a near-pristine air- and snow-sampling environment for atmospheric and climate systems research. The Quiet Sector is an area where noise and equipment activities are limited to minimize vibration effects on seismological and other vibration-sensitive research. The Downwind Sector provides an area free from obstructions for balloon launches, aircraft operations, and other 'downwind' activities. The Dark Sector aims to provide an area of reduced light pollution and low electromagnetic noise to help facilitate astronomy and astrophysical research. Following are descriptions of the objectives of and special guidelines for activities in each sector of the Scientific Zone.

Clean Air Sector

The Clean Air Sector (CAS) is established to preserve the unique conditions that are required for atmospheric research at the South Pole Station. The Earth's atmosphere near the South Pole is remote from worldwide human influence, and a predominant northerly (Grid) wind means the Atmospheric Research Observatory (ARO) is situated upwind of all other facilities more than 90% of the time. These natural conditions allow for nearly continuous measurement of important trace constituents of the atmosphere in a location remote from anthropogenic inputs. The air sampled at the South Pole is representative of the background atmosphere of the planet and may be characterized as the 'cleanest air on Earth'.

Geographic boundaries of the Clean Air Sector

The Clean Air Sector is a wedge-shaped area extending 150 km upwind (grid northeast) of the Atmospheric Research Observatory (ARO) at South Pole Station and the ski-way (Maps 1 to 4). Overland and air access to the CAS are restricted to maintain the scientific value of the Sector. The Clean Air Sector is defined by the following boundaries:

- A line extending 150 km (81 nautical miles) Grid 340° from the SW corner of the ARO building.
- A line extending 150 km (81 nautical miles) Grid 110° from the SW corner of ARO building.
- A semi-circular arc connecting the above two lines, extending ~340 km and maintaining a constant distance of 150 km (81 nautical miles) from the SW corner of the ARO building.

The United States National Oceanic and Atmospheric Administration (NOAA) has conducted many hours of aircraft air pollutant measurements and data show that plumes can be traced for hundreds of miles in stable air. To protect measurements at the ARO and in the snow within the Clean Air Sector it was recommended that aircraft fly above 2000 m (6000 ft) to remain above the boundary layer air and to limit deposition of particles and gas at the snow surface. The 150 km radius was selected as a reasonable buffer distance, although Arctic studies suggest that twice that distance is justifiable.

Aircraft overflight and landing restrictions in the Clean Air Sector

- Aircraft overflight below 2000 m (~6000 ft) and landings within the Clean Air Sector are prohibited except for essential scientific, operational or management purposes (e.g. aviation authority checks (e.g. United States Federal Aviation Authority), scientific missions, aerial photography, emergency flight paths etc.), which must be approved in advance in consultation with the National Program(s) operating within the Area.
- Pilots of any aircraft entering the Clean Air Sector are requested to fly in such a manner that will help to minimize potential contamination (e.g. avoid steep ascents, avoid repeat circling, take the most direct practicable route etc.).

Overland access restrictions to and within the Clean Air Sector

- Activities, structures, and instrumentation located within the Clean Air Sector should not interfere with projects already established, except as specifically authorized by the appropriate National Authority.
- Personnel accessing ARO should follow the marked trail from South Pole Station and observe the requirements of the ARO 'No Vehicle' and ARO 'Meteorological Tower' Restricted Zones (see Appendix C).
- Access to CAS is allowed for scientific purposes such as snow/air sampling. Access may be allowed for occasional or periodic measurement of properties such as snow depth and accumulation, provided this is coordinated in advance to avoid potential conflicts and will not compromise research being carried out within the Sector requiring clean conditions.
- Access to CAS is allowed for snow / trail maintenance, such as occasional excavation of the Met Tower and ARO.
- Access to CAS is allowed for occasional cleaning and maintenance of ski-way visibility markers located along 353° east of grid north (Table D.1).
- All overland access within the CAS should undertake travel and operate in such a manner that will help to minimize potential contamination (e.g. avoid leaving vehicles or machinery running when not necessary, take the most direct practicable route, refuel vehicles outside of the CAS etc.).
- The National Program(s) operating in the Area should document all pedestrian / surface vehicle excursions into the Clean Air Sector.

Additional guidelines for the Clean Air Sector and within ARO

- Access to the roof of the ARO building is restricted. Please contact the United States Antarctic Program (USAP) if access is required for your project. Users of the roof area must note all roof excursions in the Clean Air Sector Log. Structures, objects, etc. are not allowed on the roof of the ARO building in a location that would interfere with air sampling intakes or at a height exceeding 1.3 m (4 ft) above the roof surface, due to interference with the current solar and terrestrial radiation instruments. Do not obstruct the roof hatches with equipment or materials.
- Access to the orange and white meteorological tower and to the snow surface near the tower is restricted. Objects and activity on the tower and on the snow surface in its vicinity (particularly within a distance of approximately three times the tower's height) can interfere with measurements conducted from the tower. Please contact the USAP if access is required.
- Structures should not be placed in a manner that they could cause drifting upwind of, under, or near the ARO building.
- All instrumentation within ARO and the Clean Air Sector must meet the criteria set for current instrumentation as determined by the appropriate National Authority.
- Due to the electromagnetic (EM) sensitivity of solar and thermal atmospheric radiation measurements being conducted at and nearby ARO, the use of EM transmitters near ARO is prohibited except for infrequent but necessary use of handheld radios.
- Any individual or organization wishing to establish an experiment within ARO and/or the Clean Air Sector must coordinate with the National Program(s) operating in the area.

Restricted Chemicals

The use of chemicals listed in Table B.1, or of products and equipment that contain or emit them, is prohibited at ARO and in the CAS (this includes the area beneath the building, the roof of the building, and near the orange and white NOAA meteorological tower, which lies within a Restricted Zone (see Appendix C)). Please contact the National Program(s) operating in the area for help in finding alternatives to their use.

Table B.1 is a partial list of specific chemical substances being monitored at the ARO Clean Air facilities, and may vary over time. The atmospheric concentrations of most are being measured to a precision of parts per trillion, and the measurements are particularly susceptible to contamination from local sources.

Table B.1: Prohibited chemicals at ARO and in the CAS.

