

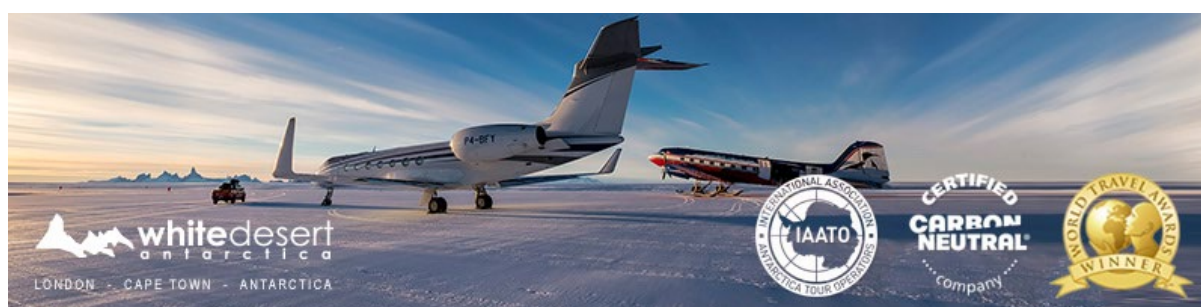


White Desert

Initial Environmental Evaluation (IEE) Update Report 2020

July 2020

For Submission to the UK Foreign and Commonwealth Office



White Desert IEE Update Report 2020

Table of Contents

White Desert IEE Update Report 2020.....	1
Introduction.....	5
Purpose of document	5
Preparation of document.....	6
Overview of White Desert Activities	8
Membership of IAATO (International Association of Antarctica Tour Operator)	8
Environmental Management Systems, Certifications and Awards	9
Scope of Environmental Assessment	11
Study Areas, Spatial and Temporal Scope	11
Environmental Impact Approach and Methodology	12
Overview of current and proposed operations.....	13
Overview of numbers.....	13
Logistics and Re-Supply Routes	14
Traverse Routes	14
Overview of fuel and supplies.....	15
White Desert Aviation.....	16
Aircraft use in Antarctica	16
Intercontinental flights	16
Plant, Equipment and Vehicles	17
Operational Environmental Measures	19
Climate Change and Antarctica.....	19
Net Zero by 2050 and the Paris Agreement.....	19
Potential Impacts	20
Establishment of Greenhouse Gas Reporting 2019-2020 Baseline	20
Carbon and Fuel Use Management Plan	21
Existing Measures	22
Pathway to Net Zero Commitment as part of five year plan.....	22
Sustainable Aviation Strategy	22
Pledge to Net Zero Commitment- Setting of Science Based Targets.....	22
Carbon off-setting.....	23
White Desert <i>Pathway to Net Zero by 2050 Policy</i>	24
Local air quality atmospheric emissions	25

Environmental Baseline Air Quality in Antarctica	25
Activities and potential impacts.....	25
Local air quality and atmospheric pollutant.....	26
Existing mitigation measures for local air quality impacts	26
Additional local air quality environmental measures.....	27
Bio-Security and Non Native Species	29
Environmental Baseline	29
Activities and Potential impacts.....	29
<i>Pathways or vectors for transporting non native species include:</i>	29
Mitigation Measures: Summary of Bio Security Measures	30
Waste Management Plan.....	32
Activities and Potential Impacts.....	32
Mitigation Measures.....	32
Environmental Emergency Preparedness and Response	40
Operational Assessment Tables	41
Geographic Specific Environmental Measures.....	45
Introduction	45
Environmental Baseline and Activities	46
Wolf's Fang Runway and Camp.....	46
Description of Activities	46
Wolf's Fang Blue-ice Runway	46
Wolf's Fang Camp	49
Changes in activities for five year period	49
Environmental Baseline	51
Land Use	51
Antarctic Heritage	51
Physical Environment.....	51
Ablation	52
Climate, Weather and Meteorological Data	52
Ecology.....	53
Whichaway Camp	57
Description of Activities	57
Whichaway Camp	57
Whichaway Skiway.....	58
Client activities.....	58

Changes in activities for five year period	58
Environmental Baseline	60
Land Use	60
Antarctic Heritage	60
Physical Environment.....	61
Climate, Weather and Meteorological Data	63
Ecology.....	65
Atka Bay and Princess Astrid Coast.....	67
Atka Bay: Visits to Emperor Penguin Colony.....	67
Description of activities.....	67
Changes in activities for five year period	68
Environmental Baseline	69
Study area	69
Land Use	69
Background Noise Levels	69
Antarctic Heritage	70
Physical Environment.....	71
Weather and Meteorological Data	72
Ecology.....	73
Princess Astrid Coast :Fuel Depot	79
Description of activities.....	79
Changes in activities for five year period	80
Land Use	80
Antarctic Heritage	80
Physical Environment.....	80
Fimbull ice shelf and climate change	80
FD 83 and South Pole.....	83
Description of Activities	83
FD 83 Field Camp and Skiway.....	83
South Pole Visits	83
Changes in activities for five year period	84
Environmental Baseline	84
Land Use	84
Antarctic Heritage	85
Physical Environment.....	85

Climate, Weather and Meteorological Data	86
Ecology.....	86
Geographic Assessment Tables.....	88
Conclusion and Discussion	121
Appendix I.....	122
Appendix II: IEE Update Report Figures	125

Introduction

Purpose of document

The activities being carried out by White Desert Limited in Antarctica have been assessed as having a *less than a minor or transitory impact* through Initial Environmental Evaluation (IEE) reports submitted previously. The previously submitted IEEs comprise:

- Appendix 2 Wolf's Fang IEE, South Pole and Atka Bay Visits, White Desert Ltd August 2017
- Wolf's Fang Runway IEE, White Desert Ltd, White Desert Ltd, April 2016
- Whichaway Camp Activity IEE, White Desert Ltd, 2013

This report provides an update on these previous IEE reports submitted by White Desert to the UK Foreign and Commonwealth Office (FCO) as a single, consolidated document and is being submitted in support of a five year permit application to the FCO. The propose of this document is:

- To provide a consolidated document where the activities being carried out by White Desert along with the corresponding environmental impact assessments (EIA) for these activities are presented
- To provide an update on how activities are being carried out and are proposed to be carried out over a five year period, identifying any relevant changes to operations
- To provide an update on the environmental baseline conditions through new published research documents, updates to policy, as well as legislation and guidance related to EIA
- To provide an update on the environmental measures, environmental management systems and sustainability improvements being implemented by White Desert since the publication of the IEEs and the plans for continual environmental improvements over a five year period

This report sets out the operational environmental measures (for example greenhouse gas reduction) and geographic specific environmental measures (for example Emperor Penguin visitor guidelines) separately.

Preparation of document

In accordance with the EU EIA Directive and UK EIA Regulations¹, which were amended in 2017, the environmental impact assessment report has been prepared by a competent expert in EIA. This follows the definition of a competent expert, as set out in the Institution of Environmental Sciences guideline document². The IEE team which has completed Report comprises the following key staff:

Table 1.0 Environmental Impact Assessment and IEE Report Team

IEE Report Element	Name Role	Qualifications Relevant
Project Environmental Lead Author of document Responsible for environmental assessment	Eleni Antoniadou Snell Project Environmental Lead EIA and Environmental Management Aviation and Infrastructure Projects Email eleni@white-desert.com E.antoniadou@eaenvironmental.com http://uk.linkedin.com/in/eleniantoniadesenvironmental/	Chartered Environmentalist (CEnv) Full Member of Institution of Environmental Sciences MSc Environmental Technology - Environmental Assessment and Analysis Option BSc Environmental Sciences Board Member of Institution of Environmental Sciences 17 years experience in EIA and Environmental Management of Aviation and Infrastructure Projects
Checker-Responsible for checking operations and activities sections of report	Stuart McFadzean White Desert Operations Manager	Antarctic Operations Specialist
Approver-Responsible for final approval	Patrick Woodhead White Desert Managing Director	Co-founder and Managing Director of White Desert

¹ EU EIA Directive (85/337/EEC) as transposed in the UK by The Town and Country Planning (Environmental Impact Assessment) Regulations 2017

²² Discussion paper: Helping our members working in EIA prove competence

https://www.the-ies.org/sites/default/files/documents/proving_eia_competence.pdf

White Desert IEE 2020 Report Final

		Antarctic expeditioner
--	--	------------------------

Overview of White Desert Activities

White Desert Ltd has been operating a commercial tourism operation in Dronning Maud Land since 2006.

The operation primarily offers small-scale, bespoke experiences for clients with numbers limited to approximately 24 clients in Antarctica at any one time. Visits are of a short duration and take place between November and February each year, over the Antarctic summer. Clients are based in Whichaway Camp in the Schirmacher Oasis and can undertake activities around this area, excursions to Atka Bay and/or the South Pole. In addition to tourism activities, White Desert also provides logistical support for the scientific community and national programs in the region. The location of White Desert operations can be referred to in *Figure 1.0 White Desert Antarctic Camps* in the Appendix section of this report.

In November 2016, White Desert began operations at Wolf's Fang blue-ice Runway, following the preparation of the Wolf's Fang Runway IEE Report and permit obtained from the FCO. The following season, in November 2017 White Desert began to take over the management and delivery of the intra-continental flights, following the preparation of the Appendix 2 IEE and permit obtained from the FCO.

Table 2.0 Timeline of White Desert Activities

Activity	Permitted
White Desert operations	2006-Operations began in 2006, permitted by FCO
Whichaway Camp current location in Schirmacher Oasis	2013-Whichaway Camp IEE permitted by FCO
Operation of Wolf's Fang Runway and supporting logistical operations	2016- operations began at Wolf's Fang Runway in the 2016-2017 season following IEE, permitted by FCO
Operation of internal flights to Atka Bay, FD83 and South Pole	2017-White Desert took over the management and operation of internal flights to Atka Bay , FD 83 and South Pole, following IEE, permitted by FCO in 2017-2018
Five year plan from 2021 onwards	Updated of previous IEEs to reflect five year plan. Changes in permitted activities have been screened as minor

Membership of IAATO (International Association of Antarctica Tour Operator)

The total number of tourists visiting Antarctica in the 2018/19 season was approximately 56,000. The vast majority of visitors travel on passenger vessels to the Antarctic Peninsula region, which can be reached from South American ports in a few days. White Desert is one of three operators providing travel to the interior of Antarctica, with the number of total guests, of approximately 200, servicing a small proportion of total visitors in Antarctica.

White Desert has been a member of IAATO since 2007 and its co-founder is currently a member of the IAATO Executive Committee. [IAATO](#) is an international member organisation founded in 1991 to advocate and promote the practice of safe and environmentally responsible private-sector travel to the Antarctic. As a member, White Desert is required to adhere to the visitor guidelines which have been set out by IAATO, the IAATO field operations manual and to provide end of season information on activities being carried out in Antarctica, including areas visited. IAATO guidelines cover all activities

carried out by tourism, including visits to wildlife and ensuring that measures are taken to reduce the risk of introducing non-native species.

The IAATO guidelines have been integrated into the White Desert Environmental Management System. Additional initiatives include supporting science, eliminating plastics and supporting Antarctic ambassadors. Membership of IAATO ensures that a consistent approach is taken by Antarctic tour operators and goes beyond compliance with legislative requirements.

This provides additional measures to protect the Antarctic environment and ensures the cumulative impacts of visitors are reduced as far as possible.

Environmental Management Systems, Certifications and Awards

White Desert implements an internal environmental management system (EMS). This system has not been externally certified though it is subject to an internal environmental audit on an annual basis and broadly follows the requirements set out in ISO 14001:2015. White Desert operations and the environmental management system were also inspected by the UK FCO in January 2019 during a UK Antarctic Permitting Authority inspection as well as by IAATO during an IAATO Field Observation inspection.

Following the submission of the 2016 and 2017 IEE reports, the EMS has been developed to include site and activity specific environmental management plans, which include all relevant environmental mitigation measures identified in the IEEs. The environmental management plans relevant to each activity are identified in each assessment section.

The White Desert EMS recognises that environmental impacts should not only be identified in an IEE, but that mitigation measures and monitoring should be implemented through:

- Site and activity specific Environmental Management Plans, updated every year
- Training of staff and those acting on behalf of White Desert
- Remaining up to date with research developments and the scientific community
- Being a strong advocate and leader in environmental management in IAATO
- Appointing environmental specialists with necessary skills
- Informing clients and visitors of environmental requirements

The White Desert EMS is continually improved and its key components are summarised in the table below.

Table 3 White Desert Environmental Management System Main Components

WHITE DESERT ENVIRONMENTAL MANAGEMENT SYSTEM Overarching elements
White Desert Environmental Policy
Environmental Legislation Register
Staff training
Staff briefings and client briefings
IAATO based environmental requirements, , package of information prior to departure (latest versions)
<ul style="list-style-type: none"> IAATO Do not pack a pest ATCM- (General Guidelines for Visitors to Antarctic Resolution 3 ATCM) IAATO Fact Sheet IAATO Guidance for Visitors to the Antarctic IAATO wildlife guidelines
Site inspections during season
Environmental audits periodic
Environmental Management Plans
Carbon and Fuel Management Plan
Fuel use monitoring during season
SECR annual report
Carbon off-setting annual report
Waste Management Plan
Waste Management Plan including handling and storage <ul style="list-style-type: none"> This includes waste segregation, labelling, containers, recycling This will include waste arrangements for field sites, Whichaway and Wolf's Fang (i.e. grey water, urine and toilet arrangements) Nomination of site waste champion
Duty of Care Audits
Bio-security and non native species plan s
Fuel /Oil Storage and Handling Protocol
Fuel/Oil Spill Contingency and Response Plan
Site and Activity Specific Environmental Management Plans
Whichaway Camp Environmental Management Plan
Environmental Information for Pilots
Atka Bay, FD 83 and South Pole Specific Guidance for Pilots
Wolf's Fang Runway Environmental Management Plan
Atka Bay Emperor Penguin Visits
Field Guides, Staff and Operatives Information

Environmental Awards and Certification

In 2017, White Desert Ltd and Eleni Antoniadis Environmental Ltd were commended by the Society for the Environment's *Team of the Year Award* and for the *Project of the Year Award* for the Wolf's Fang Runway IEE project. White Desert has also been certified as Carbon Neutral by the Carbon Neutral company since 2007.

Scope of Environmental Assessment

Study Areas, Spatial and Temporal Scope

The main activities assessed take place in the Antarctic Conservation Bio-geographic region of Dronning Maud Land, including activities at Wolf's Fang Runway, Whichaway Camp in the Schirmacher Oasis and activities in the area of Atka Bay. In addition to visits to Dronning Maud Land, there are visits to the South Pole which is not located in a bio-geographic region and is located in the East Antarctic high interior ice sheet environmental domain.

The Dronning Maud Land Antarctic Conservation Bio-geographic Region (ACBG 6) consists of a series of nunataks and mountain ranges separated by glaciers or ice covered terrain and is a biologically distinct, ice-free region. The environmental domain of the East Antarctic high interior ice sheet domain consists entirely of ice sheet land cover (Environment Q).

As these are areas with distinct characteristics, activities are considered and assessed based on geographic regions. Operational environmental measures which comprise greenhouse gas reductions in relation to climate change, local air quality, bio-security and non native species and waste management are identified separately.

Geographic environmental measures are set out in the report as follows:

Dronning Maud Land biogeographic region:

- *Wolf's Fang Runway camp and corresponding wider study area*
- *Whichaway Camp and corresponding wider area of the Schirmacher Oasis*
- *Atka Bay, Esktom ice shelf skiway and field camp to visit the Emperor Penguin colony, the fuel depot on Fimbull ice shelf and wider study area*

East Antarctic high interior ice sheet environmental domain

- *Fuel Depot 83 (FD 83) location and South Pole and corresponding wider study areas which encompass the Amundsen Scott South Pole Station landing site and wider study area as well as the FD 83 landing site and wider study area.*

The wider study areas and zone of influence vary according to the requirements of specific topics, in order to encompass the direct, indirect and cumulative impacts.

The baseline conditions have been updated using published information and desk-based research carried out between April- June 2020 as well through information from the White Desert team during the 2019-2020 summer season. In terms of temporal scope, the description of the baseline environment comprises the existing scenario of the 2019-2020 summer season and considers the impact over a five year period, though for climate change long term impacts are considered.

Ecological study areas extend across the region due to the potential routes of feeding, breeding and migration of Antarctic wildlife.

Environmental Impact Approach and Methodology

White Desert has undertaken consultation and stakeholder engagement with the FCO throughout the IEE process.

The report has been carried out to meet the requirements set out in the Protocol on Environmental Protection to the Antarctic Treaty (1991). The overall approach to the assessment methodology is based on the Guidelines for Environmental Impact Assessment in Antarctica.

In addition to mandatory requirements, and the assessment of similar schemes in Antarctica, UK best practice and industry recognised, current and upcoming technical guidance in relation to EIA has been employed to inform the assessment process.

In accordance with the Guidelines for EIA in Antarctica, the assessment process considers the *outputs of activities carried out by White Desert*. It also considers the *exposure of environmental elements* (environmental elements are often referred to as environmental resources/receptors in EIAs) *to the outputs of activities*.

The nature of each impact is assessed taking into consideration a number of factors, as required by the Protocol. This includes the impact's likelihood, potential consequences, whether the impact would be permanent or temporary, intensity, duration, reversibility, spatial extent of the impact, and whether it is direct, indirect or cumulative. The magnitude of impacts can be described as negligible/minor/moderate/major.

The *overall significance* is then identified. In accordance with the Protocol and Guidelines, the overall significance of potential impacts is described using one of three levels:

- Less than minor or transitory
- Minor or transitory or
- More than minor or transitory

The Protocol and Guidance do not prescribe a methodology for the determination of overall significance. There is no consensus agreement on the definition of the term "minor or transitory" and it is currently based on professional judgement, previous assessments and is considered on a case by case basis. To supplement this process an assessment methodology was developed during the preparation of the Wolf's Fang Runway IEE, by Eleni Antoniadou Environmental Ltd for White Desert. The assessment tables can be referred to in Appendix I.

The assessment methodology takes into consideration the sensitivity of environmental elements and the nature of the potential impact in order to derive the overall significance, for example, environmental elements which are designated are considered to be of very high sensitivity. The tables used to describe the general categories used to identify the sensitivity of environmental elements and can also be referred to in Appendix I.

Where potential impacts have been identified, appropriate avoidance, mitigation, enhancement and monitoring measures are described in order to reduce the likelihood or consequence.

Overview of current and proposed operations

Overview of numbers

An overview of existing operations, as set out in the Appendix 2 Wolf's Fang IEE Report, along with the proposed changes as part of the five year permit period, starting from 2021 is set out in the table below. At the end of each season a Post Visitation Report (PVR) is submitted to IAATO as well as the UK FCO, detailing the precise numbers of visitors, staff and areas visited

Table 4 Overview of current and future operations

Operational number	2017 - Onwards	2021- Onwards
	As set out in 2017 South Pole and Atka Bay IEE	Five year permit period
Total number of clients per season	Anticipated- 150 Maximum- 200 (2019-2020 season 159 tourists, 13 National Antarctic Program)	Anticipated- 200 Maximum- 400 Maximum-There may be more than one group present in Antarctica at the same time and up to two groups can be accommodate (28 guests at the same time)
Size of Individual Groups	Anticipated-12 Maximum- 24	Anticipated – 12-14 (Small groups will be present at Emperor Penguin , Whichaway Camp and station visits)
Total number of groups per season (rotations)	Anticipated 10 Maximum 20	Anticipated 20 Max 30
Total number of days spent in Antarctica per group	Average 8 Day trips and three day trips organised. Logistical support is provided to some individuals/teams on specific Antarctic expeditions which are longer	Average 8 days Day trips and three day trips organised. Logistical support is provided to some individuals/teams on specific Antarctic expeditions which are longer
International return flights per season	Anticipated- 10 Maximum- 20 (dedicated business jet)	Anticipated 30 (G550 or similar) Max 50 flights
Client destinations	Wolf's Fang Runway Atka Bay- Emperor Penguin Colony South Pole and FD 83 Schirmacher Oasis-Whichaway Camp	Wolf's Fang Runway Wolf's Fang immediate area and nunataks. Wolfs Fang region (Holtedahll & Drygalski Mountains) Atka Bay- Emperor Penguin Colony South Pole and FD 83 Schirmacher Oasis-Whichaway Camp Pole of Inaccessibility

White Desert IEE 2020 Report Final

Internal return flights (Clients) Clients= Tourists and Scientists	Anticipated 16 Maximum 20	Total : Anticipated 120 Maximum 190 Of which: Tourists: Anticipated 110 Max 160 Scientists: Anticipated 10 Max 30
Internal return flights (White Desert Logistical support)	Anticipated 35 Maximum 45	Anticipated 125 Maximum 150
Total numbers of staff (deployed in Antarctica across all sites)	60 Staff and 9 guides (2019-2020 Baseline Season) 672 days (8 staff for 12 weeks) In IEE	Anticipated 50 Maximum 60

Logistics and Re-Supply Routes

There are no changes proposed to the logistics and re-supply routes established in the baseline season of 2019-2020. Any future changes due to changes in the terrain, which have not been anticipated at this stage would need to be identified by White Desert and assessed in terms of environmental impacts if required, as part required by the Antarctic Treaty and permit processes.

It is proposed to continue to resupply fuel (and any heavy plant and machinery needed) via ship from Cape Town to (RSA) Penguin Bukta annually or as required by operations during the summer season. Fuel is transported using spare capacity on the S.A. Agulhas II operated by the South African National Antarctic Programme (SANAP). All bulk waste is removed from Antarctica via the same route. It should be noted that transport carried out by SANAP is subject to the SANAP environmental approvals and is not assessed in detail in this IEE report.

The remainder of the cargo and staff are transported by White Desert via aircraft mainly to Wolf's Fang Runway from Cape Town once the Wolf's Fang Runway is established each season. A small team of around 4 personnel is deployed into Wolf's Fang Runway at the start of each season by Basler aircraft from Punta Arenas, Rothera, and Neumayer stations. This team opens the Wolf's Fang Runway to allow other staff to fly in directly from Cape Town.

In an effort to achieve greater energy efficiency, White Desert intend to trial a capability to transport fuel from Cape Town directly to Wolf's Fang Runway by aircraft. This will utilise wide body jet aircraft that can transport seasonal cargo and have surplus fuel capacity that can be unloaded at Wolf's Fang Runway. While this has not yet been demonstrated, it is envisioned that between two and four flights of wide body aircraft at the start of the season (in November) could reduce the need to traverse fuel from the coast for use at the runway.

Traverse Routes

Once in Antarctica, cargo and fuel is transported via overland traverse routes by White Desert's logistical operations team. The overland traverse is usually carried out using off-road vehicles and

snow groomers/tractors, which are especially adapted or designed to operate in Antarctic condition, as well as sledges. The snow groomers/tractors are fitted with cranes and recovery equipment (more details can be referred to in the plant and equipment section of the report).

The key overland traverse routes comprise the following:

- Fuel depot to Wolf's Fang Runway
- Wolf's Fang Runway to Whichaway Camp
- Wolf's Fang Runway to FD 83

The routes used for the overland traverse were surveyed and established by White Desert as set out in the Wolf's Fang Runway, Appendix 1 Logistics and Traverse Plan 2016. White Desert would continue to ensure that the established overland traverse routes are safe as part of the company health and safety procedures. This is likely to require minor adjustments to the routes, within the identified corridors, over time.

During the season, staff, cargo and fuel would also be transported between the White Desert camps and field camps using the ski-equipped aircraft, as part of the White Desert logistical operations.

Overview of fuel and supplies

The fuel, supplies and waste generated by White Desert in the baseline season of 2019-2020 along with the anticipated changes for the five year period is set out below.

Table 5 Operations Overview

Metric		Volume 2019-2020 baseline season	Volumes anticipated per season 2021-2022 season -5 year permit period
Aviation: refuelling intercontinental flights	Jet A1 -Consumed in Cape Town	645,000 litres	Up to 760,000 litres
Aviation: refuelling intracontinental flights	Jet A1 Consumed in Antarctica	290,000 litres	Up to 410,000 litres
Operation and maintenance, traverse and electricity generation	Jet A1 consumed in Antarctica	81,200 litres	Up to 135,000 litres
Cooking equipment	Propane	1,066 kg	Up to 3,100 kg
Skidoos/snow vehicles	Petrol	2,500 litres	Up to 15,000 litres
Used in plant and equipment	Lubricating oils	1,500 litres (estimated)	Up to 1,750 litres

White Desert Aviation

Aircraft are chartered by White Desert using contracted Air Operators. The Air Operators retain responsibility for the operation of the aircraft and provision of aircrew, pilots etc. In environmental terms, the aviation activities are required to comply with White Desert permit conditions, White Desert EMS, and environmental legislation relevant to flying in Antarctica. The Air Operators are also guided by the Antarctic Flight Information Manual, which they are provided each year. This is published by COMNAP and it includes relevant aviation requirements adopted by COMNAP.

Aircraft use in Antarctica

Photograph 1 Basler BT 67 landing at Wolf's Fang



All internal flights in Antarctica are carried out using ski equipped aircraft, usually using two aircraft per year. Ski-equipped aircraft are used by both scientific programmes and Non Government Organisations (NGO) in Antarctica due to their snow/ice-landing abilities. Balser BT 67 and Twin Otter have been used by White Desert since taking over the operation and management of internal flights following the submission of the relevant IEE and permit provided by the UK FCO. Where reference is made to internal flights in the report, these are carried out by Basler BT 67. It is proposed to continue using these or similar aircraft.

Intercontinental flights

Gulfstream G550 business jet aircraft have been used by White Desert for international flights at Wolf's Fang Runway since this activity was permitted in November 2016 by the UK FCO. Staff and cargo have also been transported using other programmes where required. In the 2019-2020 season, the White Desert Antarctic Permit included the use of a wide body Boeing 767 airliner. It is proposed to use a wide body aircraft in the future to assist in resupply activities. It is not envisioned that this would replace the business jet service used to transport clients to and from the continent but rather it be as a supplementary service, particularly at the start of the season when cargo demands are highest. Wolf's Fang Runway design allows for the operation of wide bodied airliner aircraft.

Plant, Equipment and Vehicles

Photograph 2 Piston Bully at Wolf's Fang Runway



The existing and proposed White Desert fleet of main plant, equipment and vehicles and the purpose for which they are used is identified below. White Desert would review operational requirements, repair and replace as necessary on a seasonal basis. As technology develops individual models may be replaced in accordance with a sustainable procurement strategy, however it is anticipated that the types of main plant, equipment and vehicles would remain the same. It should be noted that further details are provided with the Antarctic permit application, as required by the permit process, and only plant relevant to the IEE process is identified below.

White Desert IEE 2020 Report Final

Table 6 Existing and proposed plant, equipment and vehicles

Plant, equipment and vehicle Number 2019-2020 Baseline season		Location Purpose	Changes anticipated in 5 year plan
Apron Vehicle Toyota Hilux 4x4, wheeled	1	Aviation safety Stationed at Wolf's Fang Runway	No change
Specially adapted off-road, four-wheel drive and six wheel drive vehicles adapted for Antarctic Conditions Arctic Truck	3	Passenger transport, search and rescue (SAR), cargo At Wolf's Fang Runway and Whichaway	Increase to 6
Snow groomer/Tractor Piston Bully 100	1	Skiway maintenance / snow groomer At Whichaway skiway	No change
Snow groomer/Tractor fitted with cranes and recovery equipment Piston Bully 300	5	Wolf's Fang Runway maintenance, land traverse and snow groomer They will conduct seasonal maintenance on the storage berms, maintain the skiways, and support resupply.	Increase to 7
Light, tracked, oversnow vehicles (skidoo, ATV on tracks)	8	Skiway grooming, transport staff and passengers Across all sites Where PB300s are not on site, the skiway is maintained by light groomer pulled behind a 4x4 or skidoo.	Increase to 18
Generators	2 X 8KVA 8X 2KVA	Generation of electricity Across sites	Increase by 20kVA
Heaters Diesel combustion type for internal living areas.	10 small, 2 large.	Heating purposes Wolf's Fang, Whichaway Camp, Depot and FD83	12 small, 3 large
Photovoltaic panels, peak productive capacity installed	1 kW	All sites.	Up to 14 kW to be investigated for Wolf's Fang and other camps
Grey water treatment plant		Treatment of waste grey water	Whichaway To be investigated for Wolf's Fang

Operational Environmental Measures

This section identifies the potential environmental impacts of the organisation at the operational level and the environmental measures and strategy which White Desert has implemented to reduce these impacts, as well as the environmental improvements proposed over the five year period. This section sets out the organisational strategy in relation to climate change and the reduction of greenhouse gas emissions. Geographic and site specific environmental impacts of climate change are identified in the geographic section of the report.

Climate Change and Antarctica

Antarctica not only influences climate across the globe but the impacts of climate change are becoming evident in Antarctica with an increase in the rate of ice-shelf melting. Though ice-shelf melting and calving is natural process, the rate at which ice-shelves are melting has increased. The climate and physical and biological properties of the continent and the surrounding ocean are closely coupled to other parts of the global environment by the ocean and the atmosphere³.

The West Antarctic Peninsula is one of the fastest warming areas on the planet, with only some areas of the Arctic Circle experiencing faster rising temperatures. Part of the West Antarctic Ice Sheet are also thinning. However, climate change is not having a uniform impact across Antarctica, with some areas experiencing increases in sea ice extent. In some areas where sea ice is decreasing, there are measurable impacts on wildlife. Parts of Antarctica are losing ice at a rapid rate and paleo-climate studies in Antarctica show the current changes in global climate are unusual. If greenhouse gas concentrations were to double over the next century, Antarctica is expected to warm by as much as 3°C.

Changes in sea-ice and warming of Antarctic waters can have additional impacts on marine ecosystems and species, such as penguins which rely on sea-ice as a habitat for breeding and nesting, such as penguins⁴.

Climate change has been a key area of research for Antarctic programme for the past few decades.

Net Zero by 2050 and the Paris Agreement

In 2019, the UK Government committed to a *Net Zero by 2050* target. In doing this, the UK Government has made a legally binding commitment for a 100% reduction of greenhouse gas emissions on 1990 levels by 2050. This is applicable to UK infrastructure projects as well as UK organisations which are required to set out how this commitment will be met.

In March 2020, the court ruling regarding Heathrow Airport's third Runway stated that "The Paris Agreement ought to have been taken into account by the Secretary of State in the preparation of the ANPS [Airport National Policy Statement], but was not... What this means, in effect, is that the Government when it published the ANPS had not taken into account its own firm policy commitments on climate change under the Paris Agreement"

The *Net Zero by 2050* target, which followed the Paris Agreement 2015, was not a brand new commitment, as the Government had under the Climate Change Act in 2008 already committed to reducing emissions by 80%. In 1992, the UK Government published its paper, Climate Change: Our

³ <https://www.scar.org/science-themes/climate/>

⁴ <https://www.bas.ac.uk/science/research-topic/climate-climate-change/>

National Programme for CO₂ following Agenda 21. Given that the legal framework to reduce greenhouse gas emissions has existed in the UK since at least 1992, the Heathrow court ruling represented a tipping point, a shifting landscape in how seriously the climate emergency and commitments to Net Zero by 2050 were taken. More importantly there are implications for UK infrastructure projects both existing and in the pipeline. National policy statements, individual infrastructure projects, the aviation industry and the construction industry all need to set out their path to *Net Zero by 2050* and projects be required to demonstrate how they would work towards this target.

Potential Impacts

Fossil fuel use contributes to greenhouse gas emissions which contribute to climate change. In 2016 the global aviation industry produced 2% of all human induced global greenhouse gas emissions⁵ and transportation contributed to 24 %. Aviation was accountable for 3.6% of the total EU 28 greenhouse gas emissions and for 13.4% of the emissions from transport, making aviation the second most important source of transport greenhouse gas emissions after road traffic. Greenhouse gas emissions from aviation in the EU have more than doubled since 1990, when it accounted for 1.4% of total emissions⁶.

Operations in Antarctica provide an additional challenge, as there is no existing infrastructure for the centralised provision of electricity or for the distribution of fuel. In order for activities to be carried out in Antarctica, fuel is required to be transported to Antarctica and distributed where required. Fuel is used for aviation activities, the majority of generation of electricity (including for the production of drinking water) and for transport purposes.

The use of fuel is considered to be one of the main potential environmental impacts at the operational level of White Desert. There are potential impacts in relation to climate change arising from the increase in fuel use and associated increase in greenhouse gas emissions. In order to reduce the potential increase in greenhouse gas emissions, White Desert has set out a strategy which is summarised below.

Establishment of Greenhouse Gas Reporting 2019-2020 Baseline

Since the operation of Wolf's Fang Runway commenced in 2016 and White Desert took over the management of internal flights in 2017, White Desert has established a baseline of fuel use in relation to activities in Antarctica and carried out monitoring of fuel use across all activities and geographic locations.

In the 2019-2020, White Desert established a greenhouse gas reporting baseline. A report in line with the UK Streamlined Energy and Carbon Reporting (SECR) has been produced for this purpose. Although as an organisation White Desert does not meet the mandatory reporting requirements for SECR the report will be used to monitor against targets and will be produced on an annual basis. It also allows for a more detailed analysis and understanding of greenhouse gas emissions of White Desert at the operational level.

The table below provides a summary of the total fuel used and greenhouse gas, reported as carbon dioxide equivalent across all activities for the baseline season of 2019-2020. In order to set targets

⁵ <https://www.icao.int/environmental-protection/Pages/aircraft-engine-emissions.aspx>

⁶ <https://www.easa.europa.eu/>

and assess progress, a relative parameter is required to measure against, and we have selected client and staff numbers, as set out in the table below.

Table 7 Fuel use and CO₂ equivalent 2019-2020 Season

Activity Scope	Fuel type	Volume use 2019-2020 season	Unit	CO ₂ equivalent kgCO ₂ * Based on UK Government GHG Conversion Factors for Company Reporting Valid until July 2020	Tonnes CO ₂ equivalent
Aviation: refuelling intercontinental flights (Scope 3)	Jet A1 Consumed in Cape Town	645,000	litres	1,640,273.70	1,640.27
Aviation: refuelling intracontinental flights (Scope 1)	Jet A1 Consumed in Antarctica	290,000	litres	737,487.40	737.49
Operation and maintenance, traverse and electricity generation (Scope 1)	Jet A1 consumed in Antarctica	81,200	litres	206,496.47	206.50
Cooking equipment (Scope 1)	Propane	1,066	kg	1720.74	1.720
Snow vehicles (Scope 1)	Petrol	2,500	litres	5,787.38	5.79

Table 8 Carbon calculations Jet A1 per person

Carbon Calculations Jet A1 per person		
	2018-2019 season	2019-2020 season
Total scientific clients	0	13
Total clients during season (average trip duration 8 days)	117	159
Total staff in Antarctica	36	69
Total Persons in Antarctica	153	241
Litres Jet A1 per person	4,733.19	4,216.60
CO ₂ equivalent TonnesCO ₂ per person	12.04	10.72

Carbon and Fuel Use Management Plan

As can be seen in the tables above, aviation contributes the greatest proportion of greenhouse gas emissions for all White Desert activities. The greatest greenhouse gas emissions arise from the intercontinental flights from Cape Town to Wolf's Fang, followed by internal flights in Antarctica. This

is followed by overland traverse. We have therefore targeted reductions in aviation fuel use as this has the greatest scope to reduce greenhouse gas emissions.

White Desert has been off-setting carbon emissions associated with flights since 2007, through the investment in Amazon rainforest scheme certified by Carbon Neutral. However, recognising the rate at which climate change is taking place, White Desert has set out a strategy which would be implemented through as part of the five year plan, in order to reduce greenhouse gas emissions against the 2019-2020 baseline.

Existing Measures

White Desert has already implemented a number of mitigation measures in relation to greenhouse gas emissions and climate change, some of which were identified in the Wolf's Fang Runway IEE. The use of fuel efficient aircraft for international flights has been in place since 2017 with the use of long range business jets, such as the Gulfstream G550 as the main aircraft used. White Desert has also off set carbon since 2007 through the Carbon Neutral company on a voluntary basis and invested in a reforestation scheme as part of carbon off-setting. Additional measures taken include partnering with an air operator which has signed up to CORSIA scheme (Avcon Jet). CORSIA is the Carbon Off-setting and Reduction Scheme for International Aviation.

Pathway to Net Zero Commitment as part of five year plan

Sustainable Aviation Strategy

In line with the White Desert Sustainable Aviation Strategy, White Desert is proposing to roll out the use of Sustainable Aviation Fuel (SAF) in the upcoming season on a trial basis and is currently in discussion with a leading supplier of SAF. There are a number of options for the use of SAF under consideration. The use of SAF could also be implemented for other activities (such as overland traverse) in Antarctica, which have the second highest contribution to the greenhouse gas emissions after aviation (refer to Fuel Use and CO₂ equivalent table), as SAF could also be used in place of JetA1.

Any SAF being considered for use would be required to meet a number of sustainability criteria which include that source material is a waste product, as opposed to a planted biomass/crop, and that the SAF would also have sustainability certification (e.g. International Sustainability and Carbon Certification) which would be acceptable. The use of SAF can also count towards CORSIA emissions reduction efforts, depending on its certification.

SAF currently under consideration is a mixture of up to 30 % SAF produced from the alcohol to JetA1 conversion process. SAF have a lower carbon content at source than petroleum based fuels. In addition, contrail and air emissions would also be improved with the use of SAF (discussed further in air quality section).

An environmental options appraisal would need to be carried out to calculate the carbon reductions against the current baseline year as well as the improvements in air emissions for any chosen SAF.

Pledge to Net Zero Commitment- Setting of Science Based Targets

In line with the Government target of *Net Zero by 2050*, White Desert would set science based targets for the reduction of carbon. This would be carried through a pledge programme, such as Pledge Net Zero, which provides guidance⁷ for setting science based guidance and requires reporting of progress each year. The requirement under this scheme if a linear approach to setting targets is taken, the

⁷ <https://www.pledgetonetzero.org/pledge>

minimum ambition thresholds are 2.5% per annum and pursuing efforts to achieve 4.2% per annum reduction and it excludes carbon off-setting, requiring an overall reduction.

The reduction would be achieved primarily through the use of SAF as well as the use of fuel efficient aircraft for international flights. Other measures to reduce carbon include to improve efficiency of plant, equipment and vehicle fleet as they are replaced and to consider investigate renewable energy provisions at camps and to consider additional renewable energy sources for generation of electricity.

Carbon off-setting

White Desert would continue to off-set carbon emissions through carbon off-setting programmes as part of the five year plan and would also assess other carbon off-setting options such as investment in renewables in South Africa. We would also continue to partner with aviation organisations which monitor their own carbon emissions through international schemes such as CORSIA and further refine our carbon and energy reporting.

White Desert Pathway to Net Zero by 2050 Policy

The environmental measures White Desert has already taken towards the Net Zero by 2050 Policy

ESTABLISHMENT OF GREENHOUSE GAS REPORTING BASELINE

- Establishment of greenhouse gas reporting baseline for 2019-2020
- Establishment of Streamline Energy and Carbon Report in 2019-2020 which will become an annual requirement

EFFICIENCY OF AIRCRAFT

- Aircraft efficiency: use of fuel efficient aircraft for international flights has been in place since 2017 with the use of long range business jets (such as Gulfstream G550) as the main aircraft used
- Partnered with an air operator which has signed up to CORSIA scheme (Avcon JEt)

CARBON OFF-SETTING FOR FLIGHTS

- Carbon off-setting of flights since 2007 with the Carbon Neutral company, *carried out on a voluntary basis*
- Investment in Amazon reforestation scheme as part of carbon off-setting with the Carbon Neutral Company

Future strategy

SUSTAINABLE AVIATION STRATEGY

- Achieve reduction primarily through the use of **Sustainable Aviation Fuels**
- Trial use of **Sustainable Aviation Fuel** for aviation or off-set through use of SAF at other locations
- Implement use of SAF for overland traverse and other activities in Antarctica reducing use of JetA1
- Continue to implement the use of fuel efficient aircraft for international flights
- Increase fuel efficiency of White Desert fleet of vehicles and plant
- Consider additional and viable renewable energy options at camps in Antarctica
- Continue to refine carbon and energy reporting on a seasonal basis in line with SECR reporting guidelines

A PLEDGE TO NET ZERO BY 2050

- Set and monitor in order to REDUCE greenhouse gas emissions in line with Net Zero by 2050 commitment
- Make a Pledge to Net Zero through an established programme
- **Resultant reduction in greenhouse gas emissions**

CARBON OFF-SETTING

- Assess other carbon off-setting options such as investment in renewable in South Africa
- Continue to off-set carbon emissions through carbon off-setting programmes
- Continue to partner with aviation organisations which monitor their own carbon emissions through schemes such as CORSIA

Local air quality atmospheric emissions

Environmental Baseline Air Quality in Antarctica

Air quality in Antarctica is recognised as the least impacted by human activities and atmospheric chemistry is a key area of research carried out by Antarctic programmes.

Potential impacts on air quality in Antarctica should be minimised as far as possible. Potential receptors in terms atmospheric emissions are considered to be the local air quality, the monitoring stations/research stations, human health receptors and designated ecological receptors (ASPA and IBA) which all have a high sensitivity and value in accordance with the assessment criteria. Sensitive receptor sites which are taken into consideration in relation to local air quality are identified in the geographic assessment section.

Activities and potential impacts

In addition to greenhouse gas emissions' contribution to climate change, the use of fossil fuels in Antarctica has a potential impact in terms of local air quality emissions and atmospheric emissions. Emissions include nitrogen dioxide, heavy metals, particulate matter (for example PM₁₀ and PM_{2.5}) at ground level and carbon dioxide and nitrogen oxide in the lower atmosphere which can contribute to ozone production.

Similar to other organisations in Antarctica, White Desert operates is a single fuel system. Jet A1 is the primary fuel used for aviation and also for transport and electricity generation (though unleaded petrol and propane are also used in minor quantities).

Potential impacts can arise through the following operational and logistical activities:

- Aviation: Emissions of aircraft associated with taxi, take-off and landing at Wolf's Fang Runway and at skiways which can impact on local air quality at ground level. Aircraft emissions are only considered in the landing and take-off flight phases to 3,000 ft height as, after the aircraft leaves the Runway/skiway and starts to climb, the contribution of the engine emissions to ground-level concentrations decrease with increasing height. Once the aircraft reaches a height of a few hundred metres it makes little contribution to ground level concentrations⁸. Emissions of aircraft in the upper atmosphere are associated with flight path and aircraft contrails. In 2015, aviation accounted for 14% of all EU transport NO_x emissions and for 7% of the total EU NO_x emissions
- Operation and maintenance :Emissions of vehicles used for the operation and maintenance of the Wolf's Fang Runway and at skiways including snow groomers, snow vehicles, plant and equipment
- Transport: Emissions of vehicles used for the transport of staff, clients, cargo and resupply (overland traverse) including off-road vehicles and snow vehicles
- Welfare: Emissions of generators and cookers used for electricity generation, heating and food preparation for staff and clients across camps and field sites

⁸ https://www.icao.int/environmental-protection/Pages/LAQ_Trends.aspx

There is no significant increase in the amount of plant and equipment and vehicles proposed as part of the five year plan though there may be an increase in the internal flights carried out.

Local air quality and atmospheric pollutant

The main pollutants emitted by aircraft engines in operations (in decreasing order of concentration) are carbon dioxide (CO₂), nitrogen oxides (NO_x), sulphur oxides (SO_x), unburnt hydrocarbons (HC), carbon monoxide (CO), particulate matter (PM) and soot. The main pollutants emitted by vehicles include NO_x and particulate matter. The table below identifies the potential impact of pollutants:

Table 9 Local air pollutants and potential impacts

Parameter	Potential impact on receptors
Nitrogen Dioxides and Nitric Oxide (NO _x)	Contributes to photochemical smog One of the four main contributors to eutrophication ⁹ NO _x gases react to form smog and acid rain as well as being central to the formation of fine particles (PM) and ground level ozone, both of which are associated with adverse health impacts Human health/ ecological receptor impacts
Sulfur oxides (SO _x) and SO ₂	Contributes to photochemical smog One of the four main contributors to eutrophication Short-term exposures to SO ₂ can harm the human respiratory system and make breathing difficult. SO ₂ emissions can lead to the formation of other sulfur oxides (SO _x). SO _x can react with other compounds in the atmosphere to form small particles. These particles contribute to particulate matter (PM) pollution. Small particles may penetrate deeply into the lungs and in sufficient quantity can contribute to health problems
Ground level ozone	Human health/ flora
Particulate Matter	Human health/ecology receptors
Heavy metals including lead	Lead is persistent in the environment and can be added to soils and sediments through deposition from sources of lead air pollution. Other sources of lead to ecosystems include direct discharge of waste streams to water bodies. Elevated lead in the environment can result in decreased growth and reproductive rates in plants and animals, and neurological effects in vertebrates
VOC	Refuelling and accidental spillage of fuels would lead to Volatile Organic Carbons (VOC) which have potential indirect impact on human health to staff operatives One of the four main contributors to eutrophication
Greenhouse gas emissions such as CO ₂	Assessed in climate change chapter

Existing mitigation measures for local air quality impacts

White Desert has already implemented a number of mitigation measures in order to reduce potential impacts on local air quality, some of which were identified in the Wolf's Fang Runway IEE.

- Planning routes used during the overland traverse and the client transfer to avoid being within 500 meters of designated ecological sites
- Planning routes in advance to maximise efficiency in fuel-use and therefore reduce emissions and local air quality impacts

⁹ The National Emissions Ceilings Directive (2001/81/EC)

- When planning traverse route, avoiding other non-designated areas, such as nunataks and coastal regions, which may provide suitable habitat for birds and remain at least 300 meters away from potential bird habitats (unless required for health and safety reasons)
- Ensuring that there is no unnecessary idling of snow vehicles or plant to reduce emissions during operation and maintenance, as far as health and safety allows
- Regularly inspecting and maintaining vehicles, plant and equipment to ensure good working order and air emissions are appropriate
- Use of photovoltaic panels at Whichaway Camp

Additional local air quality environmental measures

There are no specific air quality limits set in Antarctica. Therefore, the assessment of impacts and mitigation measures are based on reducing and avoiding local air quality impacts as far as possible. The UK Institution of Air Quality Management (IAQM)¹⁰ recommends that the following basic hierarchy principles, drawn from similar well-established mitigation hierarchies used for EIA development to be used as the basis for mitigating the operational air quality impacts associated with schemes:

1. Preventing or avoiding
2. Reduction and minimisation
3. Off-setting

In the absence of additional mitigation measures, there may be an increase in the potential impacts on local air quality at the operational level as part of the five year plan. In order to reduce this potential impact, White Desert has set out a Carbon and Fuel Use Management Plan which includes the following measures:

- Roll out the use of SAF for operations in Antarctica. SAF have lower emissions of particulate matter and as nitrogen dioxides (add source)
- Investigate renewable technology such as solar powered electricity generation at Wolf's Fang and other camps to reduce emissions
- Use of photovoltaic panels at Wolf's Fang to reduce local emissions and consider renewable low carbon technology
- Sustainable procurement strategy to improve fleet. As plant, equipment and vehicles are replaced over time with improved emissions standards which meet EU or international emissions standards. For example, the snow groomers purchased following the operation of Wolf's Fang meet the highest emissions standards (EPA Tier 3) and the snow vehicles purchased also have high efficiency. In the future, we would work with our supply chain to ensure any trucks would be replaced with high Euro rating diesel trucks. This would result in a fleet with improved efficiency and lower emissions. The existing emissions ratings are identified in the table below.