Class	Formula	Description	Name	Use
Chlorofluorocarbons (CFCs)	CCl_3F	trichlorofluoromethane	CFC-11	Refrigerants, solvents, foam blowing agents, aerosol propellants, and heat exchange medium (no longer manufactured in the U.S.)
	CCl_2F_2	dichlorodifluoromethane	CFC-12	
	CCl_2FCClF_2	trichlorotrifluoroethane	CFC-113	
Hydrochlorofluorocarbons (HCFCs)	$CHCl_2F$	dichlorofluoromethane	HCFC-21	Refrigerants, solvents, foam blowing agents, aerosol propellants, and heat exchange medium (HCFCs are found in the "blueboard" at South Pole)
	$CHClF_2$	chlorodifluoromethane	HCFC-22	
	CF_3CHClF	chlorotetrafluoroethane	HCFC-124	
	CCl_2FCH_3	dichlorofluoroethane	HCFC-141b	
	$CClF_2CH_3$	chlorodifluoroethane	HCFC-142b	
Hydrofluorocarbons (HFCs)	CF_3CH_2F	tetrafluoroethane	HFC-134a	Refrigerants, foam blowing agents, and aerosol propellants
	CH_3CHF_2	difluoroethane	HFC-152a	
Halons	$CBrClF_2$	bromochlorodifluoromethane	halon-1211	Fire suppression and extinguishing systems (no longer manufactured in the U.S.)
	$CBrF_3$	bromotrifluoromethane	halon-1301	
Chlorocarbons	CH_3Cl	chloromethane	methyl chloride	Solvents, cleaning agents, degreasing agents, and in other less common applications
	CH_2Cl_2	dichloromethane	methylene chloride	
	$CHCl_3$	trichloromethane	chloroform	
	CCl_4	tetrachloromethane	carbon tetrachloride	
	CH_3CCl_3	trichloroethane	methyl chloroform	
	C_2Cl_2	tetrachloroethene	perchloroethene	
Bromocarbons	CH_3Br	bromomethane	methyl bromide	
	CH_2Br_2	dibromomethane	methylene bromide	
	$CHBr_3$	tribromomethane	bromoform	
Idocarbons	CH_3I	iodomethane	methyl iodide	
Others	N_2O	nitrous oxide		Oxidizer
	SF_6	sulfur hexafluoride		Electric transformers

Quiet Sector

Sound noise and mechanical equipment activities are limited within the Quiet Sector to minimize vibration effects on seismological and other vibration-sensitive research. The South Pole Remote Earth Science and Seismological Observatory (SPRESSO) was established by the USAP ~7.5 km Grid SE of South Pole Station to provide a remote laboratory for experiments that require a vibration-quiet environment. Seismographic facilities have operated continuously at the South Pole since the 1957/58 International Geophysical Year (IGY).

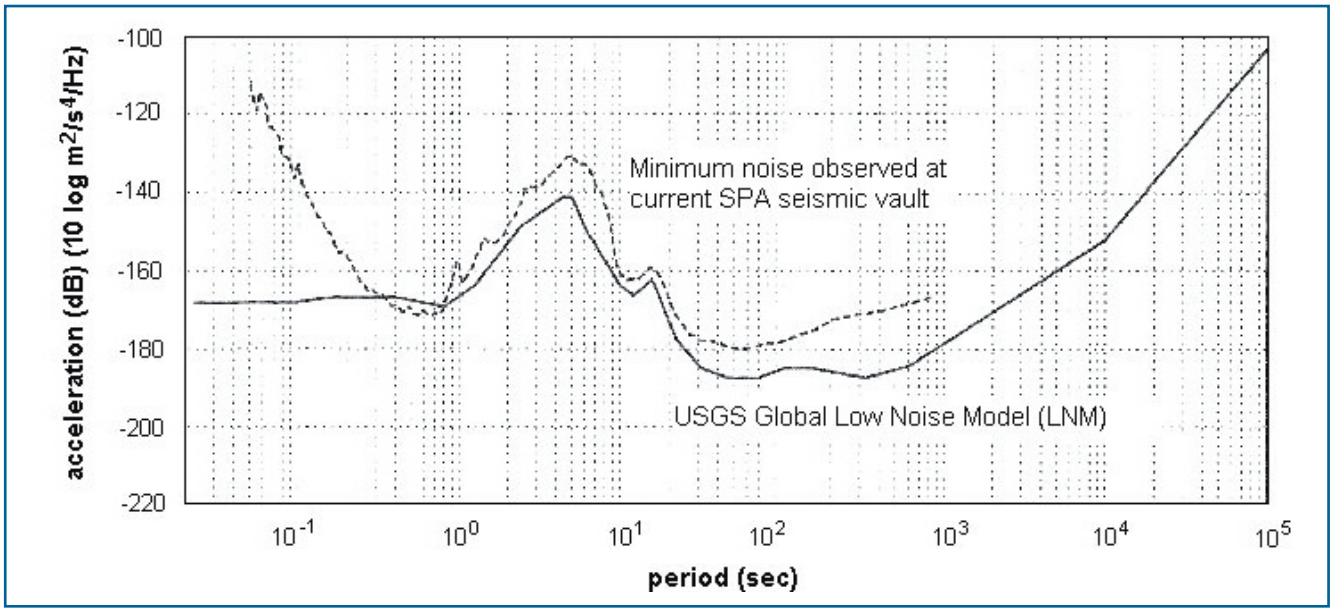
Geographic Boundaries of the Quiet Sector

The outer boundary of the Quiet Sector is defined by and coincident with the Scientific Zone and ASMA boundary, 20 km from the elevated station (Map 2). The inner boundaries of the Quiet Sector are defined by the Grid 110° line from ARO (shared by the Clean Air Sector) and by the Grid 185° line from the Quiet Sector origin (shared by the Downwind Sector), and by the boundary of the Operations Zone.

Guidelines for the Quiet Sector

- The Quiet Sector is reserved for scientific experiments that require quiet conditions or can operate under stringent quiet conditions. The Quiet Sector has the lowest measured values of seismic noise anywhere on the Earth at periods less than 1 sec. Guidelines for installations and operations within the Quiet Sector are as follows: Activities, structures, and instrumentation located within the Quiet Sector should not produce seismic vibrations at levels greater than the United States Geological Survey (USGS) low noise model (LNM) at periods greater than 1 sec. At periods less than 1 second, levels should not be greater than 12 dB below the LNM (Figure B.1);

Figure B.1. Noise thresholds for the Quiet Sector. The lowest noise levels achievable at the SPA seismic vault (in 2000) and the USGS LNM based upon quietest noise conditions globally. The seismic band of interest is from 80 Hz to tidal frequencies (<0.001 MHz).



- Structures that potentially may be buffeted by wind, producing extraneous detectable vibrations, should be located below the snow surface;
- All instrumentation located in SPRESSO shall meet the quiet criterion for seismological instrumentation established by National Program(s) operating in the Area;
- All instrumentation located in SPRESSO shall be remotely operable from South Pole Station, particularly during the austral winter;
- Individuals or organizations wishing to establish an experiment within the Quiet Sector shall coordinate in advance with the National Program(s) operating in the Area;
- Transit of motorized vehicles within or across the Quiet Sector for purposes other than support of science or management related to SPRESSO or in the event of an emergency is prohibited except as follows:
  - Access to the Quiet Sector is allowed for trail maintenance, such as when a hard-packed route to SPRESSO is required. This typically requires several passes using heavy equipment to knock down drifts caused by windstorms;
  - Access to the Quiet Sector may be allowed for occasional or periodic measurement of properties such as snow depth and accumulation, provided this is coordinated in advance to avoid potential conflicts and will not compromise seismological and other vibration-sensitive research being carried out within the Sector;
  - Access to the Quiet Sector is allowed for occasional cleaning and maintenance of ski-way visibility markers located along 113° east of grid north (Table D.1).
  - All overland access within the Quiet Sector should undertake travel and operate in such a manner that will help to minimize potential noise and vibration (e.g. avoid leaving vehicles or machinery running when not necessary, take the most direct practicable route, use the lightest vehicle practicable to meet objectives etc.), and vehicles should avoid operating within 100 m of the SPRESSO facility to the maximum extent practicable.
  - National Program(s) operating in the Area may enter the Quiet Sector to remove scientific equipment that is no longer in use, if it will not interfere with other scientific research.
- The National Program(s) operating in the area shall document all travel into the Quiet Sector.

Downwind Sector

The Downwind Sector was established to provide an area free from obstructions for balloon launches, aircraft operations, and other activities. Both scientific and operations activities are allowed in the Downwind Sector.

Geographic Boundaries of the Downwind Sector

The outer boundary of the Downwind Sector is defined by and coincident with the Scientific Zone and ASMA boundary, 20 km from the elevated station (Map 2). The inner boundaries of the Downwind Sector are defined by the Grid 185° (shared by the Quiet Sector) and Grid 230° (shared by the Dark Sector) lines from the Downwind Sector origin, and by the boundaries of the Operations Zone and Air Operations Restricted Zone associated with the ski-way.

Guidelines for the Downwind Sector

- Activities in the Downwind Sector should not require any maintenance (e.g. snow removal) and should not otherwise obstruct scientific balloon launches or aircraft operations.

Dark Sector

The Dark Sector was established to preserve the conditions of low light pollution and low electromagnetic interference (EMI) at South Pole Station that are important to facilitate many types of astrophysical, astronomical, and aeronomical research.

Geographic Boundaries of the Dark Sector

The outer boundary of the Dark Sector is defined by and coincident with the Scientific Zone and ASMA boundary, 20 km from the elevated station (Map 2). The inner boundaries of the Dark Sector are defined by the Grid 230° line from the Dark Sector origin (shared by the Downwind Sector) and by the Grid 340° line from ARO (shared by the Clean Air Sector), and the boundaries of the Operations Zone and Air Operations Restricted Zone associated with the ski-way.

Guidelines for the Dark Sector

- Science activities in the Dark Sector are restricted to experiments that do not emit light or EMI above levels approved by the National Program(s) operating in the Area.
- Telescopes and other scientific instruments that are light- and / or EMI-sensitive should be located in the Dark Sector.
- Activities both within and outside of the Dark Sector that emit EMI or have potential to obstruct the viewing horizon should take into account their potential to affect scientific values in the Dark Sector. In particular, Electromagnetic Compatibility (EMC) assessments should be undertaken as necessary in advance of the activity to minimize conflicts between uses, including between operational sources of EMI and scientific instruments, and to minimize impacts on science within the Dark Sector whilst allowing for essential operational needs. This applies also to scientific or operational projects operating from aircraft or satellite platforms that require active radio frequency (RF) emissions (e.g. imaging radars such as Synthetic Aperture Radar etc.) or light-emitting instruments (e.g. LiDAR).
- To help protect sensitive scientific observations within the Dark Sector from unnecessary EMI, pilots of any aircraft entering the Dark Sector are requested to minimize, to the extent that is safe and practicable, operational radio frequency (RF) emissions (e.g. navigation radars or other active navaids, altimeters, radar sounders, ice radars, radio communications etc.) while flying within the Sector.

APPENDIX C

Guidelines for Restricted Zones

Six sites within the Area are designated Restricted Zones (Maps 3 and 4), which are defined by boundaries and access policies as follows:

1. Aircraft Operations Restricted Zone:

Description:
An area of ~60 ha within the Operations Zone that includes the ski-way, aircraft taxi, refuelling and aircraft parking areas (Maps 3 and 4).

Boundary:
The boundary is defined as the perimeter of the aircraft operational areas as shown on Map 4.

Access requirements:
Access to the zone is prohibited except by authorized personnel, with access policies applying specifically to pilots, logistics personnel and aircraft passengers and more generally to all other personnel at South Pole detailed in Section 7(i) of this Management Plan.

2. Old Pole Station Restricted Zone:

Description:
An area of ~70 ha within the Dark Sector of the Scientific Zone that includes the former 1957 South Pole station site and the immediate surrounding area up to ~300 – 500 m (Maps 3 and 4).

Boundary:
Clockwise from the SE corner of the zone, the boundary extends Grid NW 1.2 km into the Dark Sector from the Operations Zone, extending past and immediately Grid NE of the Dark Sector Laboratory. Thence the boundary proceeds 1 m Grid NE to a point 200 m from the Clean Air Sector, thence extends for 750 m parallel to and 200 m from the Clean Air Sector to the Operations Zone. The boundary thence shares the Operations Zone boundary for a distance of 440 m Grid SW to the SE corner of the zone.

Access requirements:
Access to the Old Pole Station Restricted Zone is prohibited except by authorized personnel for essential scientific, operational or management purposes. While remediation work has been undertaken at the site, there remain possible subsurface hazards such as voids or structures that should be avoided.

3. ARO 'No Vehicle' Restricted Zone

Description:
A semi-circular area of 0.5 ha within the Operations Zone extending 50 m (150 ft) downwind (Grid SW) of the SW corner of the ARO building (Map 4).

Boundary:
Defined as the perimeter of the semi-circle described above. Part of the southeastern boundary is shared by the Antenna Field Restricted Zone.