¹⁰ Mitigation of Development Air Quality Impacts June 2018 | Version 1.1, IAQM

White Desert IEE 2020 Report Final

Table 10 Efficiency of plant, equipment and vehicles existing fleet 2019-2020

Plant, equipment and vehicle	Efficiency/ Air emissions levels Examples of efficiency of the plant include: Euro 4/ 5/6 (for diesel trucks) CO2 emission per mileage Age of vehicles STAGE IIIA or Stage IIIB EU emission regulations.
Apron Vehicle Four-wheel drive Toyota Hilux	Euro 4 2007 MODEL 8,6 litres/ 100km
Specially adapted off road, four-wheel drive vehicles adapted for Antarctic Conditions Arctic Truck	Euro 4 2008 MODEL ± 30 litres/ 100km
Snow groomer/Tractor Piston Bully 100	STAGE III A 10 litres/hr EPA TIER 3 (highest rating)
Snow groomer/Tractor fitted with cranes and recovery equipment Piston Bully 300	STAGE III A 22 litres/hr EPA TIER 3 (highest rating)
Snow vehicles (Skidoo and Skandic)	5 litres/hr in working conditions Up to 68,1 dB noise level
Generators	2,6 litres/ hr under 75% load
Heaters	0,25 litres/hr of heating 0,45 kg/hr CO2 (Websasto)
Photovoltaic panels	No emissions- up to 14kW to be investigated for Wolf's Fang and other camps

Bio-Security and Non Native Species

Environmental Baseline

Bio-security is the risk of introducing a biological agent, such as a virus or parasite, which can adversely impact the health of native species in Antarctica.

The introduction of invasive species, including vertebrates, invertebrates and plants, has greatly altered the ecosystems of many sub-Antarctic islands. The Antarctic continent currently has few confirmed non-native species, but numbers are increasing. Introduced non-native species can compete with native species and impact on natural ecosystems. Areas of ice-free ground are considered to be at greater risk.

Activities and Potential impacts

Impacts could potentially occur through the introduction of non-native species from outside Antarctica or through the introduction of a species from one site in Antarctica to another which could become established, changing the sensitive Antarctic habitat or affecting species. Impacts could also potentially occur through the introduction of diseases to birds or mammals (for example salmonella or bird flu) having more direct consequences. As White Desert does not come into close contact with wildlife the primary transmission route could potentially be through boots or through waste.

For this to happen there must be a source-pathway/vector- receptor link:

Table 11 Non native species pathway receptor link

<i>Sources of Non Native Species</i> <i>Sources of non native species and bio security risks include:</i>	<i>Pathways and vectors</i> <i>Pathways or vectors for transporting non native species include:</i>	<i>Receptors: Environmentally Sensitive Areas</i> <i>All areas in Antarctica are protected under the Antarctic Treaty. Isolated bird or marine mammal colonies may be vulnerable to disease, so additional precautions are required to prevent the introduction of pathogens. The areas White Desert visits are all within the Dronning Maud biogeographic region and the East Antarctic Ice sheet. The areas which are particularly sensitive are:</i>
<ul style="list-style-type: none"> Invertebrates (examples include. insects, spiders, worms, fruit flies, midges) Fungi (i.e. mould, mould spores) Microorganisms Soil (a habitat for invertebrates and above) Mud Seeds, spores, bulbs Animal waste Diseases which can be transferred via vectors to birds and mammals in Antarctica 	<ul style="list-style-type: none"> Boots Velcro fasteners on clothing Food Aircraft Vehicles Backpacks Camera bags Luggage 	<ul style="list-style-type: none"> Atka Bay- the Emperor Penguin colony, seals and birds present Whichaway Camp and the Schirmacher Oasis - including the small bird population and unique lake environments found there Wolf's Fang Runway facilities are a transit site between the different sites (Atka Bay, Cape Town, Schirmacher Oasis

White Desert IEE 2020 Report Final

<p>(examples of diseases include salmonella, bird flu, tapeworm)</p> <ul style="list-style-type: none"> Animal food waste (e.g. eggshells, chicken bones) 		<p>etc).Nearby Nunataks at Wolf's Fang</p>
--	--	--

Mitigation Measures: Summary of Bio Security Measures

White Desert has created a Bio-Security and Non Native Species Management Plan in order to reduce the risk of introducing non native species. This takes into consideration and incorporates published IAATO guidelines (including IAATO Boot Washing, IAATO Don't pack A Pest) and follows the Antarctic Treaty legislation CEP Non Native Species Manual (2017). This plan includes measures which are applicable to clients and staff and their luggage, belongings and cargo.

Following the mitigation measures set out in the Bio-Security and Non Native Species Management Plan reduces the likelihood of introduction of a non native species to unlikely-rare.

The following table sets out an extract of the checklist that is followed.

Table 12 White Desert Bio-Security Checklist Move to Appendix

Pre-Departure	
Clothing and Equipment:	
IAATO Don't Pack A Pest information sent out to guests and staff before their departure to inform them of why the measures are required	
In Cape Town Clothing and Equipment:	
It is very important to check and clean both client and staff luggage, clothing, boots, camera cases, walking equipment	
This includes vacuuming luggage, checking velcro fastenings for seeds, cleaning any used boots of mud/soil and sterilising if required	
All White Desert loaned boots and clothing are washed, vacuumed or disinfected as appropriate	
All boots and walking equipment must be sterilised using Virkon S (a biocide approved for use in Antarctica) prior to departure	
Extra precautions are needed if guests or staff have used clothing and have visited farms, wildlife	
In Cape Town Cargo	
Cargo: White Desert cargo includes food, equipment, plant, vehicles, clothing. Follow White Desert detailed checklist for all cargo throughout packing process. Ensure that cargo packing area is clean and free from mud, soil, insects, spores, seeds etc through packing on concrete base, keeping packing area enclosed, regular cleaning and visual inspection of cargo, use of insect sticky tapes, preventing infestation from insects or other pests. If any invertebrates are found ensure action is taken Any new timber materials required would need to be treated accordingly prior to export	
Food: Follow food packing checklist which includes measures such as ensuring all raw fruit/ vegetables packed are free from soil and insects. Any poultry must be de boned. Pre-cooking meals to reduce the raw food taken into Antarctica	
Aircraft: Ensure aircraft surfaces are thoroughly vacuumed prior to departure. Use of on board aircraft insecticide spray immediately prior to departure to ensure any insects are eliminated. Boots and shoes to be cleaned with Antarctic approved compounds (such as Virkon S)before entering aircraft	
In Antarctica:	
Solid human waste is securely stored, clearly labelled as hazardous waste and removed from Antarctica which reduces spreading of any diseases. Human waste is a bio hazard because it contains pathogens and infectious diseases.	
Waste food is securely stored to prevent birds being able to eat waste food. Waste egg shells and waste poultry are stored in an enclosed in a secure clinical waste container which cannot be accessed by birds	
No food is to be consumed at the Emperor Penguin site in Atka Bay Iceport and guests are informed of measures before visiting penguins	
Boots are checked and cleaned with Virkon S or equivalent before departure for Atka Bay or upon arrival at Whichaway	
Daily cleaning of toilet areas and visual inspections of waste storage areas are carried out by staff at Whichaway Camp and Wolf's Fang	
Required distance from wildlife ensures the risk is minimised further	
Relevant legislation	
Committee for Environmental Protection (CEP), Non-Native Species Manual Revision 2017	
ATCM XXXIV - WP 53 (SCAR) 2011 - Measures to reduce the risk of non-native species introductions to the Antarctic region associated with fresh foods.	

Waste Management Plan

Activities and Potential Impacts

The physical environment in Antarctica requires protection under the Antarctic Treaty Protocol on Environmental Protection. In addition, Annex III Waste Disposal and Waste Management of the Protocol sets out the required waste disposal measures. Taking these factors into consideration, all White Desert waste other than grey water and urine, is removed from the Antarctic Treaty area.

Waste can arise through activities carried out by White Desert staff and operatives across field camps and camp sites during the summer season between November and February. These activities include:

- Operation and maintenance activities which can give rise to hazardous and non-hazardous waste including scrap metals, waste electrical equipment, waste cardboard packaging and redundant plant and equipment
- Aviation and transport activities which can give rise to waste fuels and oils, waste fuel drums, waste containers, used spill kits
- Welfare activities which generate grey water from showers, clothes washing and kitchen, solid waste, urine waste, used waste food packaging and food waste

Prior to removal from Antarctica, waste generated, stored and handled has potential to have adverse impacts on the Antarctic environment if not handled appropriately:

- Potential impacts on the ice and snow physical environment through contamination caused by spillage
- Ecological impacts direct impacts on individual birds associated with direct ingestion of litter or entanglement in debris
- Potential aircraft impacts from Foreign Object Debris (FOD) at Runways or skiways
- Attracting wildlife and causing disturbance of and health risk to wildlife
- Dispersion of waste material into open water causing marine or freshwater (lakes) pollution impacts

These potential impacts are assessed by geographic location in the assessment tables section of the report.

At the operational level, there is potential for an increase in the total amount of waste produced due to the increase in total client numbers.

Mitigation Measures

All White Desert waste, other than grey water and urine, is removed from the Antarctic Treaty area as set out above and is transported mainly via ship to Cape Town. All recyclable waste is segregated and recycled using a licenced waste contractor in South Africa. This helps to achieve diversion from landfill in South Africa.

The total amount of waste arising in Antarctica is minimised as far as possible through the use of re-useable packing and reduction in the amount of packaging sent to Antarctica.

Potential impacts on the Antarctic environment are avoided through appropriate waste storage and handling. The use of waterless toilets reduces the total amount of sewage arising. Each camp has a nominated site waste champion which is responsible for ensuring these measures are followed, as set out in the Antarctic Permit requirements.

The Waste Management Plan is updated each season and includes requirements for waste quantity monitoring, measures for reducing waste, recycling and diversion from landfill targets, annual Duty of Care audits, in addition to the waste storage and handling requirements. The key elements of the Waste Management Plan are set out below.

Following the mitigation measures set out in the Waste Management Plan reduces the likelihood of impacts occurring and reduces the magnitude of an impact if it were to occur.

Table 13 Waste Management Plan

Objectives and Strategy	
All waste (other than greywater and urine) is removed from the Antarctic Treaty Area	
The White Desert Waste Management Plan is based on the principles of Avoid, Reduce-Re-use-and Recycle, and is part of the White Desert Environmental Policy.	
Waste arising in Antarctica is minimised as far as possible through the reduction of packaging sent to Antarctica, use of re-usable containers and removal of single use plastics in Antarctica.	
The Waste Management Plan follows the Antarctic Protocol Annex III Waste Disposal and Waste Management legislation. As well as following applicable UK waste regulations, White Desert is required to comply with South African waste regulations such as National Environmental Management Waste Act 2008.	
Other than grey water and urine, all waste is removed from Antarctica by White Desert and returned to Cape-Town for recycling or safe disposal.	
White Desert uses suitably licenced waste contractor to handle all waste streams in Cape Town and the waste contractor provides waste transfer notes and quantities of	
Waste streams are monitored by White Desert on an annual basis A Waste Management Audit is carried out on an annual basis.	
Procedures and responsibilities	
All staff and operatives are responsible for ensuring that waste is disposed of in accordance with waste legislation and White Desert requirements.	
Each location has a named Site Waste Champion responsible for ensuring compliance with the requirements and that all members of staff understand the required procedures. The Site Waste Champion will also be responsible for Foreign Object Debris (FOD) collection and detection at the Runway and skiway sites.	
Cargo and logistics manager is responsible for organising the collection of waste, collation of waste transfer notes/ Bill of Lading in South Africa and liaison with the waste contractor in Cape Town.	
The Environmental Manager carries out a waste Duty of Care audit on an annual basis. This is required to include	
Check waste carrier's license in advance of appointment and ensure that it remains valid	
The waste carrier's license should be accepted only if it has been endorsed by the appropriate environmental regulator	
The waste carrier must be licensed to carry waste streams	
The transfer notes should be completed in full and contain an accurate description of the waste and signed by the producer and carrier prior to waste leaving the site	
Keeping copies of all transfer notes for waste sent off site for two years for inert and five years for hazardous	
Carry out spot checks to ensure compliance with Duty of Care including following waste carrier to ensure the waste does arrive at the agreed disposal site	
Awareness and Training	
All staff and operators are required to read the waste management plan and undergo waste management and training as well as FOD awareness and training. The training and briefing will become an annual requirement.	
Prohibited Products:	
Annex II of the Environmental Protocol prohibits the introduction of the following products to Antarctica:	
Polychlorinated biphenyls (PCBs) found in electrical apparatus, cutting fluids etc	
Non -sterile soil	
Polystyrene beads or similar man-made packaging	

White Desert IEE 2020 Report Final

The table below summarises the waste management strategy for each waste stream and identifies the waste classification system.

Waste Stream Handling and Final Treatment

Table 14 Waste Streams Handling

Waste Stream Classification	Storage/ Handling	Legislation	Management Final Treatment
<p>Category According to Antarctic Protocol</p> <p>Waste Classification according the South Africa legislation</p>			
<p>Grey Water (shower water, urine, kitchen wastewater)</p> <p>Group 1- sewage and domestic liquid waste</p> <p>Hazardous waste</p>	<p>Oil residues from kitchen wastewater are removed using grease trap</p> <p>Grey water (excluding urine) is filtered prior to disposal</p> <p>Note: Grey water treatment plant is being designed for future seasons</p>	<p><i>Wastes not removed or disposed of in accordance with Articles 2 and 3 shall not be disposed of onto ice-free areas or into freshwater systems.</i></p> <p><i>Sewage, domestic liquid wastes and other liquid wastes not removed from the Antarctic Treaty area in accordance with Article 2, shall, to the maximum extent practicable, not be disposed of onto sea ice, ice shelves or the grounded ice-sheet, provided that such wastes which are generated by stations located inland on ice shelves or on the grounded ice-sheet may be disposed of in deep ice pits where such disposal is the only practicable option.</i></p> <p><i>Such pits shall not be located on known ice-flow lines which terminate at ice-free areas or in areas of high ablation.</i></p>	<p>Disposal in suitable location in Antarctica</p> <p>Following removal of oil residues and any micro-plastics through filtration, grey water is disposed of in a deep ice pit as disposal at sea is not an option</p> <p>Suitable deep ice pits are identified in proximity to Wolf's Fang Runway and Whichaway Camp</p> <p>Field camp grey water must, to the maximum extent practicable be removed to main camps (Wolf's Fang or Whichaway as appropriate)</p> <p>Deep ice pit must not be located within known ice-flow lines which terminate at ice-free area or in areas of high ablation (e.g. close proximity to lakes)</p> <p>Only one deep ice pit will be used at each site and will result in grey water to be contained in a frozen state.</p> <p>Note: Grey water treatment plant is being designed for future seasons</p>
<p>Blackwater</p> <p>Group 1- sewage and domestic liquid waste</p> <p>Hazardous waste</p>	<p>Waterless toilets are in use reducing total water use in Antarctica</p> <p>Waste is sealed in plastic bags and</p>	<p>All wastes to be removed from the Antarctic Treaty area, or otherwise disposed of, shall be stored in such a way as to prevent their dispersal into the environment.</p>	<p>Removal from Antarctica</p> <p>Sewage Treatment Plant in Cape Town</p> <p>All human waste is segregated from urine using a two toilet system</p>

White Desert IEE 2020 Report Final

	stored in hazardous waste containers		Solid human waste is collected in waterless toilets, stored in secure containers as hazardous waste and shipped to Cape Town for treatment
<p>Food waste and compostable waste</p> <p>Any non recyclable plastic waste used for food (e.g. crisp packets, chocolate wrappers)</p> <p>Group 4 Other Solid Waste</p> <p>General Waste</p>	<p>Biodegradable food and compostable waste is segregated from recyclable waste to prevent cross contamination</p> <p>Stored in enclosed containers, in doors to reduce risk of dispersal and potential impacts to wildlife</p>	<p>All wastes to be removed from the Antarctic Treaty area, or otherwise disposed of, shall be stored in such a way as to prevent their dispersal into the environment</p>	<p>Removal from Antarctica Disposal in Cape Town</p> <p>Avoid and Reduce:</p> <p>Food waste arising is minimised through the pre-preparation in Cape Town as far as possible. Avoidance of sending non-recyclable plastics to Antarctica</p> <p>Food is re-packaged into vacuum packed plastic bags prior to arrival, reducing amount and volume of recyclable materials imported to Antarctica</p>
<p>Egg shells and poultry waste</p> <p>Food waste</p> <p>Group 4 Other Solid Waste</p> <p>General Waste</p>	<p>Egg shells and poultry bones are not taken to Antarctica</p> <p>Food waste is stored in clinical waste containers to prevent exposure to wildlife</p>	<p>All wastes to be removed from the Antarctic Treaty area, or otherwise disposed of, shall be stored in such a way as to prevent their dispersal into the environment.</p>	<p>Removal from Antarctica Disposal in Cape Town</p> <p>Avoid and Reduce:</p> <p>Food waste arising is minimised through the pre-preparation in Cape Town</p>
<p>Recyclable materials such as packaging and containers including:</p> <p>Plastic (excluding plastics banned from Antarctica- see below)</p> <p>Metals</p> <p>Paper and cardboard</p> <p>Fabrics</p> <p>Glass</p> <p>Group 4 Other Solid Waste</p>	<p>Dry recyclable waste is segregated from food waste to prevent cross contamination</p> <p>Stored in enclosed containers, in doors to reduce risk of dispersal and potential impacts to wildlife</p>	<p>All wastes to be removed from the Antarctic Treaty area, or otherwise disposed of, shall be stored in such a way as to prevent their dispersal into the environment.</p>	<p>Removal from Antarctica Recycled in Cape Town</p> <p>Avoid and Reduce:</p> <p>Avoidance of non-essential packaging</p> <p>Re-usable packaging selected as far as possible</p>

White Desert IEE 2020 Report Final

General Waste			
Food crates Not considered waste as a re-used container	Food within vacuum packed plastic bags is transported in reusable plastic crates	All wastes to be removed from the Antarctic Treaty area, or otherwise disposed of, shall be stored in such a way as to prevent their dispersal into the environment.	Removal from Antarctica Re-used in Cape Town Food crates and cargo crates/sacks are re-useable. Contents are emptied and sent back to Cape Town on return journeys for re-use
Empty fuel drums Group 2 Other liquid wastes including fuels and lubricants Hazardous waste	Remaining oil is siphoned off, containers sealed to minimise risk of spillage	<i>Required to be removed from Antarctic Treaty Area</i>	Re-used in Antarctica if suitable and not damaged Removal from Antarctica Recycled in Cape Town through licensed waste contractor
Waste oils, waste lubricants, waste fuels and cooking oils Group 2 Other liquid wastes including fuels and lubricants Hazardous waste	Stored in appropriate secured containers to prevent accidental spillage Segregated from new fuels and oils and clearly labelled as hazardous waste	<i>Required to be removed from Antarctic Treaty Area</i>	Removal from Antarctica Recycled in Cape Town through licensed waste contractor
Materials contaminated with waste oil/ fuels e.g. contaminated spill kits, contaminated spill mats, oily rags Group 4 Other solid wastes Hazardous waste	Stored in appropriate enclosed containers to prevent contamination or dispersal Segregated from new fuels and oils and clearly labelled as hazardous waste	<i>Required to be removed from Antarctic Treaty Area</i>	Removal from Antarctica Recycled in Cape Town through licensed waste contractor or disposed of where recycling is not an option
Light bulbs, electrical batteries, waste electrical equipment Waste containing harmful metals or persistent compound Group 4 Other solid wastes Hazardous waste	Stored in appropriate enclosed containers Stored on an impermeable base to prevent contamination or dispersal Segregated and stored safely to prevent damage	<i>Required to be removed from Antarctic Treaty Area</i>	Removal from Antarctica Recycled in Cape Town through licensed waste contractor

Environmental Emergency Preparedness and Response

In terms of environmental emergencies which could arise as a result of operations these include:

- Fuel spillage, potential direct impacts on the quality of the physical environment resulting from an aircraft crash or from an accident during traverse and logistical operations
- Severe climatic conditions and weather phenomena
- Aircraft crash
- Fire incident

The White Desert preparedness and response measures in relation to environmental emergencies are set out as part of the White Desert Operations and Health and Safety procedures. The Health and Safety procedures and documentation is updated each season and submitted as part of the Antarctic Permit treaty application process.

These include:

- Preparation of a Search and Rescue in advance of each season. This is submitted with FCO Permit on annual and identifies specific measures and plans in place in case of an accident or emergency. This plan can be referred to for the most up to date information in relation to emergency preparedness and response
- Necessary climbing search-and-rescue equipment, first aid kit for the voyage and camp use
- Arrangements for aviation risks
- Procedures in relation to blizzard and white out conditions
- Health and Safety procedures covering White Desert staff and operatives activities such as operation and maintenance, overland traverse, field camps

This documentation is considered outside the scope of the IEE. The mitigation measures in relation to a fuel spills are set out in the Fuel/Oil Spill Contingency and Response Plan.

Relevant Legislation

- Protocol on Environmental Protection to the Antarctic Treaty (1991), Annex VI Liability Arising from Environmental Emergencies

Operational Assessment Tables

The following tables set out the assessment of environmental impacts at the operational level. The tables identify the environmental receptor and potential environmental impact on each receptor. It sets out the environmental measures which are taken or which would be taken in order to reduce the risk of the impact occurring, to avoid the impact all together or to reduce the magnitude of an impact. It also sets out the residual risk and magnitude and how these measures have been/ would be integrated into the White Desert EMS.

The assessment has been carried out in accordance with the methodology set out in the impact assessment tables in Appendix I.

.

A) Operational Measures					
Environmental impacts				Implementation	
Receptor	Potential impact	Mitigation measure	Residual risk	White Desert Environmental Management Plan	Monitoring/ Implementation Responsibility
sensitivity receptor	Description	Description	Residual Magnitude of impact		
Greenhouse gas emissions impacting on climate change	Increase in fuel use can lead to increase in greenhouse gas emissions if carbon reduction measures are not taken . This potential impact is discussed in more detail in operational measures section of report	The measures are discussed in detail in operational measures section of report. Some include	Low High x minor = minor or transient	Sustainable aviation Fuel strategy Carbon and Fuel Management Plan	Collation of fuel data by site team and ongoing monitoring throughout the season
		Greenhouse gas emissions baseline established for 2019-2020			Net zero by 2050 target monitoring and ensuring implementation of strategy by Environmental Manager
		Currently carrying out options appraisal for the introduction of Sustainable Aviation Fuel into operations in Antarctica			
		Set carbon reduction target in line with UK Government commitment for Net Zero by 2050 target			
		Continue with annual carbon off-setting scheme			
		Investigation other off-setting schemes			
		Continue to align with partners which are alignment with White Desert values such as signing up to CORSIA scheme			

White Desert IEE 2020 Report Final

Local air quality and atmospheric emissions	Potential impacts on local air quality arising from use of aircraft during landing and take-off, use of vehicles during transport and generator. This potential impact is discussed in more detail in operational measures section of report	The measures are discussed in detail in operational measures section of report. Some include	High x minor = minor or transient	Carbon and Fuel Management Plan	White Desert procurement team
		Use of sustainable procurement strategy to change fleet			
		Use of SAF in Antarctica to improve emissions			
Antarctic ecosystems in Dronning Maud land	Potential to introduction and establishment of non native species	Appropriate mitigation to reduce risk as far as possible is set out in details in Bio-security plan and in chapter As White Desert do not partake in any experiments and risks are associated with food, cargo, luggage and plant	Rare - unlikely	Bio-security Plan	All staff, clients, cargo and logistics manager will have responsibility to ensure plan is implemented
		Bio-security plan is set out in Operational impacts section of report			Environmental audits carried out by Environmental Manager on periodic basis to ensure Bio-security is being implemented correctly
South Africa	Potential for increase in total amount of packaging waste (grey water assessed separately above) f measures to reduce amount of waste generated	All waste is removed from Antarctica other than grey water and urine	Impacts in Antarctica from increase in waste are avoided (Potential impacts from storage, handling of	Waste Management Plan	Site waste champions in Antarctica ensure waste is stored and managed appropriately out
		Measures to reduce impacts of waste in South Africa are set out in Waste Management Plan and can be referred to in Operational Measures section of report. These include: <ul style="list-style-type: none">Carry out waste quantity monitoring			Environmental Manager to carry monitoring and Duty of Care audits

White Desert IEE 2020 Report Final

		<ul style="list-style-type: none"> • Set targets for the reduction of total waste quantities • All recyclable waste is diverted from landfill and a licenced waste contractor is employed • Ensure compliance with applicable South African legislation and carry out annual Duty of Care 	waste are assessed in Geographic impacts separately)		
--	--	--	---	--	--

Geographic Specific Environmental Measures

Introduction

This section identifies the geographic specific environmental measures in relation to activities carried out by White Desert. The first section provides a description of activities and identifies the environmental baseline conditions which are considered the most relevant to White Desert activities at each geographic location and which are taken into consideration during the environmental impact assessment process.