Access requirements:
Vehicle access is prohibited without prior authorization by NOAA and the United States Antarctic Program. All vehicles approaching ARO should use the marked trail and park at the 'turnaround' at the edge of the Restricted Zone where a sign states "No Vehicles Beyond This Point". The purpose of the Restricted Zone is to avoid vehicle emissions close to the ARO facility where sensitive atmospheric monitoring instruments are installed.

4. ARO 'Meteorological Tower' Restricted Zone

Description:
A circular area of 0.13 ha within the Operations Zone surrounding the ARO Meteorological Tower extending 20 m (~66 ft) from the center of the facility (Map 4).

Boundary:
Defined as the perimeter of a 20 m circle surrounding the ARO Meteorological Tower.

Access requirements:
Vehicle and pedestrian access is prohibited without prior authorization by NOAA and the United States Antarctic Program. Vehicles and pedestrians should avoid the Grid NW half of the Restricted Zone to prevent disturbance to the snow surface in this area, where albedo is being monitored.

5. Antenna Field Restricted Zone:

Description:
An area within the Operations Zone of ~25 ha located Grid SE of the road to ARO (Map 4).

Boundary:
Clockwise from ARO, the northeastern boundary shares the Grid 110° boundary of the CAS for ~550 m from ARO, thence extends 300 m Grid due south, thence 550 m Grid due west, thence 440 m Grid NW towards but 20 m short of the ARO road, and thence 200 m eastward to the ARO 'No Vehicle' Restricted Zone, and shares this boundary a further ~50 m to the CAS.

Access requirements:
Access to the zone is prohibited except by personnel authorized by the National Program(s) operating in the Area. Personnel operating within the zone should avoid disturbing the area where stakes are installed to measure snow accumulation (Map 4), and should be aware of other sensitive scientific or antenna infrastructure.

6. Communications Restricted Zone:

Description:
An area within the Operations Zone of ~9.5 ha, the center of which is located ~1 km Grid SW of the elevated station (Map 4).

Boundary:
Defined as a rectangle of width ~185 m and of length 510 m.

Access requirements:
Access to the zone is prohibited except by personnel authorized by the National Program(s) operating in the Area.

APPENDIX D

General Guidelines for Non-Governmental Visitors to the South Pole

The South Pole receives a number of visitors associated with Non-Governmental expeditions each austral summer, most of whom are supported by private companies that provide transportation, guides and other logistics. Guidelines have been established to improve coordination between the National Program(s) operating in the Area and Non-Governmental Visitors (NGVs) to the South Pole. The purpose of this Appendix is to inform NGVs about on-site resources, expectations, and hazards at the South Pole, while Appendix E provides specific guidance on overland approach routes.

All visitors to the South Pole shall comply with the Protocol on Environmental Protection to the Antarctic Treaty and with their respective national policies governing activities in Antarctica.

- For the purpose of this management plan, 'Non-Governmental Visitors' includes all individuals or organizations that are not sponsored by a National Antarctic Program.
- Amundsen-Scott South Pole Station is operated by the United States Antarctic Program (USAP), which is not authorized to provide support for NGVs except in an emergency.
- NGVs approaching overland should be aware of ski-way visibility markers located at various distances from the geographic South Pole in four directions around the station (Table D.1). All markers are four feet high by eight feet wide, except the 1 mile markers which are eight feet by eight feet, and mounted four feet off the snow surface.

Table D.1 Visibility markers located around South Pole Station.

Direction	Marker 1		Marker 2		Marker 3		Marker 4		Marker 5		Marker 6	
(° E of grid N)	miles	km	miles	km	miles	km	miles	km	miles	km	miles	km
113	0.5	0.8	1	1.6	1.5	2.6	2	3.2	-	-	-	-
204	0.5	0.8	1	1.6	1.5	2.6	2	3.2	3	4.8	4	6.4
270	0.75	1.2	1	1.6	2	3.2	3	4.8	-	-	-	-
353	0.5	0.8	1	1.6	1.5	2.6	2	3.2	-	-	-	-

- NGVs that intend to fly aircraft into the Area or land on the ski-way shall obtain prior approval to do so from the National Program(s) that operates the ski-way and associated air traffic control. If prior approval is granted, NGV pilots should refer to and follow guidance in the Antarctic Flight Information Manual (AFIM) and information provided by the National Program(s) operating in the Area.
- NGVs shall not conduct a parachute operation from an aircraft and no pilot in command of an NGV aircraft may allow a parachute operation to be conducted from that aircraft over or near the ski-way or other infrastructure in the Area, unless specific written authorization is provided in advance by the National Program(s) that operates the ski-way and associated air traffic control.
- No access to email, telephones, or radios will be provided except as authorized by the appropriate National Program.
- The ideal timeframe for visits to the South Pole Station is on Sunday from 13:00 to 17:00 South Pole Station Time [00:00 to 04:00 GMT/UTC]. This time period is recommended to minimize disruption to station science and operations. Services and access to the station at other times are highly unlikely.
- NGVs are required to be self-sufficient in their provision of transport, camping, food, communications and any other support required by their expedition.
- Within the Operations Zone, NGVs should keep within the designated NGV camping and parking areas (Map 4), or the area immediately surrounding the Ceremonial South Pole and geographic South Pole markers and to move between these sites by a direct line or by following the designated vehicle route, unless otherwise authorized by the National Program(s) operating in the area. The reason for this provision is to ensure hazardous sites such as the Old Pole Station and Aircraft Operations Restricted Zones and areas of scientific research with highly sensitive instrumentation are avoided, as well as to ensure safety in other areas where heavy vehicles or machinery may be operating, often in conditions of poor visibility.

- The designated NGV camping area within the Operations Zone has been selected for the following reasons: it is located near the NGV aircraft parking areas, it is close to medical or other emergency services (if needed), it does not usually interfere with vehicle traffic or USAP aircraft operations, and it is away from most hazardous areas, communications facilities and sensitive scientific instrumentation.
- To avoid disruption of official USAP activities, all South Pole Station buildings and operation and science areas are off limits to NGV personnel except when guided by an individual designated by the USAP or when within the aforementioned areas.
- In the event of an aircraft or medical emergency in the Area, NGVs shall notify Amundsen-Scott South Pole Station Communications Center (COMMS) immediately. Station staff shall notify the on-site U.S. National Science Foundation (NSF) Representative and other personnel as necessary.
- Amundsen-Scott South Pole Station staff shall record NGV arrivals and departures, and make this information available to Antarctic Treaty Party members upon request.

APPENDIX E

Guidelines for Non-Governmental Visitor Overland Approach to the South Pole

No approach to the South Pole through the Clean Air Sector

- The Clean Air Sector extends 150 km Grid NE from the South Pole, its point of origin being the Grid SW corner of the Atmospheric Research Observatory (ARO) building at Amundsen-Scott South Pole Station. The Sector lies between a line extending Grid 340° and a line extending Grid 110° from ARO, which equates approximately to the area lying between W020° and E110° (clockwise).
- Do not approach the South Pole through the Clean Air Sector (see maps).

Approach from Grid northwest – west (Ronne Ice Shelf / Hercules Inlet etc.)

- The Grid northwest and west approach to South Pole lies between W020° and W110°.
- When approaching from this region, on reaching the ASMA boundary at 20 km from the South Pole, proceed directly to 'West Waypoint' at S89° 59.0' W016° 00.0', where a sign is located. Do not enter the Clean Air Sector (see maps).
- Call Amundsen-Scott South Pole Station at least 24 hours in advance of your anticipated arrival at the South Pole to advise of your position and plans. Be prepared to wait and camp if necessary until advised that it is safe to proceed.
- On reaching 'West Waypoint', proceed on the marked trail (bamboo canes and flags) 0.88 km to the non- governmental visitor campsite and thence 1 km to the South Pole (2016), taking care not to cross into the Clean Air Sector, the boundary of which is marked by flags.

Approach from Grid south – southwest (McMurdo / Ross Ice Shelf)

- The Grid south and southwest approach to South Pole lies between E110° and W110°.
- When approaching from this region, on reaching the ASMA boundary at 20 km from the South Pole, proceed directly to the 'Pole Turn 1 Waypoint' at S89° 55.29' W132° 00.0' where a sign is located, following the South Pole Traverse route on the W132° meridian as far as practicable. Do not enter the Quiet Sector (see maps).
- Call Amundsen-Scott South Pole Station at least 24 hours in advance of your anticipated arrival at the South Pole to advise of your position and plans.
- On reaching 'Pole Turn 1 Waypoint', which is 8.8 km from the South Pole (2016), again Stop & Call Amundsen-Scott South Pole Station before proceeding further. Be prepared to camp at 'Pole Turn 1 Waypoint' until advised by Amundsen-Scott South Pole Station it is safe to proceed. This is to ensure safety because the approach route lies close to the skiway.
- From 'Pole Turn 1 Waypoint' proceed 5.2 km on the South Pole Traverse route to the skiway threshold where a sign is located at the Grid south end of the skiway.
- From the skiway threshold, proceed parallel to and along the **Grid west** side of the skiway (i.e. the left side on approach towards the Pole) for 4 km, maintaining a distance of at least 30 m from the line of flags marking the edge of the skiway. Proceed to the road between the elevated station and Dark Sector science buildings, where a red beacon light is installed at the designated crossing point of the aircraft taxi area at the Grid north end of the skiway (see Map 6).
- Do not enter onto the skiway other than at the designated crossing point or in an emergency.
- Do not cross the aircraft taxi area at the end of the skiway if the red beacon light is flashing.
- When safe to do so, cross the aircraft taxi area at the designated crossing point and proceed towards the South Pole markers and onward to the non-governmental visitor campsite.

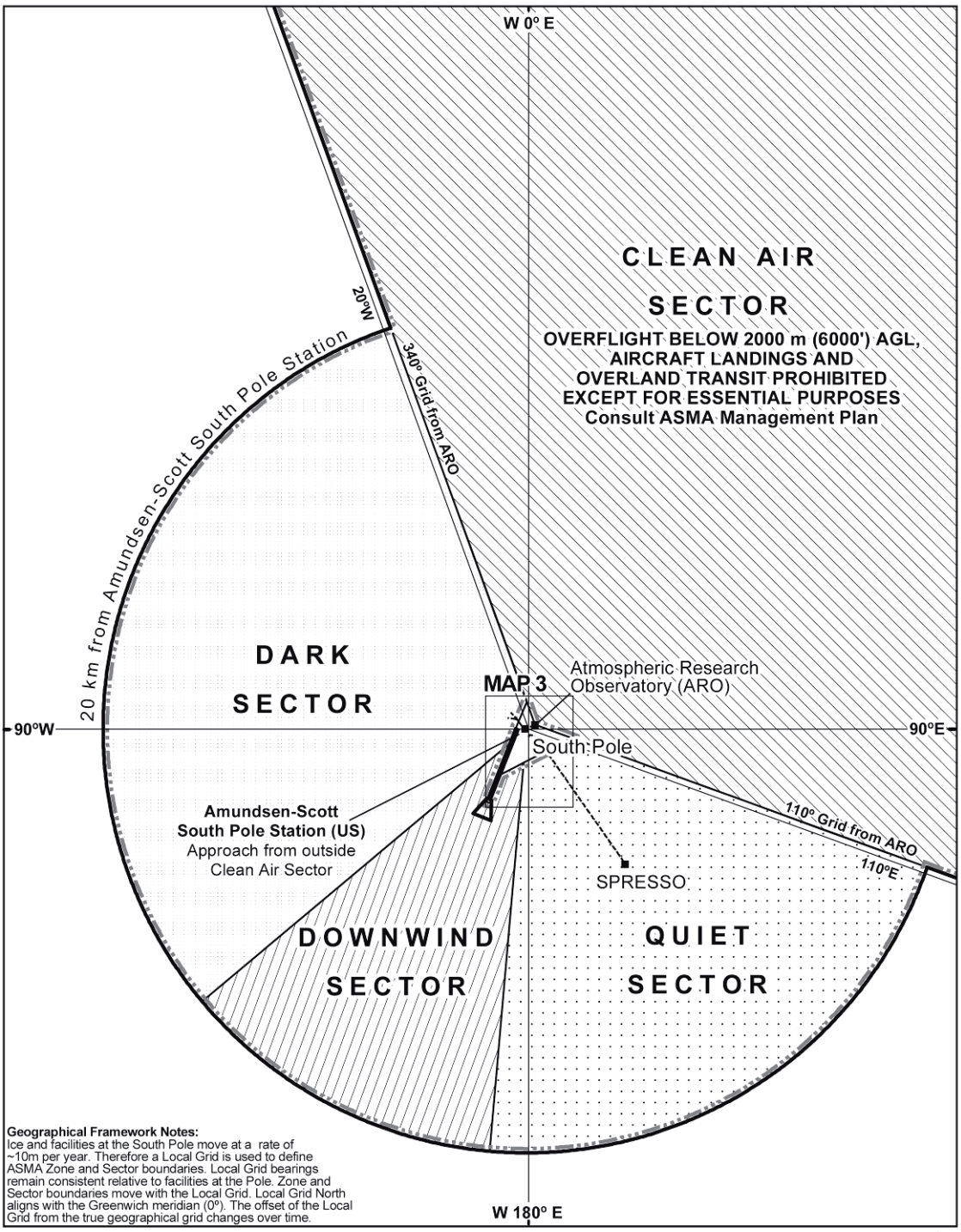
Map 1: ASMA No. 5 - South Pole - Location and topography