Environmental Baseline and Activities

Wolf's Fang Runway and Camp

Photograph 3 Gulf Stream Landing at Wolf's Fang



Description of Activities

Wolf's Fang Blue-ice Runway

Wolf's Fang Blue-Ice Runway is the main gateway to Antarctica for all White Desert operations. Wolf's Fang Runway is only manned and operated during the summer operating period between November and February. The activities at this location are therefore temporary and seasonal in nature.

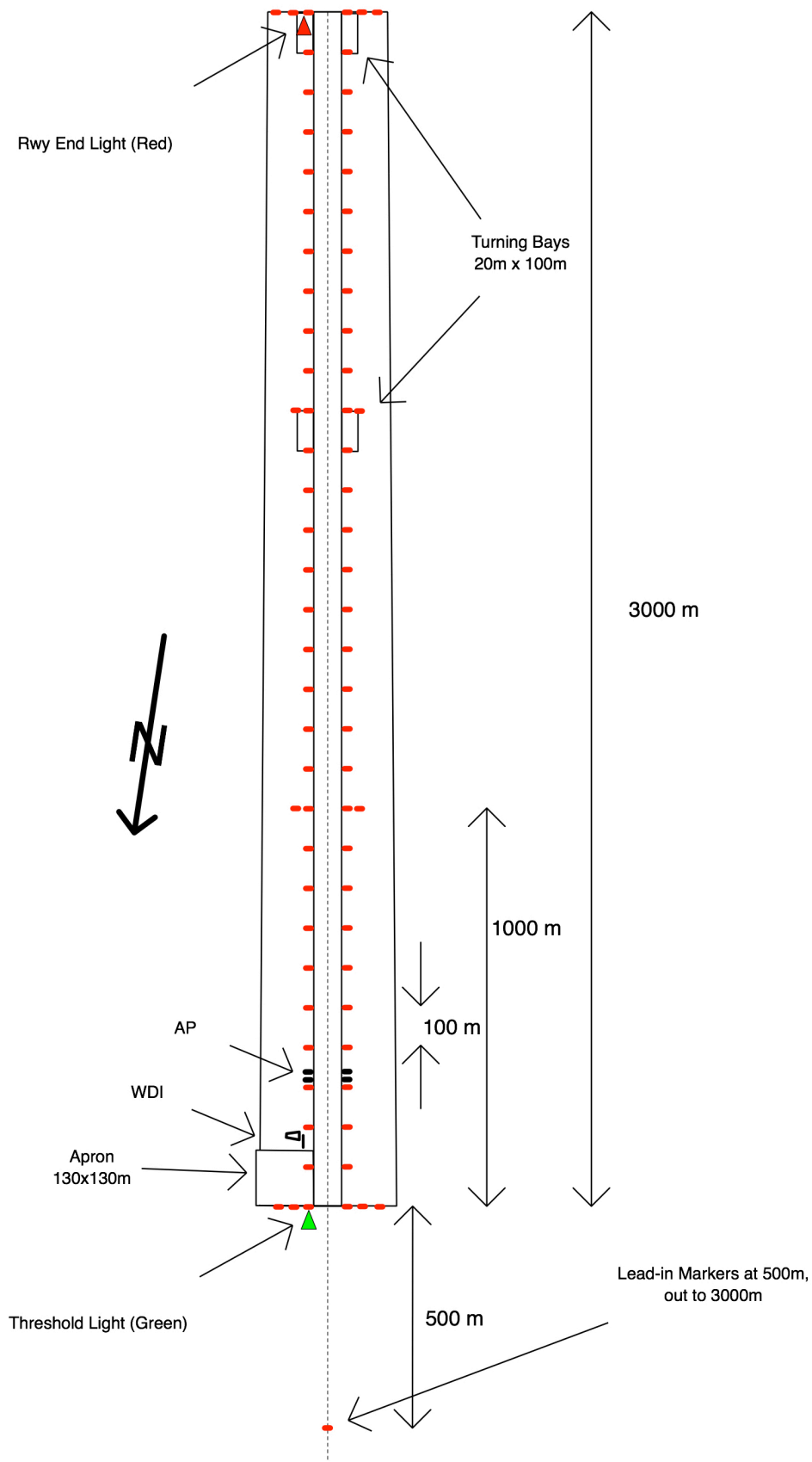
Wolf's Fang Runway has been permitted to operate by the UK FCO since the 2016-2017 season. This followed the preparation of the Wolf's Fang Runway IEE and Appendix 1 Logistics and Traverse Plan, 2016 by White Desert, which can be referred to for a more detailed description of the environment in the wider study area.

Site instatement commences during the last week of October, when the Runway is prepared using a snow groomer (known as a Pisten Bully) to meet specification requirements. The Runway is made entirely of ice, located on natural blue glacial ice. Due to the dynamic nature of glacial ice, ongoing maintenance activities are required. Unlike a conventional Runway which is generally always available for use, the Wolf's Fang Runway is only opened for brief flight windows during periods of good weather. Additionally, the Runway moves northwards at approximately 14 meters per year. The runway therefore requires repositioning every year to its original coordinates.

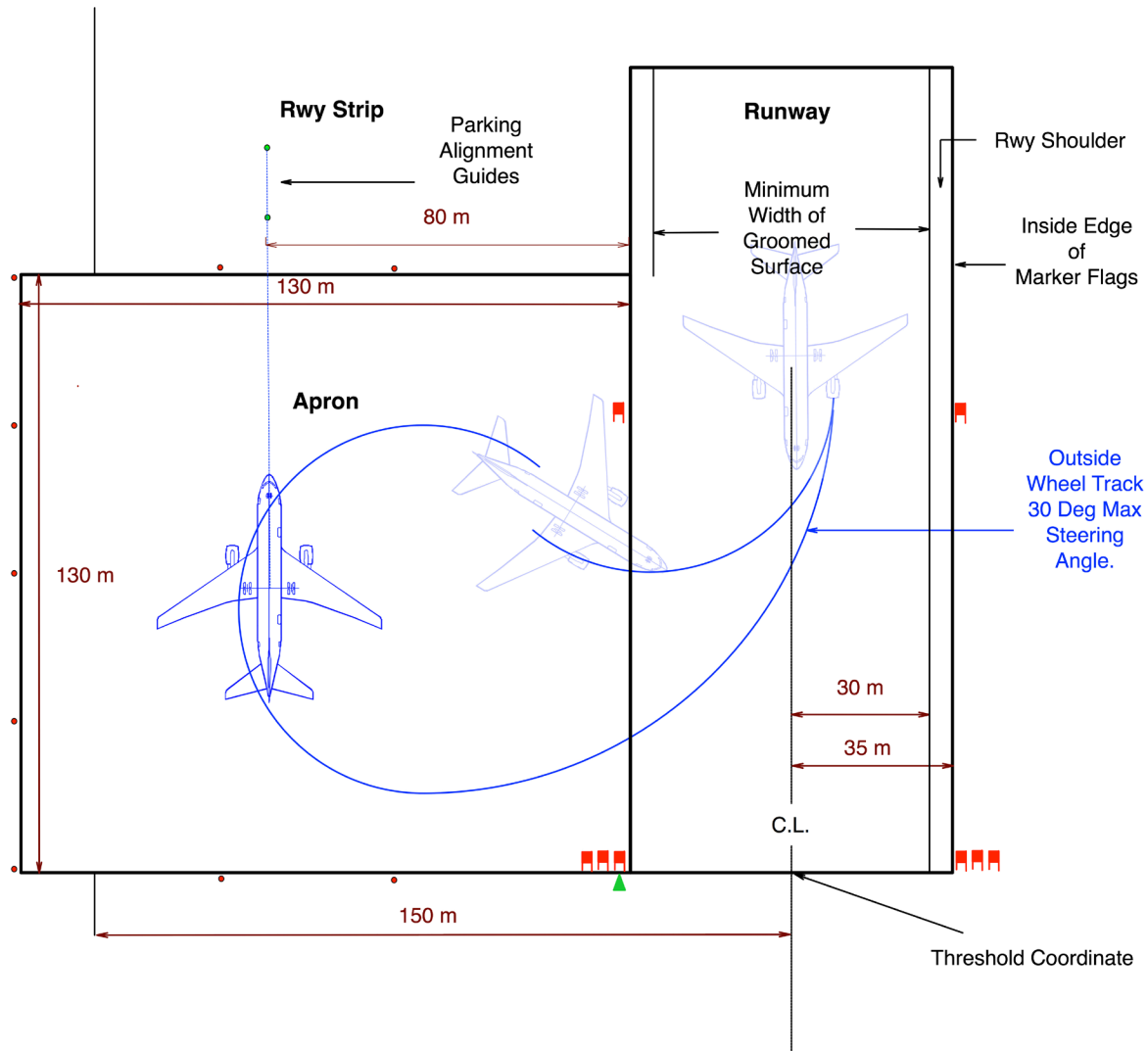
The blue-ice Runway is approximately 3km in length with a width of 60 meters. A layout plan of the airfield operating surface (AOS) can be seen in the schematics below. It is designed to meet the

standards required in a category 4 civil Runway and includes a taxiway and apron and is currently a non certified runway. It is one of five blue-ice Runways in Antarctica.

Schematic 1.0 Wolf's Fang Runway Layout



Schematic 2.0 Wolf's Fang Apron Layout



Wolf's Fang Camp

The Wolf's Fang Camp provides support for the aviation operations as well as a transit camp for clients arriving in Antarctica, enroute to White Desert locations, or upon their return trip to Cape Town International airport. To date, clients have only used the camp as a transit camp, staying overnight for a short period of time.

White Desert's aviation and logistical staff are based at Wolf's Fang Runway using one-man tents. Support for aviation includes ground to air communications, fuel storage and materials storage in container units. Clients in transit are temporarily accommodated in tents, whilst waiting for flights or overnight prior to flights. The camp is also used on a temporary and seasonal basis.

Changes in activities for five year period

Tourist activity

It is proposed to use Wolf's Fang Camp as a base for client activities in the area as well as continuing its use as a transit camp, as part of the five year plan This would be carried out in addition to the

existing client activities based out of Whichaway Camp and as a result there may be two groups present concurrently in Antarctica.

To date, only occasional client activities have been carried out in the area, such as a marathon run or visits to the nearby Wolf's Fang/Ulvetanna peak (in the Drygalsky mountains), which have been permitted on a case by case basis as part of the annual Antarctic Permit process.

Clients would be taken on similar activities to those carried out at Whichaway Camp within the existing wider study area and environs of Wolf's Fang Runway. It is proposed that these could be to the nearby mountain ranges such as Wolf's Fang peak in the Drygalsky mountains or Kurze mountains. Clients would at all times be accompanied by White Desert trained field guides to ensure their safety. More detailed reconnaissance surveys would be carried out in advance of these excursions in order to establish safe transport routes and map the terrain. Once safe transport routes are established, they would be reviewed for safety every year. Transport would be carried out using snow vehicles or off road vehicles.

Some clients would also stay camp overnight at the nearby nunatak, in a satellite camp in close proximity to the main camp. Clients would be accompanied by White Desert staff at all times. The proposed location of the satellite camp is approximately 2 km from the main camp and 1km from the Runway. It is anticipated that the size of the group at the satellite camp would be 12-14. The proposed location of the satellite would be confirmed following a more detailed survey of the location. The satellite camp would also be used on a temporary and seasonal basis.

The Wolf's Fang Main Camp would have a similar layout to the current layout, with additional containers required for the safe storage of oils during the five year plan and the number of tents remaining the same.

The indicative layout of the Wolf's Fang Runway and Camp can be referred to in *Figure 2.0 Wolf's Fang Runway Area* and *Figure 3.0 Wolf's Fang Staff Camp and Main Camp Indicative Layout*. The proposed layout can be referred to in *Figure 4.0 Wolf's Fang Satellite Camp Indicative Layout*.

Scientific Programme Support

In parallel, White Desert will increase the logistical support services provided to the science programmes in Antarctica. It is proposed that logistical support for the science programmes would be based at Wolf's Fang Runway. In the most recent season of 2019-2020, logistical support was provided to a number of different science programmes including:

- Alfred Wagner Institute (AWI)
- British Antarctic Survey (BAS)
- Chinese National Antarctic Institute (CHINARE)
- South African Antarctic Expedition (SANAEE)
- Norwegian Polar Institute (NPI)

Environmental Baseline

The location of protected areas and sites can be referred to in *Figure 10.0 Protected Areas and Sites in Dronning Maud Land Study Areas*.

Land Use

Historically, the Wolf's Fang Runway was used as a blue-ice Runway between 1996 and 2001 known as the Blue One Runway and was operated by Antarctic Network International (ANI). Further details on the site's history can be referred to in the Wolf's Fang Runway IEE. There are no active Antarctic stations in the immediate study area.

The wider study area surrounding Wolf's Fang is considered to be an area of existing and historical land use with a medium intensity of land use, by Antarctic standards. This is primarily due to the existing and historical aviation use:

- The Ulvetanna peak (Wolf's Fang peak), some 38km to the South West has been a popular attraction for climbers since the 1990s.
- The ALCI airbase is located at a distance of approximately 130km to the north east of the Runway (see Whichaway Camp section for more details)
- Tor station is a summer only station, operated by the Norwegian Polar Institute It is located at a distance of approximately 135km south west of the site and in use since 1993 and is associated with Svarthamaren
- Troll airfield and station are located outside the study area at a further distance of more than 200 km south west. The station is a year round station and has been in use since 1990
- There are other stations located further afield and these are identified in the Whichaway Camp chapter

Antarctic Heritage

There are no Antarctic Heritage protected sites in the immediate study area. The closest designated historical site is:

- **HSM 78** Memorial Plaque at India Point, Humboldt Mountains, Wohlthat Massif, in memory of the 9th Indian Antarctica Expedition. It is located more than 80km from the site and considered to be outside the zone of influence or spatial scope of the activities at Wolf's Fang Runway

Physical Environment

The Wolf's Fang Runway and Camp site is located in the biogeographic region of Dronning Maud Land and is located on the ice-sheet immediately adjacent to the Fimbulheimen mountain range. A number of smaller ranges and mountain areas constitutes Fimbulheimen and the closest to the Wolf's Fang Runway site are the Kurze, Conrad, Orvin and Drygalski mountains.

The Runway is located approximately 130 km South West of the Schirmacher Oasis where Whichaway Camp is located. It is 2.5km west of Henrickson nunatak a highly visible feature rising 150m meters above the Runway .

A survey of the physical environment was carried out by White Desert in advance of the preparation of the Wolfs' Fang IEE report in 2015. The survey report¹¹ provides more detailed information on the physical environment at the Wolf's Fang Runway site and a summary is provided below.

The area is generally flat (<2%) rising to the South with increasing steepness. The area is an ablation zone with blue ice predominating. The blue ice area is bounded by a line of nunataks to the East and gradually increasing snow cover to the south, west and north. Glacial movement is to the North and estimated at approximately 20m per year (55mm /day). There are several minor features (ridges and gullies) that run through the area in a North-South alignment. Local gradients at these features are as steep as 4% in an East-West orientation.

Snow cover is generally less than 300mm, although depths greater than 1.3m were found in isolated locations along 'gullies'. The snow deposits were observed to be ablating from the top surface while simultaneously shielding the underlying ice from ablation. The blue ice surface is marked with minor bumps generally less than 100 mm deep that are located where isolated snow depositions have occurred in the past, possibly over winter. The ice surface is otherwise sun cupped with approximately 'dinner plate' sized depressions up to 70mm deep.

Surface and sub-surface melting was not evident at the site during the survey, however large melt streams have occurred at the Eastern edge of the site. These have deposited large boulders, up to 14m across, along the path of the melt streams. These run in a north to south alignment and appear to stem from the northern face of nunataks to the east and south.

Operations at the Runway since 2016 have confirmed these findings.

Ablation

Melting in Antarctica is limited to elevations which are below 1500 m. In coastal East Antarctica, there are significant melt rates between 50–100 kg m² yr⁻¹¹². Additional site specific ablation data for the Wolf's Fang area will be available in the 2020-2021 season.

Climate, Weather and Meteorological Data

Climate change

The recently published bed topography maps¹³, published by SCAR through BAS MAGIC project have been referred to. In addition, observations are made each season and a more detailed survey has been carried out at Wolf's Fang Runway in 2019-2020. The site of Wolf's Fang Runway has not been researched extensively in terms of future predictions with regards climate change. Additional research would be required to determine the likely longer term scenario at the site. However, the site is located in the mountain range and is not considered to be within an area of high risk (such as an ice-shelf or sea ice).

¹¹ Wolf's Fang Runway Reconnaissance, Report of Findings, Stuart McFadzean, December 2014

¹² Identification of Antarctic ablation areas using a regional atmospheric climate model Michiel van den Broeke, 1 Willem Jan van de Berg, 1 Erik van Meijgaard, 2 and Carleen Reijmer 1 Received 26 January 2006; revised 20 April 2006; accepted 15 June 2006; published 30 September 2006.

¹³ <https://www.add.scar.org/> and <https://www.bas.ac.uk/media-post/new-high-precision-map-of-antarcticas-bed-topography/>

Weather and Meteorological Data

Since 2016, the weather on site over summer has proven to be exceptionally good for flying with only a handful of days of 'storm' conditions each summer. These are typically mild with winds less than 40 knots. The runway experiences very low precipitation and cloud cover only descends below 1,000m AGL during 'storm' events. Katabatic winds are reliable and mild, generally less than 20 knots and from the South East. Day time temperatures can approach -2°C, too warm for the safe use of the ice runway, necessitating a switch to 'night time' operations when temperatures are reliably below -6°C. Early season temperatures (early November) can drop to -25°C. The good flying weather extends into March, outside of the White Desert operating window in Antarctica.

White Desert will continue to monitor site conditions prior to and during each flight to ensure the Runway can operate safely. In addition, White Desert will continue to review new research carried out in relation to climate change.

Ecology

Flora and Fauna

A more detailed description of the flora and fauna at the site can be referred to in the Wolf's Fang Runway IEE, White Desert 2016¹⁴. The section below provides information on designated ecological sites and new information as identified since operations began at Wolf's Fang.

The main mountain range and nunatak area at Wolf's Fang is located approximately 200km from the ice shelf edge and extends in an east-west direction.

The nunataks are exposed mountain peaks projecting from and surrounded by a glacier or ice sheet¹⁵ and provide suitable habitat for breeding sea birds inland. There are three species of birds which are known to breed in the inland nunataks of Dronning Maud Land, these are the Antarctic Petrel (*Thalassoica antarctica*), the Snow Petrel (*Pagodroma nivea*) and the South Polar Skua (*Catharcata maccormicki*)¹⁶. The table below summarises their habitat and distribution within the wider study area.



¹⁴ Wolf's Fang Runway IEE, White Desert, 2016

¹⁵ A complete guide to Antarctic Wildlife, the Birds and Marine Mammals of the Antarctic Continent and Southern Ocean, Hadoram Shriahai, Second Edition, 2007


¹⁶ Nature Environment Map: Dronning Maud Land 1: 100,000, Gjelsvikfjella and western Muhlig-Hofmannfjella, Description, 1999

White Desert IEE 2020 Report Final

Table 15 Birds typically found in inland nunataks of Dronning Maud Land

Species	Habitat	Distribution	Conservation status
<p>Antarctic Petrel (<i>Thalassoica antarctic</i>)</p> 	<ul style="list-style-type: none"> • Nests openly on the ground • Feeds on cephalopods, crustaceans and small fish • Breeding season from late November in colonies on level snow free surfaces often on slopes and cliffs 	<ul style="list-style-type: none"> • Feeding is confined to the pack-ice zone in the Antarctic seas • Breeding is exclusively on the Antarctic continent; breeding colonies are located up to 200km in land • Most abundant of Dronning Maud land breeding seabirds 	Not globally threatened currently
<p>Snow Petrel (<i>Pagodroma nivea</i>)</p> 	<ul style="list-style-type: none"> • The Snow Petrel is known to nest in crevices. • Nest sites have been identified in nearby Nunataks of Wolf's Fang Runway • Feeds on cephalopods, crustaceans and fish • Breeding season from November-December onwards in colonies on cliffs and steep slopes using crevices and clefts under boulders 	<ul style="list-style-type: none"> • Feeding is confined to the pack-ice zone in the Antarctic seas • Breeding is on the Antarctic continent, breeding colonies are located up to 400km in land • Forms large concentrations of breeding birds 	Not globally threatened currently

White Desert IEE 2020 Report Final

<p>South Polar Skua (<i>Catharcata maccormicki</i>)¹⁷.</p> 	<ul style="list-style-type: none"> • Nests openly on the ground in mountain • Feeds mainly on fish, can prey on penguin and petrel eggs or chicks • Breeding season from November onwards • Can be aggressive if nests are approached 	<ul style="list-style-type: none"> • When feeding inland known to prey upon eggs or chicks of petrels, and can be found adjacent to petrel colonies • Breeding is on the Antarctic Continent and adjacent islands 	<p>Not globally threatened currently</p>
---	---	---	--

Source: Information adapted from Complete Guide Antarctic Wildlife and Nature Environment Map

The closest nunataks to the Wolf's Fang Runway site are the Henrickson nunatak, located 2.5 km to the east, the Kurze Mountains, located approximately 18km to the south and the Conrad Mountains 30km to the southeast. Though no published information has been found in relation to these specific sites, it can be assumed that these sites may provide suitable habitat for these three species of birds.

The presence of nesting Snow Petrels has been identified by White Desert team members. During the 2019-2020 season, a number of sites of nesting Snow Petrels have been identified in the mountain ranges to the south of the site. Their locations will need to be taken into account so the areas and potential impacts can be avoided. The locations of nesting sites can be referred to in the *Figure 12.0 Wolf's Fang Environmental Features*.

Fauna and flora in the wider study area have been identified from published ecological mapping¹⁸, though this does not extend to cover the immediate study area. The closest information to the study area is approximately 110 to the south west of the site (Sagladet and Cumulus region) and indicates that in terms of flora, moss cushion, fruticose lichen, epilithic lichen are present. In terms of invertebrates, mites and collembola can be found at Svarthamaren. Terrestrial invertebrates of Dronning Maud Land are often associated with mosses, lichens, cyanobacteria and green algae found in this region. It is assumed that similar flora and terrestrial invertebrates can be found at the closest nunataks to the site, using a precautionary principle.

Protected Areas

In terms of designated flora and fauna features, the closest protected ecological area to Wolf's and Runway and Camp are located at a distance of 135 km and 165 km from the Wolf's Fang site:

Svarthamaren ASPA (142) is also designated as an **Important Bird Area (IBA 112)** is located approximately 135 km south west of Wolf's Fang. This has been designated for its population of Antarctic Petrel, (with approximately 100 000 – 200 000 breeding pairs) and Snow Petrel (with approximately 1000 pairs)¹⁹.

¹⁷ Nature Environment Map: Dronning Maud Land 1: 100,000, Gjelsvikfjella and western Muhlig-Hofmannfjella, Description, 1999

¹⁸ Nature Environment Map: Dronning Maud Land 1: 100,000, Gjelsvikfjella and western Muhlig-Hofmannfjella, Description, 1999

¹⁹ Information on IBA: Important Bird Areas in Antarctica, Birdlife International 2015

IBA Gruber Mountains (ANT 113) is located at a distance of approximately 165km east of the site. Approximately 10 000 pairs of Snow Petrel are reported breeding at several locations near Lake Unter, where 1000 Snow Petrel are reported breeding.

The location of these designated sites will need to be taken into consideration during the flight path planning and the traverse routes in order to avoid these areas.

Whichaway Camp

Photograph 4 Aerial Photograph of Whichaway Camp



Description of Activities

Whichaway Camp

Whichaway Camp is located on the Schirmacher Oasis of Dronning Maud Land.

Whichaway Camp provides the main client accommodation camp for White Desert, having obtained permission from the FCO to operate a seasonal temporary camp at its current location. Tourist activities take place between the beginning of November up until the beginning of February each season, with a week at either end of the season used for mobilisation/ de-mobilisation. Clients are accommodated in fibre glass pod structures and White Desert staff members are accommodated in one man tents. Activities are temporary and seasonal at this location.

The client accommodation area comprises kitchen, dining and ablution pods. Materials are stored within an enclosed within container units. Energy is provide using on site generators, whilst heating is provided using individual heaters and solar heaters. As carried out by the stations in the area, water is provided from the lake located at the edge of the camp. Water is pumped from the lake into storage containers as required. There is no permanent infrastructure for pumping water from the lake.

Due to the construction impacts associated with dismantling at the end of each season, the pods are now left in situ though they can easily be dismantled on site.

At the end of each season and as required throughout the season, all waste, fuel drums, waste oils and equipment is removed from the site for transport to Cape Town. All tents are dismantled and plant is stored safely to prevent accidental dispersion during winter. Any rocks and stones which have been moved aside in order prevent trips and falls are replaced.

Whichaway camp is located on ice free ground of the Schrimacher Oasis and therefore all infrastructure would be easily accessible and retrievable for dismantling and removal when required. In case of de-mobilisation, there would be some holes in rocks once anchors are removed and any loose gravel would be pushed back where the structures once stood.

In terms of White Desert staff, the camp includes at least one fully qualified medic at all times, trained mountain guides who accompany and supervise clients at all times, a chef, as well as operation and maintenance staff.

Whichaway Skiway

Since 2017, clients access the camp through a short flight operated by White Desert, flying in from Wolf's Fang Runway to Whichaway skiway located at a short distance 4km from Whichaway camp. The skiway is located on snow covered ice, on the ice-sheet and does not require the use of ice-free ground. Clients are then transported by modified off road vehicle to the camp. The layout plan of the skiway can be referred to in *Figure 6.0 Whichaway Camp Skiway Indicative Layout*

Client activities

Using the camp as a base, clients can undertake a number of activities in the Schirmacher Oasis and are accompanied by trained guides. The activities undertaken include:

- Walking to base or top of nearby nunatak
- Hiking to the ice waves or melt water stream/river
- Rock climbing
- Ice climbing
- Via cordite at nearby rock face overlooking ice waves
- Short hike to crystal caves and ice tunnels
- Visit the nearby Novo or Maitri station with advanced permission

These activities take place in established locations each season, which can be referred to in the figures which accompany the permit application.

Changes in activities for five year period

- White Desert is proposing to install a new pod at the location indicated in the *Figure 5.0 Whichaway Camp Indicative Layout*. This will be a multifunctional pod which can be used by clients as a viewing platform as well as by staff in case of emergency
- The additional pod will be constructed within the existing footprint of Whichaway Camp, adjacent to the existing dining pods. The pod will be similar in terms of design, size and materials to the existing pods but will have a larger glass pane for viewing
- The additional materials required for its construction will be transported as part of the logistical operations in advance of the season commencement

- As with the existing temporary infrastructure at the camp, it is not proposed for the pod to be dismantled at the end of each season but it would be feasible for it to dismantle it at short notice
- Then number of clients and staff at the camp at any one time is proposed to remain as per current operations. There is no proposed increase the size of client groups at Whichaway which is limited by the number of client accommodation pods
- There are no new geographical areas being proposed for the client activities off camp. The established areas and activities will continue to be used unless there is a change in the environment which makes these areas unsafe
- There may be an increase to the total amount of grey water arising at this location, due to the slight increase in total numbers of clients each season. White Desert is proposing to carry out additional treatment to grey water arising at the camp. Details of the existing systems can be referred to in the Waste Management Plan as set out in the Wolf's Fang Runway IEE.
- An environmental and feasibility options appraisal of the potential grey water treatment plant is being carried out. One option is to install a new grey water treatment facility and obtain dispensation for discharge of acceptable water quality onto ice-free ground as carried out by stations in the Dronning Maud area. Alternatively, there may be treatment with UV prior to disposal outside ice-flow lines. The grey water treatment plant would be installed within a container unit.

Environmental Baseline

The location of protected areas and sites can be referred to in *Figure 10.0 Protected Areas and Sites in Dronning Maud Land Study Areas* and in *Figure 13.0 Whichaway Camp Environmental Features*.

Land Use

The wider study area of the Schirmacher Oasis and its environs is considered to be an area of medium intensity of land use, by Antarctic standards. This is primarily due to the existing and historical research stations in the area:

- Novolazarevskaya research station located at a distance of approximately 7 km to the east of Whichaway Camp. This is summer only station, with 70 summer staff as part of the Russian research programme. It has been operating since 1961
- Novo blue ice runway, operated by Antarctic Logistics Centre International (ALCI) serves the Novolazarevskaya station and Maitri Station and has been operational since 2014. It was used by White Desert prior to the seasonal use of Whichaway Camp skiway and is located at a distance of approximately 6 km to the south of Whichaway Camp. A former Russian airfield is also located further to the south
- Maitri research station, located at a distance of 4km to the east of Whichaway Camp. This is a year round station, located on ice-free ground in the Oasis. It has been operating since 1989, as part of the Indian National Centre for Polar and Ocean Research programme

There were a number of research stations present historically in the area:

- The Whichaway Camp itself is the historical site of a refuge site for the Georg Foster research station. It included a 20 feet container with beds and table inside and small wooden hut with diesel-generator. The main Georg Foster research station was located at a distance of 8km to the east of the current Whichaway Camp location and was a year round station operational between 1976 and 1993, operated by East Germany and then Germany, as part of the AWI. When operations ceased, a clean up operation took place both at the main site and satellite site where 1000 tons of materials were removed from Antarctica as waste between 1992-1996. The IEE for this activity has been referred to for information.
- The Dakshin Gangotri year round station was also located in the Schirmacher Oasis and was support a base for the Indian National Centre for Polar and Ocean Research between 1984 and 1990

Antarctic Heritage

There are three designated historical sites related to the area's history of research stations in the Schirmacher Oasis:

- **HSM 44** Dakshin Gangotri Plaque is located within the immediate study area approximately 1km north of Whichaway camp
- **HSM 87** Location of the first permanently occupied German Antarctic research station Georg Forster, marked by a commemorative bronze plaque. The plaque is well preserved and affixed to a rock wall, located 8km to the east of Whichaway Camp

It is considered that there is no adverse impact on the Antarctic heritage arising from White Desert activities. The location of these historical monuments is included in the Whichaway Camp Environmental Management Plan and their location can be referred to in *Figure 13.0 Whichaway Camp Environmental Features*.

Physical Environment

The physical environment in the Schirmacher Oasis has been studied extensively by the research stations in the area. This section provides a summary of the physical environment as it relates to White Desert activities, as opposed to a detailed analysis of the physical environment.

Surface waters

Photograph 5 Meltwater streams in Schirmacher Oasis



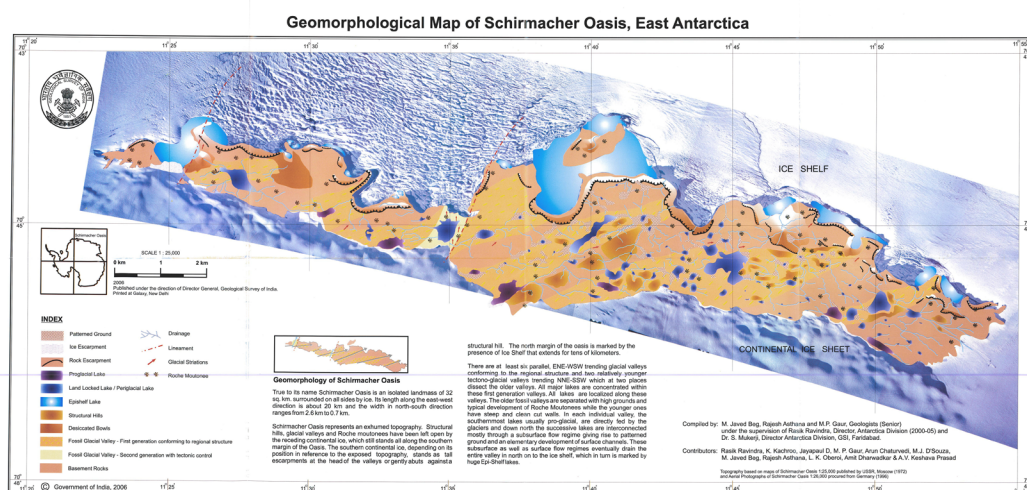
The Schirmacher Oasis is an area of ice-free ground bounded by the ice shelf along its northern edge with sea-ice beyond the ice-shelf and the continental ice-sheet along its southern edge. There are over 100 freshwater lakes across the Oasis, which can be categorised as epi-shelf lakes, concentrated along its northern edge, land locked lakes and pro-glacial lakes along the southern edge²⁰. Pro-glacial lakes are directly fed by glaciers. The local climatic conditions cause a period of annual melt during the austral summer when running waters, such as meltwater streams, subglacial streamlets, rapids and waterfalls are present²¹. Some of the lakes can be interconnected through the subsurface flow regime. The lake located at the southern edge of Whichaway Camp is pro-glacial lake and there is a small land locked at the north west of the camp. A geomorphological map of the Schirmacher Oasis is provided below, from research ²²carried out by Maitri research station.

²⁰ Bathymetry of Schirmacher lakes as a tool for geomorphological evolution studies, Ashit Kumar Swain Geological Society, London, Special Publications, 461, 77-93, 11 July 2017,

²¹ Geology, H.J Paech and W. Stackenbrandt

²² Dakshin Gangotri ASPA Management Plan

Schematic 3 Geomorphological Map of Schirmacher Oasis



Ablation

Photograph 6 Northern Boundary of the Schirmacher Oasis



The ablation zone during the austral summer period extends up to 28 km south of the Schirmacher Oasis polar ice sheet margin but the extent of this zone reduces during the remaining period and is dependent upon factors such as wind velocity and direction. However, most of the area in this region away from the Schirmacher Oasis shows net annual accumulation²³. The accumulation and ablation

²³ Glacial dynamics of Polar ice sheet between Schirmacher Oasis and Wohlthat Mounatins, East Antarctica

pattern on the ice shelf area near former Dakshin Gangotri station shows mainly accumulation, with some ablation²⁴.

Taking these factors into consideration the physical environment in the immediate and wider study area is considered to be of high value in accordance with the assessment criteria.

Protected Areas

Dakshin Gangotri Glacier Antarctic Specially Protected Area (ASPA No 163) is located within the Schirmacher Oasis approximately 700 meters north of Whichaway Camp, within the immediate study area of Whichaway Camp and is designated for scientific research purposes. Dakshin Gangotri Glacier is a small tongue of polar continental ice sheet, overriding the Schirmacher Hills. It was identified by the second Indian Antarctic Expedition in 1982-83 and since then it has been monitored regularly in terms of fluctuation, retreat and advance.

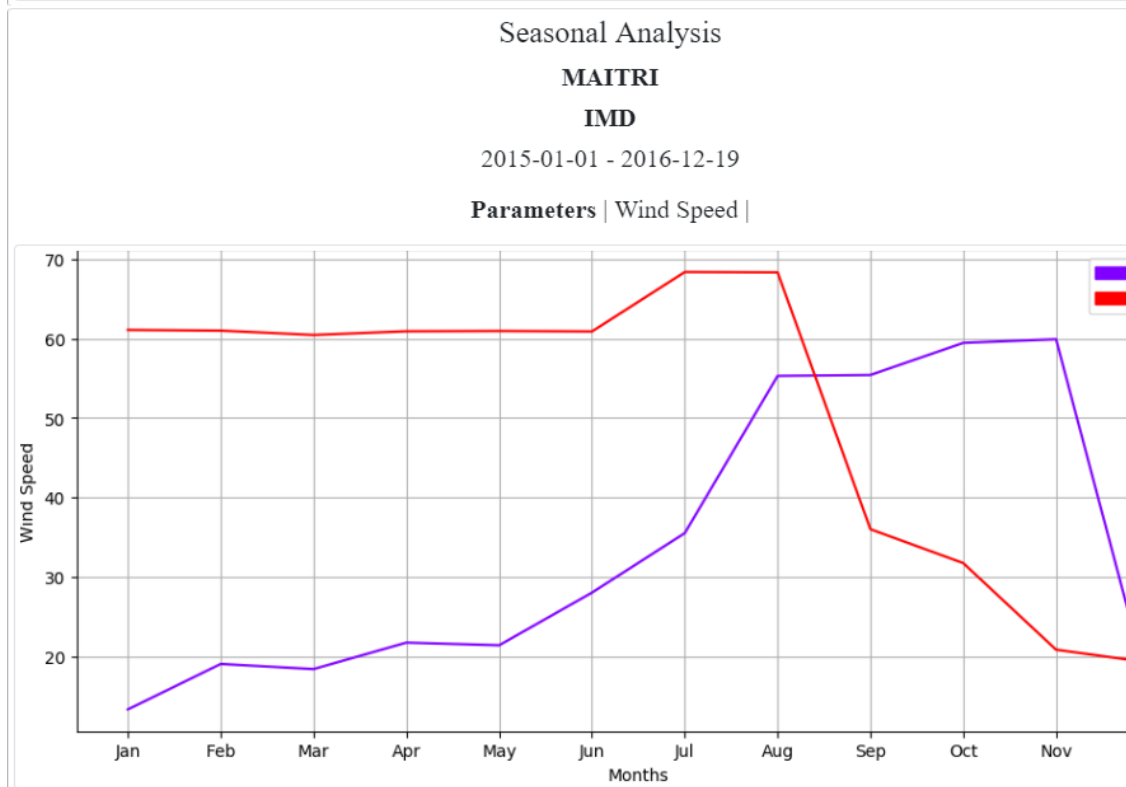
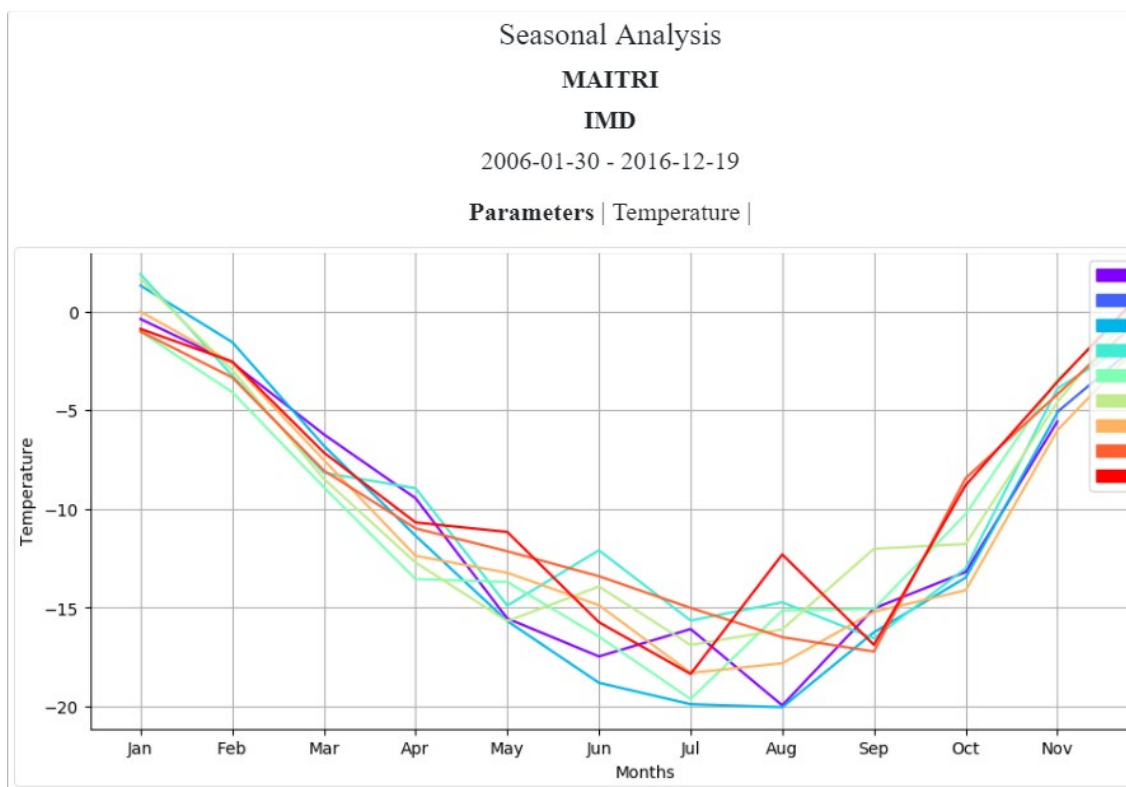
The boundary of the designated area is signed at some locations and entry into this area is not permitted. All White Desert guides are required to be familiar with management plan of the ASPA and a copy of this plan can be found in an easily accessible location at Whichaway Camp. The location can be referred to in *Figure 13.0 Whichaway Camp Environmental Features*.

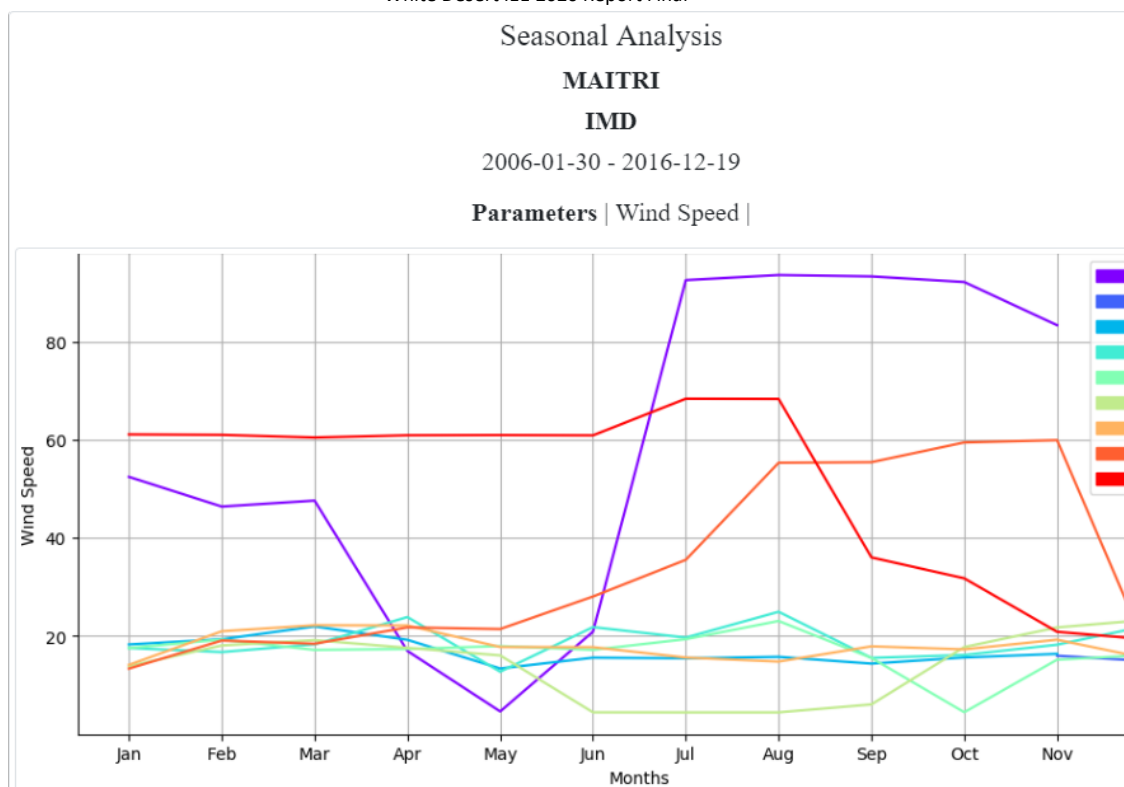
Climate, Weather and Meteorological Data

The climate in the Schirmacher Oasis is mild in comparison to other Antarctic regions between November and February when activities take place, with summer temperatures between November and February fluctuating between -6 and 2 degrees Celsius. When activities take place there is a mild climate and a lower likelihood of extreme weather events such as blizzards according to data information. Meteorological

Conference Paper, Kumar Swain et Al May 2017

²⁴ Glaciological Observations In and Around Schirmacher Oasis, East Antarctica during 27th Indian Antarctic Expedition Kumar Swain et Al





data has been obtained from nearby Maitri station²⁵.

Climate change

The microfauna and microflora within the freshwater lake system are vulnerable to climatic warming, changes to UV radiation, changes in seasonal direction of ice cover, changes to meltwater input from snow and ice²⁶. The degrees to which the melt water streams form, the extent of the lake at Whichaway, snow cover at the camp varies each year. There is also potential for the water level of the closest lake to increase throughout the year, as is evident from the aerial photographs.

Ecology

Flora and Fauna

The coastal hills of the Schirmacher Oasis are located along the northern coastline, between the inland ice and the ice-shelf and provide habitat for lichen, moss and limnological communities.

In terms of fauna, there is potential for avifauna found typically found in this region of Dronning Maud Land to be present including the Antarctic Skua, Antarctic Petrel, Snow Petrel, Wilson's storm petrel and rarely Adelie Penguins²⁷.

At Whichaway Camp individual Antarctic Skua have been observed by White Desert during most seasons, as occasional visitors. Although no nesting sites or breeding sites have been identified by White Desert, using the precautionary principles it is assumed that nesting birds may be present in the mountains of the Schirmacher Oasis and nearby nunataks. Nesting birds should not be disturbed or approached.

²⁵ Antarctic data from Indian stations: <http://data.ncaor.gov.in/>

²⁶ The Continent of Antarctica, Dowdeswell and Hambrey, 2018

²⁷ The Continent of Antarctica, Dowdeswell and Hambrey, 2018,

The sediments and lakes in the oasis have also been studied in terms of flora and microfauna populations extensively by the research stations in the area. The lakes have been found to include (in decreasing order of abundance) moss, filamentous blue-green algae, protozoa, micro-invertebrates, nematodes, turbellarians, tardigrades, rotifers, oligochaetes and acarides²⁸. Other fauna identified include collembola, diptera, nematodes and mites.

In terms of flora, the ice free rock areas also provide a limited habitat for lichen and moss.

Protected Areas

In terms of protected ecological areas, there are no protected ecological sites which could be directly impacted by activities at Whichaway Camp.

The closest protected ecological areas are located more than 90 km away:

Gruber Mountains IBA ANT 113 is located 90km south of Whichaway Camp. Approximately 10 000 pairs of Snow Petrel are reported breeding at several locations near Lake Unter, and 1000 Snow Petrel are reported breeding in the surroundings of Lake Unter.

Svarthamaren ASPA (142) which is also designated as an Important Bird Area IBA 112 located approximately 200km south of Whichaway Camp. This has been designated for its population of Antarctic Petrel, (with approximately 100 000 – 200 000 breeding pairs) and Snow Petrel (with approximately 1000 pairs)²⁹.