0 25 50
Kilometers

23 Mar 2017 (Map ID: 10069.010.07)
United States Antarctic Program
Environmental Research & Assessment

Contour (50 m) | ASMA Boundary | Clean Air Sector
Permanent ice | Scientific Zone | Station building

Projection: Polar Stereographic;
Spheroid and horizontal datum: WGS84;
Data source: Coast & topography: SCAR ADD (v.6 - 2012);
ASMA boundary, Zones & Sectors: ERA (Feb 2017).



Map 2: ASMA No. 5 - South Pole - Management Zones and Sectors

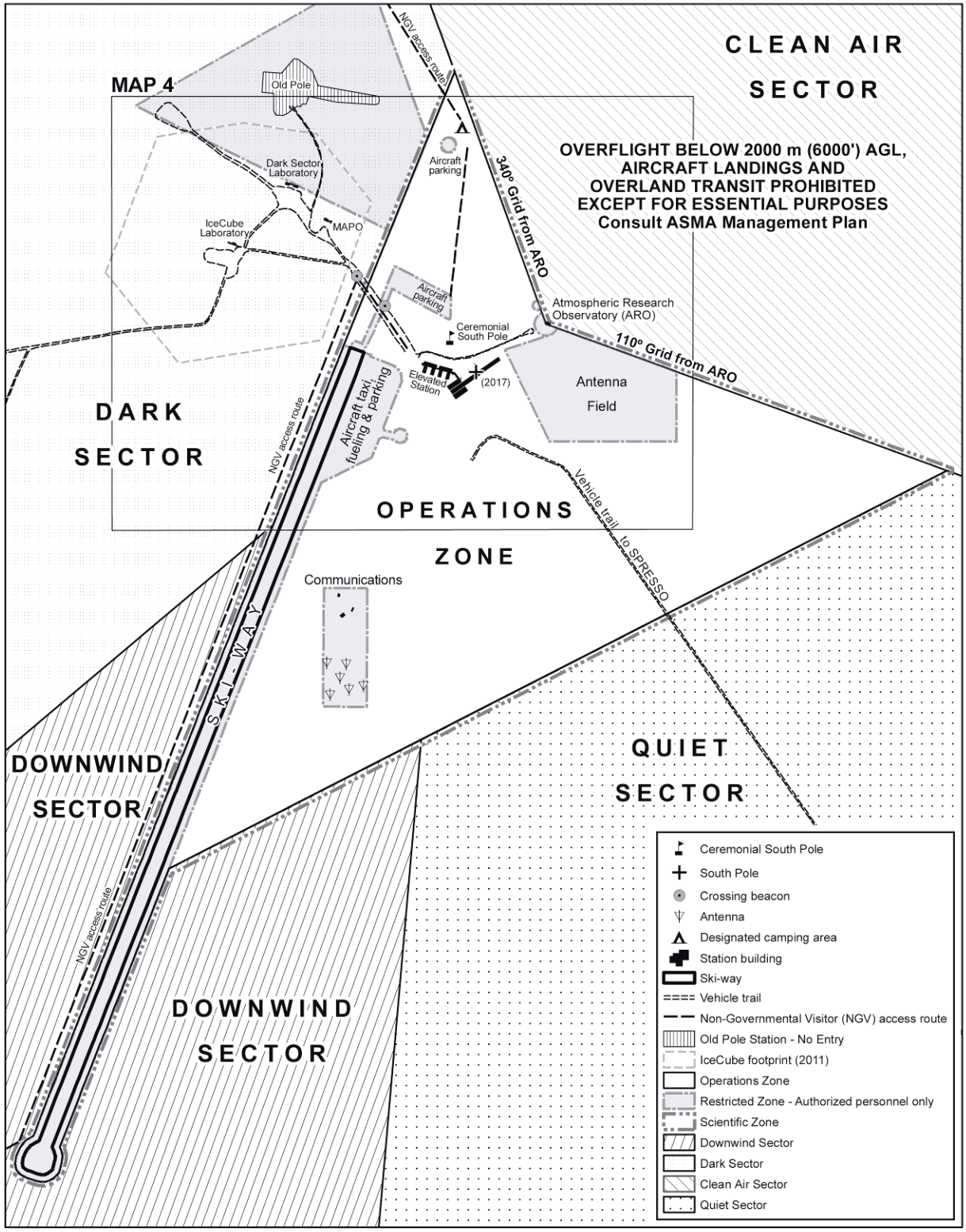
23 Mar 2017 (Map ID: 10069.011.10)
United States Antarctic Program
Environmental Research & Assessment

ASMA Boundary
Operations Zone
Scientific Zone
Downwind Sector
Dark Sector
Clean Air Sector
Quiet Sector
Station building
Ski-way
Skiway threshold
Vehicle trail

GRID

0 5 10
Kilometers

Projection: Polar Stereographic;
Spheroid and horizontal datum: WGS84;
Data source: Infrastructure: ASC CAD Survey (2016/17);
ASMA boundary, Zones & Sectors: ERA (Feb 2017).



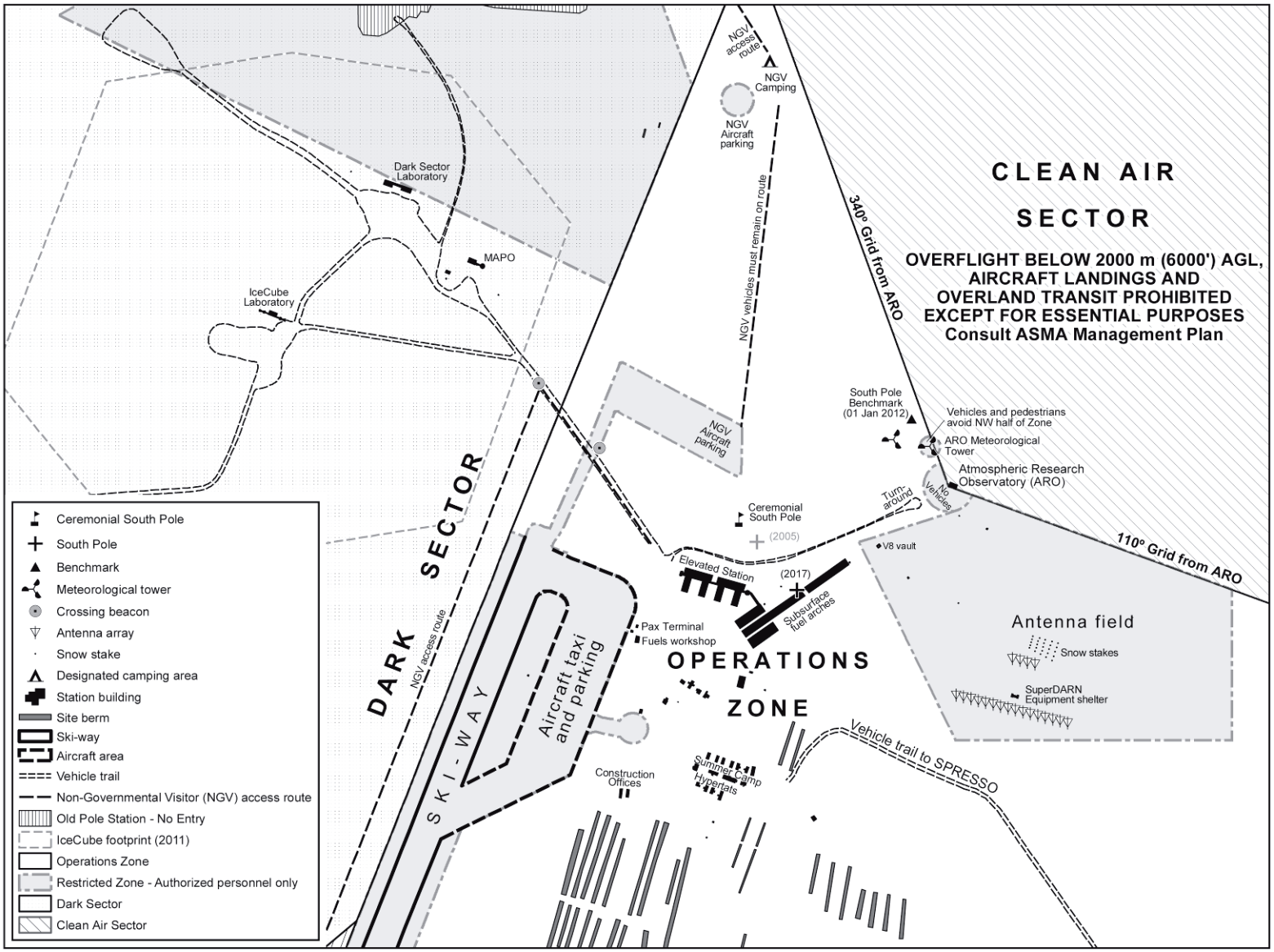
Map 3: ASMA No. 5 - Amundsen-Scott South Pole Station - Operations Zone

03 Apr 2017 (Map ID: 10069.013.12)
United States Antarctic Program
Environmental Research & Assessment

0 500 1000
Meters

GRID

Projection: Polar Stereographic;
Spheroid and horizontal datum: WGS84;
Data source: Infrastructure: ASC CAD Survey (2016/17);
Zones & Sectors: ERA (Feb 2017).



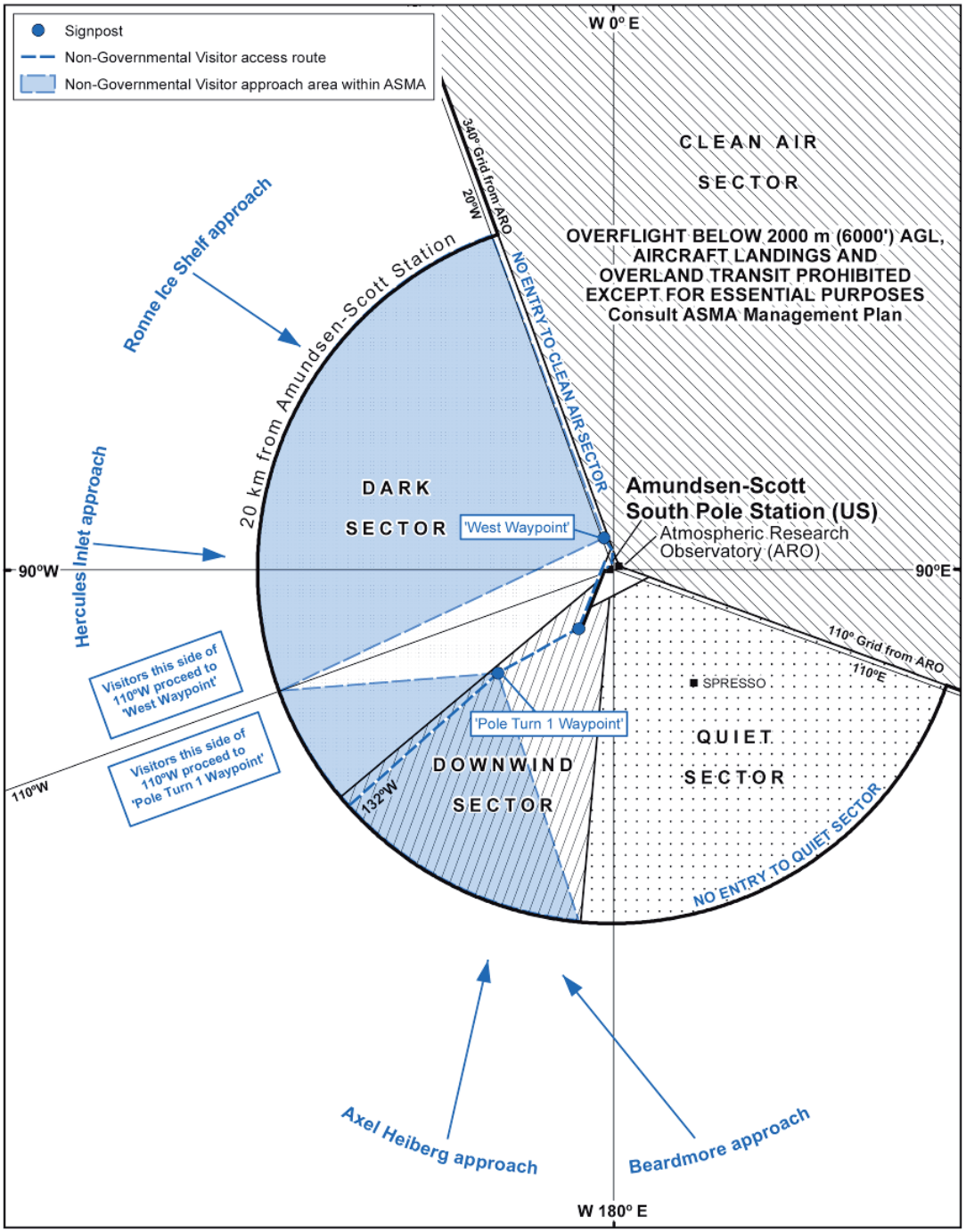
Map 4: ASMA No. 5 - Amundsen-Scott South Pole Station