The location of these designated sites would continue to be taken into consideration during the flight path planning and can be referred to in *Figure 10.0 Protected Areas and Sites In Dronning Maud Land Study Areas*.

²⁸ Limnology of Freshwater Lakes at Schirmacher Oasis, East Antarctica, Baban Shravan Ingole, 1993

²⁹ Information on IBA: Important Bird Areas in Antarctica, Birdlife International 2015

Atka Bay and Princess Astrid Coast

Photograph 7 Emperor Penguin Colony and IBA at Atka Bay



Atka Bay: Visits to Emperor Penguin Colony

Description of activities

One of the main activities for White Desert clients are the visits to the Emperor Penguin colony at Atka Bay, which take place between the beginning of November and end of January.

Recognising the sensitivity of the site, this activity is carried out in small groups of 12 on average, with a maximum group size of 14 and clients are accompanied by White Desert guides at all times to ensure the strict protocols are implemented. The groups spend the minimum time necessary at the site in order to minimise the footprint of this activity. The total number of trips to Atka Bay is also low.

Atka Bay is reached by propeller ski-equipped aircraft, usually Basler BT67 or Twin Otter and these flights have been operated by White Desert since 2017-2018, following the submission of Appendix 2 IEE report³⁰.

In the 2018-2019 season, the White Desert Atka Bay skiway was relocated to the Ekstrom ice-shelf as opposed to the Atka Bay sea-ice in order to entirely avoid the potential presence of Emperor Penguins which are present on the sea-ice and any risks associated with landing on sea-ice.

After landing at the skiway, clients are transported via snow vehicle driven sled from the sea-shelf down to the sea-ice (driven by White Desert trained guides). Specific routes which have been identified by the AWI scientific programme at Neumayer are used each season. The access routes are set out prior to each season and avoid the penguin highways (routes used by the Emperor Penguins for feeding). The snow vehicle and sleds are parked a safe distance from the edge of the colony, usually

³⁰ Appendix 2 Atka Bay and South Pole IEE, White Desert, 2017

at least 300-400 meters with the remaining distance carried out on foot to minimise impacts from noise or physical interaction. The White Desert Atka Bay Environmental Management Plan Protocols (these are summarised in the assessment tables) are followed maintaining a safe distance. No food is consumed whilst on the sea-ice and there is no physical interaction with the penguins and wildlife.

Clients then return via skidoo driven sled to the skiway for transport back to camp. As the skiway is manned and requires maintenance for the ski-equipped aircraft to land there, there is a small field camp, including two tents and staff mess. This is only required to be operational during the season between the beginning of November and end of January. There is no refuelling of aircraft carried out at this skiway. The layout plan for this location can be referred to in *Figure 7.0 Atka Bay Indicative Layout*.

Changes in activities for five year period

There are no proposed changes to how activities are carried out during visits to the Emperor Penguin Colony at Atka Bay, though White Desert will continue to review the visitor guidelines.

A small refuge is intended to be positioned at Atka bay to provide additional protection for the staff members there from severe weather. This will be an air transportable structure, sled based and approximately 2m by 4m in size.

Environmental Baseline

The location of protected areas and sites can be referred to in Figure 10.0 Protected Areas and Sites in Dronning Maud Land Study Areas.

Study area

The Atka Bay study area comprises the location of the Emperor Penguin colony (70°36'45" S, 8°07'25" W in Atka Bay, which is sea-ice between November- end of January, the Ekstrom ice-shelf, which is location of the White Desert skiway and field camp. The area of Fimbull ice-shelf which is the location of the White Desert Fuel Depot site is described separately.

The wider study areas and zone of influence vary according to the requirements of specific topics, in order to encompass the direct and indirect impacts of the activities. For example, in terms of potential impacts from noise of aircraft the study area is wider.

Land Use

The immediate and wider study area are considered to be areas of existing and historical land use with a relatively medium intensity of land use, by Antarctic standards. This is primarily due to the existing and historical research stations in the area which comprises a number of permanent and seasonal structures, facilities and activities.

- Neumayer III research station located at a distance of 6.5 km to the south of Atka skiway and field camp is also located on the Ekstrom ice-shelf. This is a year round station which is part of the German Alfred Wegener Institute (AWI) research programme. It has been operating at its current location since 2009. As of 2016-2017 there was a total of 77 staff working at the station during the summer and 9 over winter staff. These facilities include the Neumayer III Research Station structure itself and other associated facilities and structures.
- Neumayer III skiway serves the research station. In terms of aircraft, supplies were provided to the station using a two Basler BT67 aircraft during the 2018-2019 summer season. Other light aircraft used in previous seasons include Twin Otter and Dornier 228. The skiway includes a fuel storage and refuelling area, and a fleet of vehicles to support logistics. The Neumayer skiway is operational each season from mid-October to end of February. Cargo is also supplied to the station via shipping routes during the austral season.
- SANAP summer station is also located in the Atka Bay immediate study area on the Ekstrom ice-shelf. It has a maximum population of 20 and is only used in the summer months associated with SANAE IV

The research stations and the scientific monitoring being carried out are to be taken into consideration throughout activities at this location, in order to ensure that there are no adverse impacts on or interactions with the research and in order to assess cumulative impacts.

Background Noise Levels

Aircraft

Activities carried out in the immediate study area on the Ekstrom ice-shelf include the use of the skiway at Neumayer III and associated use of Basler BT67, the current use of White Desert Atka Bay skiway using Basler BT 67, as well as the use of logistics vehicles to support scientific research and the

snow vehicles used to access Atka Bay have been taken into consideration in order to identify the background noise levels.

During the 2019-2020 season, White Desert undertook a total of 11 return flights to transport clients to the area for the visits to the Emperor Penguin colonies which were carried out over a 56 day period between the 22nd November 2019 and 16th January 2020 (the baseline season for this IEE). White Desert does not land on the sea ice. White Desert pilots are also required to approach the skiway from the south avoiding overflying the colony and also to take into consideration the clean air sector in the area. The skiway is located a distance of 3 km from the known Emperor Penguin Colony location. Further details of the measures to avoid noise impacts on the Emperor Penguin colony are set out in the mitigation section.

The most recent published Neumayer expedition report identifies that the number of flight missions depends on logistic and scientific requirements. These are delivered as part of the DROMLAN network. It is known that the same aircraft is used and therefore the noise emissions would be of a similar nature.

White Desert as standard practice does not use drones in this area, as the use of drones is prohibited in proximity to wildlife (in accordance Annex 12 ATCM40 WP020 State of Knowledge of Wildlife Responses to Remotely Piloted Aircraft Systems (RPAS) (2017) and Annex 13 COMNAP Antarctic Unmanned Aerial Systems Handbook (2016)), unless obtained by special permission.

Transport

In terms of background levels associated with transport used by White Desert, the maximum sound power level (L_{AFmax}) associated with snow vehicles driven at a constant speed of 30km/ hour is between 63.3 and 68.8 dB³¹ depending on the make and model year.

One area of uncertainty is the frequency which is audible to the Emperor Penguin species. However, using the precautionary principle snow vehicles are parked at least 300 meters away to avoid any potential impacts.

As the White Desert skiway and field camp is located 3km from the Emperor Penguin Colony and the snow vehicles are parked at least 300 meters away, it is unlikely that there would be noise impacts associated with the use of snow vehicles on the Emperor Penguin Colony and other birds in Atka Bay.

Whilst there has not been any background monitoring carried out at the site, the land use indicates that the background noise levels in the area would be generally quiet and intercepted by noise from aircraft landing and taking off as well as noise arising from use of snow vehicles (skidoos) and other vehicles for logistical and research purposes by the two research stations in the area. The activities associated with the two research stations would also be taking place in the summer season.

Antarctic Heritage

There are no listed Historic Site and Monuments in this area or the wider study area. However, at Atka Bay, there is a memorial cross.

³¹ THE FINNISH ENVIRONMENT 33en, 2007 Snowmobile Noise Larri Liikonen, Mikko Alanko, Sirpa Jokinen, Ilkka Niskanen

Physical Environment

Atka Bay

Atka Bay is located along the Princess Martha Coast, a coastal zone in the western area of Dronning Maud Land. Atka Bay (also referred to as Atka Iceport) is 440 square kilometres area of seasonal sea ice, adjacent to the Ekstrom Ice Shelf.

The closest nunataks to the site are the Kurze Mountains, located approximately 18km to the south and the Conrad Mountains 30km to the southeast.

Atka bay is covered for most of the year with fast ice reaching a thickness of 2 metres or more by late winter. Icebergs often run aground in the bay, and some remain in situ for a number of years before breaking up and drifting away. Drifting snow forms natural steep ramps from sea ice to ice shelf surfaces at many places when it is deposited in the protected zones of the ice edge.

Atka Bay: Sea- Ice and Climate Change

The sea ice begins to break out in December-January each year via a process influenced by the Ekstrom ice shelf. The seasonal sea-ice cover of Atka Bay usually forms between March and April, reaching the maximum thickness by December. The extent of the sea-ice varies and is dependent on a number of environmental factors such as grounded or passing icebergs and polynyas. Sea-ice begins to break out once it is destabilized enough by higher water and air temperatures, tidal motion and wind forcing. These factors lead to an outbreak of floes starting in the eastern part of the Bay, usually between December and January. In the south-western part, sea ice may stay as long as early March, but in most years the Bay is completely ice free at the end of March³².

Sea ice fastened to coasts, icebergs and ice shelves, also referred to as fast ice, is of importance to climate and ecosystems. The complex process is an area of ongoing research.

The *Antarctic Fast Ice Network-Sea Ice Monitoring* in Atka Bay project (AFIN), which is run from Neumayer III has monitored the sea-ice thickness across a number of sample locations throughout the year.

The extent of the sea ice and therefore the sea ice conditions which will be encountered each season, vary each year. The extent of the sea ice and the lines of the fast ice edge, if required in advance of client visits to the Emperor Penguin colony, can be considered further using the information from the AFIN project.

Ekstrom ice shelf

The Ekstrom ice shelf is a small to medium sized ice shelf, with a total surface area of approximately 8,700 square kilometres. It is part of the Eastern Weddell Ice Shelves, a group of several small ice shelves in the Weddell Sea. The Ekstrom ice shelf is between 140 and 250 meters thick at the edge, where it rises between 10 and 40 meters above the sea level. The ice shelf is not free floating but moves over ridges rising from the bottom of the sea. Grounded ice shelves form approximately 40 percent of the Antarctic coastline.

³² Field work on Atka Bay landfast sea ice in 2012/13 Field Report (see references for authors)

Weather and Meteorological Data

Atka Bay Weather and Meteorological Data

Neumayer Station provides operational weather forecasts for DROMLAN activities and has been carrying out meteorological forecasts for DROMLAN since 2002/2003. Weather observations carried out include air temperature, wind vector, cloud type and cloud height, horizontal visibility, past and present weather as well as snow drift.

As the White Desert visits take place between the beginning of November and end of January, the annual weather averages in Neumayer-Station III, based on weather reports collected during 2005–2015 for December are summarised below:

December Climate & Weather Averages at Neumayer Station³³:

- High Temp: -2 °C
- Low Temp: -9 °C
- Mean Temp: -5 °C
- Precipitation: 18.9 mm
- Humidity: 87%
- Dew Point: -7 °C
- Wind: 17 mph
- Pressure: 986 mbar
- Visibility: 24 km
- January (warmest month) average -4.1°C
- Air temperature (Gube-Lehnhard 1987 and various later sources):
- Summer (season) -23.0°C to +1.2°C (average min. to max. 15.12 to 10.03)

³³ <https://www.awi.de/nc/en/science/long-term-observations/atmosphere/antarctic-neumayer/meteorology.html>

Ecology

Emperor Penguin

Photograph 8 Emperor Penguin Colony at Atka Bay



The breeding distribution of the Emperor Penguin (*Aptenodytes forsteri*) is the most southerly of any penguin and is restricted to the Antarctic continent and Antarctic Peninsula, enduring the coldest conditions of any bird. Colonies occur in three main areas: the Weddell Sea and Dronning Maud Land, Enderby and Princess Elizabeth land and the Ross Sea. They are the only bird known to breed on the ice, with 44 of the 46 colonies located on sea-ice.

The population of Emperor Penguins at Atka Bay, estimated in 2012 using satellite imagery and was the first global, synoptic survey of a species from space³⁴ was estimated at 9657 and covered a total surface area of 10 355 m². The extent of the area³⁵ utilized by colony in 2017 and 2018 can be seen in *Figure 14.0 Atka Bay Environmental Features*. The colony, which often comprises several sub-colonies consists of approximately 12933 – 14024 pairs (25866 – 28048 adult specimen), which raise around 6.000 chicks each season. This makes the colony at Atka Bay one of the largest Emperor penguin colonies in Antarctica.

The global population of Emperor Penguins is estimated to be 238 000 pairs³⁶.

³⁴ An Emperor Penguin Population estimate: The first global, synoptic survey of a species from space, 2012 Fretwell et Al (see reference section)

³⁵ Based on 2017 / 2018 observations and estimations, Draft Guidelines for Visiting the Emperor Penguin (*Aptenodytes forsteri*) Colony at Atka Bay, Ekström Ice Shelf, Dronning Maud Land, Antarctica, AWI, 2019

³⁶ An Emperor Penguin Population estimate: The first global, synoptic survey of a species from space, 2012 Fretwell et Al (see reference section)

Status of Emperor Penguin

The Emperor Penguin's reliance on sea-ice for breeding in combination with recent concerns over changed sea-ice patterns consequent on regional warming, has led to their designation as near threatened in the IUCN red list in 2012. Current climate models predict that future loss of sea-ice around the Antarctic coastline will negatively impact emperor numbers. Recent estimates suggest a halving of the population by 2052³⁷. The discovery of new breeding behaviour at marginal sites could mitigate some of the consequences of sea-ice loss.

In October 2019 a proposal was put forward to increase the status of near threatened to vulnerable by leading scientists studying Emperor Penguins as they depend on sea-ice as part as part of their breeding cycle, sea-ice is vulnerable to the impacts of climate change including changes in wind and temperature and could impact on their habitat. At this stage, the status has not yet changed but this would be monitored.

Life cycle

Emperor penguins follow a complicated and unique breeding cycle where the eggs are laid early in the Antarctic winter, and chicks fledge in December, prior to sea-ice break. At this time, large parts of Atka bay become ice-free within a few days, and most of the adult and juvenile penguins have left, except for several hundred adults associated with groups of still moulting chicks that have hatched outside the optimal period. The social behaviour and complicated breeding cycle of the Emperor Penguin attracts the attention of scientists and visitors to the Antarctic:

- Breeding cycle begins in early winter, breeds on fast ice.
- Monogamous each season and female lays large egg in May/ June.
- Males incubate the egg whilst females forage at sea, returning to colony for chick emergency.
- Males then return to sea over a large distance to forage at sea before returning to chicks. Chicks moult into suite of down and fledge at approximately 150 days, when sea-ice begins to break up.
- Chicks usually return to the colony at 4 years, breeding the following year.

During the client visits to Atka Bay the Emperor Penguin chicks are observed in advance of fledgling, which usually takes place in advance of the sea-ice beginning to break-away.

³⁷ Emperor Penguins Breeding on Iceshelves Peter T. Fretwell, Phil N. Trathan, Barbara Wienecke, Gerald L. Kooyman

Table 16 Emperor Penguin Species Information

Photograph 9 Emperor Penguin adult with chick at Atka Bay on the sea-ice



Emperor Penguin Species Information		
Species	Habitat	Distribution
Emperor Penguin (<i>Aptenodytes forsteri</i>)	<ul style="list-style-type: none"> Population at Atka Bay: 9657-2012 estimate. 12933 – 14024 pairs 2017 estimate Size: Male birds can reach 122 cm and 45 kg, and females 114 cm and 28-32 kg respectively. Chicks fledge at 9.9-14.8kg and some enter water with some down Diet: Feeds mainly on fish, small cephalopods and crustaceans using pursuit diving. Can dive for 15-20 minutes at a time to depths of 50 meters or greater 	<ul style="list-style-type: none"> Distribution Coastal Zone of Antarctica between 66-78 °S, largely confined to pack ice, fast-ice and adjacent seas. Conservation status- Near Threatened in the IUCN red list Breeding cycle begins in early winter, breeds on fast ice. Monogamous each season and female lays large egg in May/ June. Males incubate the egg whilst females forage at sea, returning to colony for chick emergency. Males then return to sea over a large distance to forage at sea before returning to chicks. Chicks moult into suite of down and fledge at approximately 150 days, when sea-ice begins to break up. Chicks usually return to the colony at 4 years, breeding the following year.

Assessment of potential impacts arising from noise

Noise impacts birds through interruption in feeding or of the breeding cycle. If birds are disturbed by noise, feeding or the breeding is interrupted and if this occurs regularly with adverse impacts.

Noise impacts on human receptors have more established methodology in environmental impact assessment. Acoustic specialists are turning attention to the assessment of noise on wildlife and a number of papers have recently been published on methodology. There are number of factors to consider the frequency which is audible to birds is not the same as humans. Audible frequency varies depending on the species.

OTHER WILDLIFE

At Atka Bay there is potential to encounter birds which are known to inhabit the coastal zones of Dronning Maud land. These include the South Polar Skua, Antarctic Petrel and the Snow Petrel as well as the Adelie Penguin.

In terms of the marine environment, species encountered in the coastal zones of Dronning Maud Land include the Leopard Seal, Weddell Seal, Crabeater Seal and Ross Seal. Acoustic recordings carried out by Neumayer research station in 2005-2006 had identified Weddell seals, Crabeater Seals, Ross Seals, Leopard seals, killer whales, blue whales, minke whales, along with several vocalizations which could not be assigned to a species.³⁸.

During the client visits carried out by White Desert to Atka Bay, Weddell Seals, Adelie Penguins, South Polar Skua and Snow Petrels have all been encountered when visiting the Emperor Penguin colony.

³⁸ PALAOA – an autonomous SAM device in the Atka bay Lars Kindermann, Alfred Wegener Institute for Polar and Marine Research Marine Observing Systems / OceanAcoustics, Am Alten Hafen 26, 27568 Bremerhaven, Germany

Table 17 Species found at Atka Bay

Species	Habitat	Distribution/Location
Adélie Penguin (<i>Pygoscelis Adelie</i>)	Despite the modelled projections suggesting future decline, there has actually been a recent population increase, particularly in East Antarctica (where most of the world population breeds) and the Ross Sea (Southwell et al. 2015a,b, Lyver et al. 2014) and on the southern Antarctic Peninsula south of 66° S (Sailley et al. 2013). The net change in world population is now positive (Lynch and LaRue 2014) and qualify the species to be downlisted as Least Concern.	<ul style="list-style-type: none"> • Feeds principally on crustaceans, some fish and cephalopods, caught by pursuit-diving. • Coastal Antarctica (including Peninsula and Enderby Land), South Sandwich, South Shetland, South Orkney, • Total population estimated at 2.4million breeding pairs in 1990s. Currently 2.37 million pairs Increasing • Conservation status Least Concern
Antarctic Petrel (<i>Thalassoica antarctic</i>)	<ul style="list-style-type: none"> • Nests openly on the ground • Feeds on cephalopods, crustaceans and small fish • Breeding season from late November in colonies on level snow free surfaces often on slopes and cliffs 	<ul style="list-style-type: none"> • Feeding is confined to the pack-ice zone in the Antarctic seas • Breeding is exclusively on the Antarctic continent, breeding colonies are located up to 200km in land • Most abundant of Dronning Maud land breeding seabirds • Conservation status- not globally threatened currently
Snow Petrel (<i>Pagodroma nivea</i>)	<ul style="list-style-type: none"> • The Snow petrel is known to nest in crevices • Feeds on cephalopods, crustaceans and fish • Breeding season from November-December onwards in colonies on cliffs and steep slopes using crevices and clefts under boulders 	<ul style="list-style-type: none"> • Feeding is confined to the pack-ice zone in the Antarctic seas • Breeding is on the Antarctic continent, breeding colonies are located up to 400km in land • Forms large concentrations of breeding birds • Conservation status- not globally threatened currently
South Polar Skua (<i>Catharcata maccormicki</i>) ³⁹ .	<ul style="list-style-type: none"> • Nests openly on the ground in mountain • Feeds mainly on fish, can prey on penguin and petrel eggs or chicks 	<ul style="list-style-type: none"> • When feeding inland known to prey upon eggs or chicks of petrels, and can be found adjacent to petrel colonies • Breeding is on the Antarctic Continent and adjacent islands • Conservation status- not globally threatened currently

³⁹ Nature Environment Map: Dronning Maud Land 1: 100,000, Gjelsvikfjella and western Muhlig-Hofmannfjella, Description, 1999

White Desert IEE 2020 Report Final

	<ul style="list-style-type: none"> Breeding season from November onwards Can be aggressive if nests are approached 	
Weddell Seals	<p>Average Weight: 400 - 450 kg / 880 - 990 lb</p> <p>Average Length: 2,9m - 9.5 ft males / females up to 3.3m - 11ft</p> <p>Weddell Seals can reach 600m in depth and spend as long as 82 minutes, the longest dives are undertaken when swimming under ice searching for new breathing holes.</p>	<ul style="list-style-type: none"> Feeding: Mainly fish, especially Notothenids known as "Antarctic cod", squid and invertebrates (inevitably including krill) in much lower quantities. Predators: Killer whales, Weddell seals were taken as one of the main food sources for sledge dogs when these were used in Antarctica from 1899 to 1994, any local effects of population seem to have been reversed now Conservation status: Least concern. Protected by the Antarctic Treaty and the Convention for the Conservation of Antarctic Seals. <p>Estimated world population: - 500,000 to 1 million. Difficult to gauge the population size as the seals are circumpolar and many live in and amongst the pack ice.</p> <p>They do not form colonies as such other than loose associations of mothers and pups briefly after birth. The number of seals at sea during population estimates is a further unknown</p> <p>Breeding Season: Pups born from September to November, females become pregnant again very quickly as the males guard territories around breathing holes, there is an implantation delay of 2 months and then the female is pregnant for 11 months, typically 2 pups are produced every 3 years.</p> <p>Distribution: Circumpolar, the most southerly breeding mammal in the world, as far north as sub-Antarctic Islands and as far south as 78° in McMurdo Sound.</p>

The overall sensitivity of the site and immediate study area is considered to be **very high-high** in accordance with the with the criteria set out in the General Guidance Developed for the Assessment Process table.

Protected Areas

The Emperor Penguin colony site visited is designated as an Important Bird Area Atka Iceport (IBA ANT 109) (70°36'45" S. 8°07' 25"W) located on the Atka Bay sea-ice and is entirely marine. It's location along the coast can be seen in *Figure 10.0 Protected Areas and Sites In Dronning Maud Land Study Areas*.

The total population of Emperor Penguins at the colony has been estimated by a scientific research project, using satellite imagery taken in 2009, to be approximately 9657⁴⁰. This is a greater population than the previous estimate of 8000 made in 1986⁴¹.

In accordance with the IBA in Antarctica 2015 document, the site has qualified as an IBA on the basis of two criteria:

- IBA criterion A1: Globally threatened species.: The site is known or thought regularly to hold significant numbers of a globally threatened species, or other species of global conservation concern
- IBA criterion A4ii: The site is known or thought to hold, on a regular basis, 1% or more of the global population of a congregator seabird or terrestrial species

This designation, importance and sensitivity of the Emperor Penguin Colony are taken into consideration throughout planning this activity.

Important Bird Areas are part of network of internationally protected sites. The closest Important Bird Area to Atka Bay is Muskegbukta (IBA ANT 110) and is also designated for the presence of an Emperor Penguin Colony with a population of 3193 ⁴². It is located along the same coastline, at a distance of more than 300 km east of Atka Bay and is therefore considered to be outside the wider study area, though its location is taken into consideration during the planning of flight paths. Its location along the coast can be seen in *Figure 10.0 Protected Areas and Sites In Dronning Maud Land Study Areas*.