03 Apr 2017 (Map ID: 10069.014.15)
United States Antarctic Program
Environmental Research & Assessment

0 100 200 300 400 500
Meters

GRID

Projection: Polar Stereographic;
Spheroid and horizontal datum: WGS84;
Data source: Infrastructure: ASC CAD Survey (2016/17);
Zones & Sectors: ERA (Feb 2017).

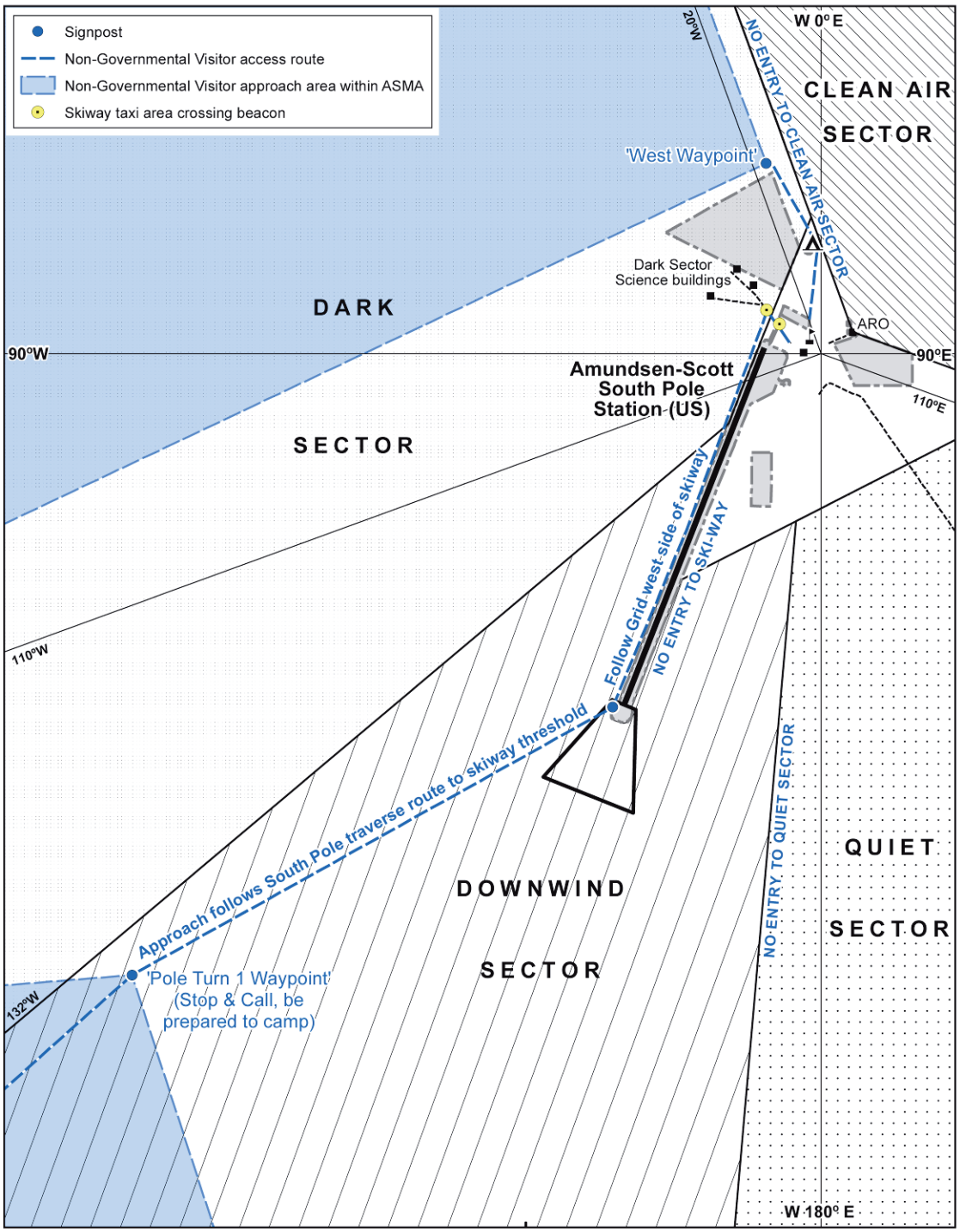


Map 5: South Pole Non-Governmental Visitor approach routes & guidelines overview

23 May 2017 (Map ID: 10069.008.10)
United States Antarctic Program
Environmental Research & Assessment

ASMA Boundary
Operations Zone
Downwind Sector
Dark Sector
Clean Air Sector
Quiet Sector
Station building
Ski-way

0 5 10
Kilometers
Projection: Polar Stereographic;
Spheroid and horizontal datum: WGS84;
Data source: Infrastructure: ASC CAD Survey (2016/17);
ASMA boundary, Zones & Sectors, NGV access guidance: ERA (Feb 2017).



Map 6: ASMA No. 5 - South Pole Non-Governmental Visitor approach guidelines

03 Apr 2017 (Map ID: 10069.007.11)
United States Antarctic Program
Environmental Research & Assessment

GRID

Operations Zone
Restricted Zone
Downwind Sector
Dark Sector
Clean Air Sector
Quiet Sector
Hazardous Zone
Ski-way
Skiway threshold
Vehicle trail
Station building
Designated camping area
Ceremonial South Pole

0 1 2
Kilometers

Projection: Polar Stereographic;
Spheroid and horizontal datum: WGS84;
Data source: ASMA boundary, Zones & Sectors, NGV access guidance: ERA (Feb 2017); Infrastructure: ASC CAD Survey (2016/17).