Antarctic Special Protected Areas (ASPA), Antarctic Specially Managed Areas (ASMA) and CCMALR Sites

There are no other designated sites (ASPA, ASMA or CCMALR sites) in the immediate study area or wider study area at Atka Bay which could be directly or indirectly impacted by the client visits to the Emperor Penguin Colony.

Princess Astrid Coast :Fuel Depot

Photograph 10 Fuel Depot

Description of activities

White Desert's main Fuel Depot is located on the Fimbulsen ice-shelf, approximately 10km from the sea in the vicinity of Penguin Bukta, along the Princess Astrid Coast. It is located approximately 200km from Atka Bay.

⁴⁰ An Emperor Penguin Population estimate: The first global, synoptic survey of a species from space, 2012, Fretwell et Al (see reference section)

⁴¹ The Distribution and Abundances of Antarctic and Sub Antarctic Penguins, 1983

⁴² An Emperor Penguin Population estimate: The first global, synoptic survey of a species from space, 2012, Fretwell et Al (see reference section)

Bulk fuel arrives is delivered from Cape Town to Penguin Bukta before being transported a short distance to the Fuel Depot.

The Fuel Depot location has been in use by White Desert since the 2016 season. It is the main site where fuel is stored in bulk containers. The bulk fuel containers are UN approved used by national Antarctic programmes and are ISO tanktainers, 20 feet in length with a 22,000 to 24,000 litres maximum capacity. There is a small field camp for White Desert logistical staff and skiway at this location.

Activities take place at this location on seasonal basis, during the summer season between the end of October and end of February. At the end of the season the ISO tanktainers remain in situ and prior to season commencement the site is cleared of snow accumulation. The activities at this location include refuelling of aircraft and refuelling of vehicles in order to carry out the overland traverse.

The Fuel Depot is also the main location where White Desert waste is stored temporarily before being transported for removal via ship. All waste is removed from Antarctica and the Fuel Depot at the end of each season for recycling and sorting in Cape Town as part of the White Desert Waste Management Plan.

Changes in activities for five year period

There are no proposed changes to how activities are carried out at the Fuel Depot. The total fuel stored at the Fuel Depot will increase as part of the five year plan and this is assessed in the operational measures section of the report. The indicative layout plan can be referred to in *Figure 8.0 Depot Indicative Layout*.

Land Use

- SANAE IV research station is located at a distance of approximately 150km from the White Desert Fuel Depot and is located on the Vesleskarvet ice-shelf. SANAE IV is a year round station as part of the South African National Antarctic Programme (SANAP). It has been operating at its current location since 2009. It has a summer population of 60 and over winter population of 10. The station has been operational since 1997 and there have been three other stations in the area on the Fimbull ice-shelf since 1960, which have been closed down. Atka Bay also provides an unloading site for the South Africa Regional Programme.

Antarctic Heritage

There are no listed Historic Site and Monuments in this area or the wider study area of the Fuel Depot.

Physical Environment

The Fuel Depot is located in the environmental domain of the East Antarctic ice shelf (Domain I). This environmental domain consists entirely of ice shelves and therefore contains no geology. Climatically the environment is warm in comparison to other locations based upon its coastal location. The average air temperature is -11.74 Celsius. The environment is window with an average wind speed of 16.66 m/second, the second fastest.

Fimbull ice shelf and climate change

The Fimbull ice-shelf is subject to research in relation to ice-shelf calving, melting and potential impacts from climate change, carried out by National Antarctic Programmes. The processes which take

place have been recently summarised in the schematic below taken from a recent research paper⁴³ which can be referred to for a more detailed description of the processes.

Schematic 5 Schematic cross section of the Fimbul ice shelf recent research paper⁴⁴

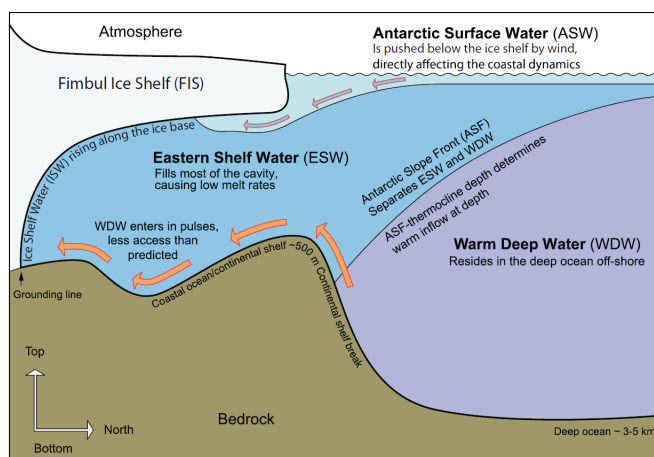


Fig. 1. A schematic cross section of the Fimbul Ice Shelf configuration, illustrating the water masses and processes controlling basal melting along the Eastern Weddell Sea coast.

There is evidence that the ice shelf edge at the location of the RSA Penguin Bukta off-loading location along the coast, is in the process of calving with ice penetrating radar imagery identifying several developing rifts parallel to the coast. The RSA Penguin Bukta off-loading location along the Fimbul ice-shelf edge is used as part of the White Desert fuel resupply, as set out in the Logistics and Re-supply section of this report. It should be noted that transport carried out by SANAP is subject to the SANAP environmental approvals.

The White Desert fuel depot storage location is sited seven kilometres inland of these potential rifts and would therefore not be directly affected.

Flora and Fauna Fuel Depot

The site is located 10km from the ice-shelf edge and the sea. As there are no ice-free areas such as nunataks or water bodies, and there is no macroinvertebrate, microfauna, or flora (such as moss or lichen) likely to be present at the site. The site is not located on sea-ice but on the ice-shelf. The site is not considered to provide a suitable habitat for nesting or breeding birds. There be individual birds present at the site and the type of avifauna typically found in Dronning Maud Land can be referred to in Table X. Anecdotal evidence from the White Desert team suggests that skuas and petrels have been found to be present occasionally.

Protected sites

The closest protected ecological site the Fuel Depot is an Important Bird Area IBA Muskebukta (IBA 110). It is located at a distance of 50km north east of the Fuel Depot. Muskegbukta is a small bay. An Emperor Penguin (*Aptenodytes forsteri*) colony breeds on fast ice that forms in cracks along the western coast of the Fimbul Ice Shelf. The IBA qualifies on the basis of the Emperor Penguin colony

⁴³ Eddy-resolving simulations of the Fimbul Ice Shelf cavity circulation: Basal melting and exchange with open ocean, T. Hattermann et Al, 2014

⁴⁴ Eddy-resolving simulations of the Fimbul Ice Shelf cavity circulation: Basal melting and exchange with open ocean, T. Hattermann et Al, 2014

present and is entirely marine. Analysis of a satellite image acquired 28 Oct 2009⁴⁵ indicated that approximately 3193 Emperor Penguins were present at the colony. This study referred to this colony as 'Sanae' in reference to the nearest research station. No other birds are known to breed in the area.

Antarctic Special Protected Areas (ASPA), Antarctic Specially Managed Areas (ASMA) and CCMALR Sites

There are no other designated sites (ASPA, ASMA or CCMALR sites) in the immediate study area or wider study area at Fuel Depot which could be directly or indirectly impacted by the activities at the Fuel Depot .

⁴⁵ Fretwell et al. 2012

FD 83 and South Pole

Photograph 11 Field Camp at FD 83



Description of Activities

FD 83 Field Camp and Skiway

One of the main activities for White Desert clients are the visits to the geographic South Pole, which take place between the beginning of November and end of January. This activity is carried out in small groups of 12 on average.

In order to reach the South Pole from Whichaway Camp or Wolf's Fang Runway in Dronning Maud land, a stop off location is required for refuelling purposes as well as for rest, acclimatisation and health and safety for the aircraft pilot. The stop off location is known as FD 83 and is at a distance of approximately 740 km from the South Pole. The flight activity has been carried out by White Desert since the 2017-2018 season, as permitted by the UK FCO, following the submission of the IEE.

The FD 83 location comprises a skiway, a small temporary field camp as well as fuel stored in IBC and drums. The site layout can be referred to in *Figure 9.0 FD 83 Indicative Layout*

White Desert field staff are responsible for the preparation of the skiway at FD 83, accommodated in one-man field tents. Clients are accommodated in one man tents and usually stay for one night en-route to and from the South Pole visits, though this can vary depending on weather or logistical requirements.

South Pole Visits

All client flight activities to the South Pole station site are carried out in strict accordance with the requirements set out in the Management Plan for the ASMA 5. White Desert tour guides are responsible for tour activities and comply with IAATO guidelines as well as the Amundsen Scott station requirements.

The South Pole station is specifically organised to accept tourist visitors. Flight landings take place at the designated aircraft landing area, which is operated and maintained by the station. This requires advance notification and agreement with the South Pole station organisation. Clients carry out the tour activities on foot, accompanied by White Desert staff, visiting the station and the South Pole flag mast.

White Desert is required to comply with the requirements set out within the management plan for ASMA 5: Amundsen -Scott South Pole Station, South Pole. Measure 2 (2007) -Annex A, in order to carry out the client site visits.

The White Desert client visits take place entirely within the operational zone and historical zone. The code of conduct relevant to White Desert activities include:

- Code of conduct for access and movement within the South Pole designated area (ASMA 5)
- Code of conduct for access to the area via aircraft- other expeditions

Changes in activities for five year period

Even though the total number of trips to the south Pole may increase over the five year plan, the size of the groups will remain the same. The requirements asset out within the ASMA 5 Management Plan and the most up to date version of the station map⁴⁶ would continue to be followed.

Environmental Baseline

The location of protected areas and sites can be referred to in *Figure 11.0 Protected Areas and Sites in FD 83 and South Pole Study Area*.

Land Use

FD 83 Field Camp and Skiway

The Fuel Depot 83 location site (83°00'S 11°38'E), has been used as fuel storage depot by White Desert since the 2017-2018 season and has been used as a logistical base facility jointly by the Antarctic Logistic Centre International (ALCI) and The Antarctic Company (TAC) since 2010.

South Pole

- Amundsen-Scott South Pole Station, a United States scientific research station and comprises a number of permanent and seasonal structures, facilities and activities. This includes the Amundsen Scott Research Station structure itself (90°S, 0°) which is a permanent structure used throughout the year. Other external associated facilities and structures include⁴⁷ Atmospheric Research Observatory (ARO), located approximately 500 m from the elevated station Summer Camp construction offices, Air operations facilities including landing strip. Amundsen-Scott South Pole Station accommodates up to 250 personnel in summer
- During winter, approximately 50 scientists and support personnel live at the station to run experiments and maintain facilities, while in the summer this increases up to a maximum of around 250. The station is completely isolated between mid-February and late-October, as air and overland support to the Pole cannot be undertaken because conditions are so extreme.
- The South Pole station is divided into five zones: Scientific, Historic, Operations, Hazardous and De-motorized zones. Each zone has specific guidelines which are to be followed for the

⁴⁶ <http://www.southpole.aq/maps/station.html>

⁴⁷ Source of information <http://www.southpole.aq/>

conduct of activities. The management plan for the ASMA includes detailed requirements for each of these zones, as well as a code of conduct.

- The operational zone is used for scientific support and is where human activity takes place, including tourism. The historical zone encompasses and preserves historical sites and is located within the operational zone. Human activities are restricted from the hazardous zone and the scientific zone is used for scientific research activities.

A small number of private companies operate organized tours and support expeditions to the South Pole, both overland and by air.

Antarctic Heritage

FD 83 Field Camp and Skiway

There are no features designated for their historic or cultural significance at the location of FD83 or the wider study area.

South Pole

- **Amundsen- Scott South Pole Station Antarctic Special Management Area (ASMA 5)** has been designated as an ASMA since 2007. It has been designated in order to manage human activities for the protection of scientific, environmental and historical values. It is considered to be an area of high scientific and historical value. A management plan has been developed for the area, which includes a description of the values to be protected, a description of the area as well as the code of conduct and a set of detailed guidelines for all activities at the site, as described above. The historic and Antarctic heritage significance of this site forms the basis of White Desert's client visits.
- **South Pole Flag Mast HSM 1** is the site of the ceremonial South Pole Flag mast surrounded by the flags of the twelve original Antarctic Treaty nations. It also commemorates the International Geophysical Year and is symbolic of all expeditions which have reached the South Pole. It was first installed in 1965 by the first by the First Argentine Overland Polar Expedition.
- **Amundsen's Tent (HSM 80)** is a symbolic dedication to the location of Amundsen's Tent, which was installed at 90° by the Norwegian group of explorers led by Amundsen on their arrival at the South Pole on 14 December 1911. The actual tent is currently buried underneath the snow and ice.

Physical Environment

In terms of the published Environmental Domains of the Antarctic, FD 83 and South Pole Station are both located within the East Antarctic high interior ice sheet (Environment Domain Q). This environmental domain is comprised entirely of ice sheet land cover and contains no exposed geological features such as bedrock or soil.

It is a large environment focused around the South Pole and covers the largest total surface area (3 709 111 km²) within the classification. Climatically the environment is extremely cold and holds a number of distinctions: it contains the coldest annual air temperature (−47.64°C) and largest seasonal range (−29.50°C). The environment also has the third lowest level of solar radiation (7.56 MJ/m²/day). The average wind speed (9.99 m/sec) is quite calm in comparison with the other environments. It is also quite flat, with an average slope of only 3.10⁴⁸.

⁴⁸ Environmental Domains , Version 2.0 Final Report, 2007

The Amundsen-Scott South Pole Station has an elevation of 2835 meters on Antarctica's interior ice sheet, which is approximately 2700 meters thick at this location. The station, which is 850 nautical miles south of McMurdo Station, is drifting with the ice sheet at about 10 meters (33 feet) each year⁴⁹.

Ablation

FD83 is located in a zone on net accumulation. While specific data is not available, the accumulation rates are generally observed to be less than 0.5m per year.

Climate, Weather and Meteorological Data

FD 83

As FD 83 is located within the same Environmental Domain as the South Pole station,

South Pole Meteorological data

The Amundsen-Scott South Pole Station includes the South Pole Atmospheric Research Observatory (ARO). Recorded temperature has varied between -13.6° C and -82.8° C. Annual mean is -49° C; monthly means vary from -28° C in December to -60° C in July. Average wind is 10.7 knots (12.3 miles per hour); peak gust recorded was 48 knots (55 miles per hour) in August 1989.

Snow accumulation is about 20 centimetres of snow (6-8 centimetres water equivalent) per year, with very low humidity

The temperature at the South Pole station consists of 6 months when it is fairly stable from April to September. After this, there is a 3 month period where the temperature rises to a peak and then drops again. This corresponds to light and dark. When it is permanently dark, the temperature is very stable. As the sun rises higher in the sky and has more heating power, so the temperature rises. After the longest day, December 21st, the sun falls again and so does the temperature.

Wind

Compared to the coastal areas, surface winds at South Pole are relatively light. Averaging about 11 knots annually, wind speeds rarely exceed 40 knots. The prevailing direction is from grid north. When wind speeds exceed 15 knots, blowing snow begins to significantly reduce visibility. Dangerous whiteout conditions (zero visibility with total loss of the horizon) usually occur when sustained winds exceed about 25 knots. The strongest gust ever recorded at South Pole is 48 knots. Orographically forced clouds and precipitation are common when the wind blows from the grid north or grid northwest, while down-slope conditions prevail when winds are from the grid northeast through grid southeast. Winds from the grid south and grid southwest are rarely observed.

Ecology

Flora and Fauna

FD 83 and South Pole locations and the corresponding wider study areas are considered to have a similar environment in terms of ecology. The sites are located in the interior of Antarctica, at a distance of approximately 300 km from the closest geological features and approximately 650 km inland from the coastal region.

⁴⁹ <https://www.nsf.gov/geo/opp/support/southp.jsp>

Terrestrial invertebrates are present where there is soil to provide a water film and where there is productivity in the form of growth of plants such as algae, mosses or liverworts. They are also often found around the nests of birds that nest on nunataks. As these features are absent from these locations, there is limited/no potential for terrestrial invertebrates to be present.

These locations are not considered to provide a suitable habitat for flora, avifauna or fauna or invertebrates associated with their presence. Off-course south polar skuas and snow petrels have been occasionally observed at the Amundsen-Scott South Pole Station.⁵⁰

In 2000 it was reported that microbial life had been detected living in the South Pole ice. In August 2014, scientists reported finding thousands of different types of microorganisms in a large lake 800 meters under the Antarctic ice sheet⁵¹.

The sensitivity of the environment at both locations in terms of flora and fauna is therefore considered to be **Low**, in accordance with the criteria set out in the General Guidance Developed for Assessment Process table.

Protected Areas

There are no ecological protected sites including (ASPA or IBA) at FD83 or South Pole sites or in the corresponding wider study areas.

⁵⁰ Antarctic Sun, United States Antarctic Program, January 2003

⁵¹ A microbial ecosystem beneath the West Antarctic ice sheet, 2011

Geographic Assessment Tables

The following tables set out the assessment of environmental impacts in accordance with geographic locations. The environmental assessment takes into consideration the environmental baseline conditions and description of activities as set out in the preceding section of this report.

The tables identify the environmental receptor and potential environmental impact on each receptor. The tables set out the environmental measures which are taken or which would be taken in order to reduce the risk of the impact occurring, to avoid the impact all together or to reduce the magnitude of an impact. The tables also sets out the residual risk and magnitude and how these measures have been or would be integrated into the White Desert EMS.

The assessment has been carried out in accordance with the methodology set out in the impact assessment tables in Appendix I. The applicable legislation for each environmental topic is identified at the end of the document.

Geographic Area: Wolf's Fang Runway and Camp, Dronning Maud Land
Physical Environment: Blue-ice surrounded by nunataks
Ecology On Site: None on site- nearby nunataks provide habitat for storm petrels, lichen and moss
Protected Areas: Closest is 80 km away

Geographic Area: Whichaway Camp, Schirmacher Oasis, Dronning Maud Land
Physical Environment: Ice-free ground oasis with glaciers, freshwater lakes and melt streams
Ecology On Site: Freshwater lakes provide habitat for microfauna, ice-free ground for lichen/moss, oasis provides habitat for some bird species
Protected Areas: Closest is Dakshin Gangotri Glacier ASPA 163, 800 meters away

Geographic Area: Atka Bay visits and Princess Astrid Coast (Fuel Depot)
Physical Environment: Ekstrom ice-shelf coastal zone and Fimbull ice-shelf coastal zone
Ecology On Site: Emperor Penguin and other wildlife in Atka Bay on sea-ice are visited
Fuel Depot some birds found in Dronning Maud Land may be present occasionally
Protected Areas: Atka Bay Important Bird Area

Geographic Area: FD 83 and South Pole
Physical Environment: High Interior East Antarctic Ice-sheet
Ecology On Site: None on site
Protected Areas: Historic Sites and Monuments and ASMA 5 at South Pole

A) GEOGRAPHIC LOCATION WOLF'S FANG RUNWAY AND CAMP					
ENVIRONMENTAL IMPACTS				IMPLEMENTATION	
RECEPTOR	POTENTIAL IMPACT	MITIGATION MEASURES	RESIDUAL RISK	WHITE DESERT ENVIRONMENTAL MANAGEMENT PLAN	MONITORING/ IMPLEMENTATION RESPONSIBILITY
SENSITIVITY RECEPTOR	DESCRIPTION	DESCRIPTION	RESIDUAL SIGNIFICANCE OF IMPACT		
PHYSICAL ENVIRONMENT i					
Blue-ice and snow on site at Wolf's Fang Runway and Camp	Potential contamination of blue-ice and snow through accidental spillage of waste (grey water and urine).	Measures to store and handle grey water safely would reduce likelihood of accidental contamination and also reduce the magnitude of a spillage if it did occur. These measures include:	Unlikely Medium x minor Less than minor or transitory	Waste Management Plan	Monitoring and testing of grey water in order to assess requirement for grey water treatment plant at Wolfs' Fang Runway and Camp
	White Desert use dry toilets and segregate solid waste from urine. Grey water arises from showers and washing.	Secure, enclosed storage of grey water in appropriate containers which minimise risk of accidental spillage. Minimise handling of grey water			
Medium value receptor in accordance with assessment tables	There would be an increase in the total grey water arising at the camp.	Water efficiency measures: Use of water efficient fixtures and fittings (showers and taps) to minimise the amount of water used and therefore minimise amount of grey water generated			Site waste champion nominated at each site
	Temporary Direct	Disposal of grey water in area outside zone of ablation, ice-flow lines and in crevasse in accordance with regulations. Proposed to continue using the same grey water disposal area which is in use			Environmental audits carried out by Environmental Manager on periodic basis to ensure Waste Management Plan is being implemented appropriately
		Consider the requirement to install a new grey water treatment system to			

		improve grey water quality prior to disposal			
Blue-ice and snow on site at Wolf's Fang Runway and Camp	Potential contamination of blue-ice and snow through accidental spillage or dispersion of fuels, oils, hazardous materials associated with the use of Runway and for the support of logistical operations This can take place during storage, handling and refuelling. Temporary Direct	Appropriate measures for handling, storage and refuelling would reduce the likelihood of spillage to occur and reduce magnitude of potential impact if it were to occur to minor. These measures include:	Unlikely Medium x minor= Less than minor or transitory	Fuel /Oil Storage and Handling Protocol Fuel/Oil Spill Contingency and Response Plan	Wolf's Fang Runway Manager and Traverse Manager to monitor implementation Environmental Audits carried out by Environmental Manager on periodic basis to ensure Fuel/Oil Storage and Handling and Contingency Response is being implemented correctly
		Storage on of fuels, oils and materials on a bund, impermeable base or inside COSSH container unit to contain any spillage			
		Use of spill mat/drip tray available during refuelling and for plant and equipment			
		Ensure that there is adequate snow cover so that any minor /drops do not reach blue-ice directly			
		Ensure oils are stored on a bund unit (or snow berm) to store 110% of any spillage or identify other appropriate measures to contain a potential spillage caused by damage to container unit			
		Refuelling of vehicles takes place with dedicated areas			
		Refuelling to take place with use of drip tray or absorptive mat			
		Pump and snow/oil separator to be available in order to ensure a large spillage can be pumped out. Any spillage would be pumped into a waste oil IBC or other suitable container			

White Desert IEE 2020 Report Final

		Adequate quantity of absorptive spill kit available at all locations where fuel is stored as well as on back of vehicles			
Blue-ice and snow on site at Wolf's Fang Runway and Camp	Potential contamination of blue-ice and snow through accidental dispersion of waste leading to a hazard to humans and animals ((for example sewage waste, waste oils, food waste)	Measures for safe storage and handling of waste which contains pathogens would reduce the risk of occurrence and avoid human health impacts . If waste is not accessible to birds this would reduce likelihood to unlikely or low.	Unlikely-low Medium x minor = less than minor or transitory	Waste Management Plan	Site waste champion nominated at each site
	Indirect Temporary	All waste to be stored in secured, closed and clearly labelled containers, safe from accidental dispersion by wind and ingestion by wildlife			
		Food waste stored in clinical waste bins and restrictions on import of high risk foods (e.g. egg shells) in place		Bio-security Plan	Environmental audits carried out by Environmental Manager on periodic basis to ensure Waste Management Plan is being implemented correctly Site waste champion nominated at each site
Blue-ice and snow on site at satellite camp	Potential impacts as set out above in relation to grey water and solid waste at the satellite camp in nearby nunatak	Waste to be stored securely inside containers for transport to main waste storage area in order to minimise risk of contamination or spillage	Unlikely-low Medium x minor = less	Waste Management Plan	Site waste champion nominated at each site

White Desert IEE 2020 Report Final

adjacent to Nunatak area	Temporary Direct		than minor or transitory		Environmental audits carried out by Environmental Manager on periodic basis to ensure Waste Management Plan is being implemented correctly
ECOLOGY FLORA AND FAUNA RELEVANT LEGISLATION ⁱⁱ					
The Runway and camp site does not provide a habitat for nesting or breeding birds, which normally breed in crevices. However, there is potential for presence of individual birds (such as Storm Petrel and Skua) at	Direct bird strike from aircraft or from use of snow groomers to prepare Airfield Operating Surfaces	It is unlikely that there would be a bird strike as birds are rarely observed at the Runway. Standard measures are followed: Ensure Runway and skiway are clear of birds in advance of landing/ take-off and in advance of grooming Runway/skiway	Unlikely	As part of Runway /skiways preparation procedures	Runway manager to implement
	Direct ingestion of litter	Ensure food waste is safely secured so that birds cannot access it in order to discourage presence of birds Plastic packaging has been reduced as far as possible	Unlikely Medium x minor = less	Waste management plan Bio security plan	Site waste champion to implanted and audited by Environmental Manager

White Desert IEE 2020 Report Final

Wolf's Fang Runway and Camp Site Medium					
Nesting storm petrels or other birds in nearby nunataks Medium	Visits to nearby nunataks by small groups of clients during season has potential to encounter nesting storm petrels causing a potential disturbance through noise or physical presence Direct Temporary	This potential impact can be avoided entirely if nesting areas are avoided during activities. Implementing the following measures would ensure that impacts are avoided if birds are encountered, reducing the magnitude:	Low Medium x minor = less than minor or transitory	Wolf's Fang Runway Environmental Management Plan	Training to be carried out by Environmental Manager/ Wolf's Fang Manager
		Nesting birds and their nests must not be disturbed			Reporting of any new nests to Environmental Manager in order to update the project GIS system
		If a nest is encountered the camp manger should be informed and a buffer protection zone protected around the nest to ensure they are not disturbed			All field guides and staff to be made aware
		If encountered, avoid areas where birds are nesting or breeding. Create buffer zone where activities will be excluded in order to avoid disturbance to nesting from noise and stress. It is proposed to have a buffer zone with a radius of at least 100 meters which would avoid any visual and noise impacts.			Environmental Manager periodic site Audits
		Training and awareness of site team			

White Desert IEE 2020 Report Final

		If individual birds are encountered, maintain distance set out in IAATO bird watching guidelines.			
		Map location of nests on White Desert GIS system prior to season commencement			Wolf's Fang Camp Manager to monitor implementation throughout season
NOISE AND VIBRATION					
<p>Birds in immediate proximity of Runway and skiway at Wolf's Fang Runway site such as including Skua and Storm Petrel</p> <p>Nesting storm petrels or other birds in nearby nunataks</p> <p>Medium</p>	<p>Disturbance of birds through noise of aircraft, operation of vehicles during transport.</p> <p>The birds in the area have not been studied for their sensitivity in terms of noise. It is normally an issue when it impacts on feeding, nesting or breeding. Based on observations made on site and the fact that the Runway site does not provide suitable nesting/ breeding or feeding ground for birds this is considered unlikely.</p> <p>Direct Temporary</p>	<p>Ensure there is no overflying of areas of concentration of birds at heights below 610 metres in accordance with guidelines</p> <p>Plan vehicle routes to be at least 500 meters from known bird nesting sites using precautionary principles</p> <p>Distance of Runway take-off and landing area from nunatak would reduce likelihood of impact occurring</p>	<p>Unlikely Medium x minor = less than minor</p>	<p>Runway location</p>	<p>Runway and logistics manager to implement</p>

White Desert IEE 2020 Report Final

Protected sites in wider study area including Svarthama ren ASPA (High Value) as well as nesting sites in nearby Nunataks (Medium Value(Disturbance of birds through noise of aircraft via flight path or through snow vehicles /off road vehicles used for re-supply via re-supply routes	Low overflying of protected areas is prohibited by legislation (as set out in guidance <i>Guidelines for the Operation of Aircraft near Concentrations of Birds in Antarctica. Annex to Resolution 2 (2004))</i> and flight paths planned to avoid low over flying There would be a low likelihood of impact occurring when following guidelines	Low likelihood High x minor=minor or transitory	Environmental Information for Pilots Pilot Information And Atka Bay, FD 83 and South Pole Specific Guidance for Pilots	Aircraft pilots
	Direct Cumulative impact	Transport and resupply routes are planned to avoid being within 500 meters of protected areas and area where birds are concentrated			
WILDERNESS AND VISUAL IMPACT					
There have been no visual receptors (such as scientific field camps) identified at the satellite	The satellite camp will be a new feature during summer season between November and February. However, there are no visual receptors of the proposed satellite camp so there would be no visual impacts.	There is an absence of visual receptors in the area. However, the camp tents will be dismantled at the end season itthough the safety refuge container may remain.	Unlikely Low x negligible= less than minor or transient	Demobilisation	Logistics team
		Any waste would be removed from the satellite camp on a regular basis or stored inside container to avoid visual impacts		Waste Management Plan	Site Waste Champion to implement
	Environmental Manager to carry out period audits				

White Desert IEE 2020 Report Final

camp location near the nunatak This is based on a review of submitted IEEs		Continue to monitor other organisation IEEs and identify any potential cumulative impacts		Environmental Management System updates	Environmental Manager to check each season
---	--	---	--	---	--

B) GEOGRAPHIC LOCATION WHICHAWAY CAMP AND SKIWAY					
ENVIRONMENTAL IMPACTS				IMPLEMENTATION	
RECEPTOR	POTENTIAL IMPACT	MITIGATION MEASURE	RESIDUAL LIKELIHOOD OF IMPACT	WHITE DESERT ENVIRONMENTAL MANAGEMENT PLAN	MONITORING/ IMPLEMENTATION RESPONSIBILITY
SENSITIVITY RECEPTOR	DESCRIPTION	DESCRIPTION	RESIDUAL SIGNIFICANCE OF IMPACT		
PHYSICAL ENVIRONMENT					
Freshwater lakes in wider study area of Schirmacher Oasis and ice free ground at Whichaway camp Ice free geology surfaces in Schirmacher Oasis High value receptor in accordance with assessment tables	Potential contamination of the freshwater lake system through accidental spillage of liquids, such as fuels and oils or waste fuels and oils, or through accidental spillage of waste waters. Any contaminants spilt would be mobile within this system. Waste greywaters would potentially increase the biological oxygen demand (BOD) , increase the organic carbon and nitrates and pathogens. Temporary	<div>The potential contamination risk is avoided through safe storage (for example in IBC) and handling of grey water. Grey water is currently filtered through grease trap prior to disposal in crevasse. Disposal of grey water in area outside zone of ablation, ice-flow lines and outside the zone of influence of the freshwater systems</div> <div>Identify a suitable grey water treatment system to improve grey water quality prior to disposal. In order to reduce potential risk of spillage, a grey water treatment system is being assessed which would reduce likelihood of occurrence of impacts further.</div>	<div>Low likelihood</div> <div>High value receptor x minor = minor or transient impact</div>	Waste Management Plan	Monitoring and testing of grey water in order to help inform requirement for grey water treatment plant

White Desert IEE 2020 Report Final

<p>The Schirmacher Oasis also has seasonal meltwaters, streams and water flow beneath the glaciers.</p>	<p>Direct</p>				
		Carry out options appraisal of plant biological treatment plant (for example from Martin Systems), filtration or UV treatment.			
		Updated grey water treatment system to reduce bacterial load and reduce Biological Oxygen Demand (BOD) of water prior to disposal			
		Obtain dispensation if discharge into rocks is carried or alternatively dispose of outside flow ice-flow lines		<p>Environmental Management System updates</p>	Environmental Manager to carry out waste water testing of output of greywater treatment plant once installed to ensure quality meets requirements -ongoing monitoring programme to ensure there is no potential to contaminate freshwater lake system
		Hydrogeological risk assessment would be carried out or ongoing monitoring of grey water treatment prior to discharge onto ice free areas, if required. Precedent has been set by other stations in Schirmacher Oasis			
		Use of water-less toilets solid waste is separated from grey water and urine resulting in grey water which has a lower bacterial load than sewage		<p>Waste Management Plan</p>	Site waste champion nominated at each site

White Desert IEE 2020 Report Final

		Solid waste is stored in secure hazardous waste containers which are clearly labelled. This reduces the likelihood of accidental spillage of solid waste (bacteria and pathogens) into freshwater system		Waste management Plan	Environmental audits carried out by Environmental Manager on periodic basis to ensure Waste Management Plan is being implemented correctly
	Potential contamination of ice free ground or lakes through accidental spillage or dispersion of fuels, oils, hazardous materials and waste Temporary Direct	Storage on of fuels, oils and materials on an impermeable base or inside COSSH container unit to reduce likelihood of spillage Ensure there is a containment unit to store 110% of spillage Ensure oils are stored on a bund unit to store 110% of any spillage or identify other appropriate measures to contain a potential spillage caused by damage to container unit Refuelling of vehicles to take place with dedicated areas. Use of spill mat during refuelling and for plant and equipment	Low likelihood High value receptor x minor = minor or transient impact	Fuel /Oil Storage and Handling Protocol Fuel/Oil Spill Contingency and Response Plan	Whichaway Camp manager to ensure plan is implemented by operatives Environmental audits carried out by Environmental Manager on periodic basis to ensure Fuel/ Oil storage plan is being implemented correctly
Dakshin Gangotri ASPA High value	As this area is protected for the purposes of scientific study, there should not be any interaction with the environment or scientific equipment in the protected areas, damage	Entry into the ASPA is prohibited by legislation and so area is entirely avoided Activities are not planned in this area Map of area included on White Desert GIS system	Unlikely to occur	Whichaway Camp Environmental Management Plan White Desert GIS	Whichaway Camp manager to ensure plan is implemented by operatives Environmental audits carried out by Environmental Manager on periodic basis to

White Desert IEE 2020 Report Final

	to scientific equipment or experiments Potential to accidentally enter the ASPA during off site visits Temporary Direct				ensure plan is being implemented correctly
Loose rocks and stones on ground of Schirmacher Oasis	Movement aside of small rocks/ stones in footprint of Whichaway Camp to create pathways and prevent trips and falls for health and safety on a temporary basis during the season Temporary Direct	Ensure that small rocks/stones are returned to original position at the end of each season No stones would be removed	Unlikely to occur	Whichaway Camp Environmental Management Plan	De-mobilisation procedure Whichaway Camp manager to ensure plan is implemented by operatives
ECOLOGY FLORA AND FAUNA RELEVANT					
Microfauna in freshwater lakes of Schirmacher Oasis High value receptor in accordance with assessment tables	Reduction in water quality caused by accidental spillage (as described above) impacting on freshwater ecosystem and microfauna within lakes Temporary -some recovery time	<div>The risk is currently avoided through the safe storage and handling of grey water as set out above</div> <div>Disposal of grey water in area outside zone of influence of freshwater lake system</div> <div>Updated grey water treatment system to reduce bacterial load and reduce Biological Oxygen Demand of water prior to disposal</div>	<div>Low likelihood</div> <div>High value receptor x minor = minor or transient impact</div>	Waste management plan	Water quality monitoring of freshwater lake quality on a periodic basis to be carried out by Environmental manager

White Desert IEE 2020 Report Final

High value receptor in accordance with assessment tables		Use of waterless toilets- solid waste is separated from grey water and urine, resulting in lower bacterial load of grey water. Also reduces total quantity of waste water arising			
		Human waste is stored in secure hazardous waste containers which are clearly labelled. This reduces the likelihood of accidental spillage of solid waste (bacteria and pathogens) into freshwater system			
There are no known nesting bird sites at the Whichaway Camp and skiway and areas visited during the client activities off site sites. However, wider study area of Schirmacher Oasis provides a habitat to birds including	Increase in overall number of visitors to the areas over season, potential to encounter nesting or breeding birds such as skua and snow petrel. This has potential to cause disturbance of birds	Even though risk is considered low, measures to discourage presence of birds on site are implemented	Likelihood low	Waste management plan	Site Waste Champion
		Ensure all waste is safely stored and removed from off-site client trips	Medium receptor x negligible= less than minor or transient		Whichaway Camp manager to ensure plan is implemented by staff
		Ensure food waste is safely secured so that birds cannot access it			
	Temporary Direct	Nesting birds and their nests must not be disturbed		Whichaway Camp Environmental Management Plan	Environmental Manager to carry out period audits and check compliance
		If a nest is encountered the environmental manger should be informed and a buffer protection zone protected around the nest to ensure they are not disturbed	Field guides		

White Desert IEE 2020 Report Final

Antarctic Skua, Adelie Penguin and individual birds have been observed at sites Medium value receptor		If encountered, avoid areas where birds are nesting or breeding and			
		If birds are encountered follow guidelines set out in IAATO guidelines for bird watching			
Individual birds present at the skiway	Direct bird strike from aircraft or from use of snow groomers to prepare skiway is considered unlikely as skiway is not considered to provide a suitable habitat for birds	It is unlikely that there would be a bird strike as birds are rarely observed at the Runway. Standard measures are followed	Unlikely	As part of Runway /skiways preparation procedures	Runway manager to implement
		Ensure Runway and skiway are clear of birds in advance of landing/ take-off and in advance of grooming Runway/skiway			
NOISE AND VIBRATION					
Human receptors at Novo and Maitri research stations	Potential noise impact from aircraft landing and taking off at skiway impacting on human receptors. Noise is	In frequency of flights and distance of receptor from skiway indicates it is unlikely to cause noise issues.	Unlikely to occur	Aviation procedures	Aircraft Pilots and aviation team

White Desert IEE 2020 Report Final

	normally an issue for humans when it causes annoyance.	Ongoing communication with Novo regarding flights			
<p>Birds in the wider of Schirmacher Oasis which provides a habitat for birds including Skua and Storm Petrel</p> <p>Medium value receptor</p> <p>Closest ASPA located at a distance of 300 km away (high)</p>	<p>Disturbance of birds through noise of aircraft via flight path or through snow vehicles /off road vehicles used for re-supply via re-supply routes and transport</p> <p>The birds in the area have not been studied for their sensitivity in terms of noise. It is normally an issue when it impacts on feeding, nesting or breeding.</p> <p>Cumulative impacts of Novo Runway and Whichaway skiway in terms of noise impacts</p>	<p>Low overflying of protected areas is prohibited by legislation (as set out in guidance <i>Guidelines for the Operation of Aircraft near Concentrations of Birds in Antarctica. Annex to Resolution 2 (2004)</i>) and flight paths planned to avoid low over flying</p> <p>There would be a low likelihood of impact occurring when following guidelines</p> <p>Transport and resupply routes are planned to avoid being within 500 meters of protected areas and area where birds are concentrated</p>	<p>Low likelihood</p> <p>Medium receptor x minor= less than minor or transient</p>	<p>Environmental Information for Pilots Whichaway Camp Environmental Management Plan</p>	<p>Continue to monitor and identify nesting bird locations and report any incidents to environmental manager</p>
WILDERNESS AND VISUAL AMENITY					
<p>Receptors are considered to be scientists visiting the lake to carry out research</p>	<p>It is not considered that the additional multi-function pod would alter the character of the camp</p>	<p>Maintain an organised and tidy camp and ensure waste, any fuel, equipment is safely stored throughout the season to minimise the visual impact at the camp</p>	<p>Unlikely to occur</p>	<p>Waste Management Plan</p>	<p>Whichaway Camp Manager</p>

White Desert IEE 2020 Report Final

	Visual receptors would be present occasionally and any impacts would be temporary and seasonal	Design camp to minimise visual impact on landscape.			
--	--	---	--	--	--

C) GEOGRAPHIC LOCATION ATKA BAY AND PRINCESS ASTRID COAST					
RECEPTOR	POTENTIAL IMPACT	MITIGATION MEASURE	RESIDUAL LIKELIHOOD OF IMPACT	IMPLEMENTATION	
SENSITIVITY RECEPTOR	DESCRIPTION	DESCRIPTION	RESIDUAL MAGNITUDE OF IMPACT	WHITE DESERT ENVIRONMENTAL MANAGEMENT PLAN	MONITORING/ IMPLEMENTATION RESPONSIBILITY
PHYSICAL ENVIRONMENT					
Ice and snow surface at Ekstrom ice shelf (location of the skiway and field camp used to visit Atka Bay) Low in accordance with assessment tables	During refuelling of generator or snow vehicles or during preparation of skiway there is a risk of a minor spillage of fuel Potential contamination of ice free through minor accidental spillage or dispersion of oils Temporary Direct	Measures to reduce likelihood of a minor spill during refuelling and handling are following including the following:	Low-unlikely to occur Low x Negligible= less than minor or transient	Fuel /Oil Storage and Handling Protocol Fuel/Oil Spill Contingency and Response Plan	Field camp team to implemented during refuelling
		Camp is located 5 km from sea-ice avoiding direct spillage onto sea-ice			
		No refuelling of aircraft takes place at Atka Bay and therefore there are no significant volumes of fuel stored at this location			Environmental Manager to monitor compliance through period environmental audits
		Minor volumes of fuel stored at this location used for generator and transport			
		Refuelling of vehicles / generators takes place within dedicated areas Use of spill mat during refuelling and for plant and equipment			
		Identify crevasses in the area which would create a pathway to sea-ice			

White Desert IEE 2020 Report Final

		Minimal amount of waste arises at this site (small field camp) and waste is removed on a regular basis to the Fuel Depot site	Unlikely	Waste management Plan	Site Waste Champion
Ice and snow at Fimbull ice shelf, at the location of the Fuel Depot and ice/snow physical environment of overland traverse Low value	Main fuel storage location for White Desert and is the site where ISO tanktainers are stored	Measures for the safe storage and handling would reduce the likelihood of occurrence. Measures for the containment and response to a spillage would reduce the magnitude of an impact.	Low Low and minor- less than transient	Fuel /Oil Storage and Handling Protocol Fuel/Oil Spill Contingency and Response Plan	Field camp team to implement during refuelling and staff training
	Potential contamination of blue-ice and snow through accidental spillage or dispersion of fuels, oils, hazardous materials associated with the use of Runway and for the support of logistical operations	Some of these measures are highlighted below. This list is not exhaustive and would be updated and modified as required to mitigate risks:			Environmental Manager to monitor compliance through period environmental audits
	This can take place during storage, handling and refuelling.	At all storage and traverse locations, sufficient ullage space to be maintained in case a leakage develops in a container, the container can be decanted at that site			
	Temporary Direct	Bulk fuel tanks are stored on specially prepared snow berms-over winter			
		Ensure there is a containment unit to store 110% of spillage			

White Desert IEE 2020 Report Final

		Ensure oils are stored on a bund unit (or snow berm) to store 110% of any spillage or identify other appropriate measures to contain a potential spillage caused by damage to container unit			
		Visual inspections of containers and all valves is carried out to ensure there are no leaks			
		Drip trays or spill mats used during refuelling process, which presents the greatest risk of spillage			
		A storage berm is used to minimise burial of equipment over winter, this is rebuilt each summer			
		Position containers where the risk of the containers being damaged by direct impact is minimised (for example away from turning circles and routes)			
		A custom made pump is in place at Fuel Depot to minimise risk of spillage during refuelling. Staff should be trained in the correct use of the pump			

White Desert IEE 2020 Report Final

		Spill kits provided within close proximity to fuel and oil storage areas and operatives will be trained in their use. Also carried out overland traverse			
		Follow reporting procedures which are set out within Fuel Protocol			Incidents reported to Operations Manager
Emperor Penguin Colony at Atka Bay IBA Very High value receptor	Potential disturbance of Emperor Penguin Colony due to presence of visitors The presence of humans can potentially cause stress to the colony and individual penguins. Measures need to be taken to ensure that disturbance is avoided Temporary Direct	White Desert has followed IAATO Guidelines when visiting Emperor Penguin Colony. Advisory measures were provided in 2019 by AWI. These have been implemented with agreement from the consenting authority. These measures reduce likelihood of impact to low and magnitude of potential impact to minor. White Desert will continue to visit colony in small group sizes of 12-14 guests and guides. Over a three month period a relatively small number of visits would continue to be carried out- as set out in Operations Table to reduce cumulative impacts Only one group of guests (size up to 14 guests) can be taken to visit the colony at a time in accordance with White Desert's permit	Likelihood reduced to low Very high x negligible minor = minor or transient	ATKA BAY EMPEROR PENGUIN VISITS Field Guides, Staff and Operatives Information	Field Guides, Staff and Operatives Information

White Desert IEE 2020 Report Final

		Implement White Desert specific guidelines which go beyond IAATO species guidelines and are site specific			Environmental Manager to monitor compliance through period environmental audits
		Distance Guidelines			
		Persons should not approach the colony or concentrations of penguins closer than 30 meters			
		Note that this is a greater distance than previous seasons and mandatory distance has been increased from IAATO guidelines			
		Visiting groups should stay together and approach the colony very slowly with regular stops during the approach. Any abrupt movements are to be avoided. If animals show signs of disturbance or distress (e.g. <i>flipper movements, alarm calls, standing up, rapidly sliding away in the opposite direction</i>), the approach should be stopped and visitors should knee down as much as possible.			
		It has to be ensured that the visitor group does not block the routes from the colony to the sea.			

White Desert IEE 2020 Report Final

		<p>Individual penguins or a pair of penguins should not be approached closer than 5 m</p> <ul style="list-style-type: none"> In order to approach <i>individuals</i>, implement the IAATO guidelines. Only approach an individual or pair of penguins gradually. Stop at an established point for a minimum of 5 minutes and assess penguin behaviour. If there are no nervous reactions (such as continual flipper flapping) , slowly move the group closer to the colony. Continually assess the behaviours and retreat if there are any signs of disturbance. If in doubt, maintain the 30 meter distance rule 			
		<p>Encircling the colony, sub-colonies or concentrations of penguins, even partly, is strictly forbidden, as it causes a lot of stress to the animals. The penguins always should have plenty of room to move and to escape from the visitors, at least more than 270°.</p>			<p>Environmental Manager to monitor compliance through period environmental audits and Field guides, Operative to implement</p>

White Desert IEE 2020 Report Final

Other wildlife at Atka Bay which can include Weddell seals (refer to baseline conditions for full list) High value	Physical disturbance of wildlife through human presence	Implemented above guidelines and species specific guidelines provided by IAATO	Low High x negligible minor= less than/minor or transient	ATKA BAY EMPEROR PENGUIN VISITS Field Guides, Staff and Operatives Information	Field Guides, Staff and Operatives Information
	Temporary Direct	Use of drones is prohibited in this area			Environmental Manager to carry out periodic audits
Emperor Penguin	Potential risk of collision with Emperor Penguins which are using the "penguin highway" to feed and return to the main colony.	White Desert leave snow vehicles at least 300 meters away from colony and walk the rest of the way. Follow updated guidelines advised by AWI on penguin highway each season and highway will be confirmed each season and avoided.	Rare (extremely unlikely)	ATKA BAY EMPEROR PENGUIN VISITS Field Guides, Staff and Operatives Information	Field guides
		The closest distance permitted to the edge of a colony is 100 meters, including when driving on the ice shelf.			Environmental Manager to carry out periodic audits
		The use of engine-driven vehicles near the colony / sub-colonies should be kept at a minimum.			
		Driving through gaps between sub-colonies smaller than ~300 m must be avoided. These gaps act as connection corridors and are frequently used by parents seeking			

White Desert IEE 2020 Report Final

		for their chicks and by individuals or groups of chicks, which are very sensitive to disturbance by noise.			
NOISE AND VIBRATION					
<p>Emperor Penguin Colony in Atka Bay on the sea-ice</p> <p>Colony site is also an Important Bird Area</p> <p>Other wildlife present at Atka Bay including Weddell seals, Skua</p>	<p>Potential noise impact from ski-equipped aircraft take-off and landing at skiway</p>	<p>White Desert skiway was relocated to ice shelf in 2018-2019 to entirely avoid any direct potential impacts/risks of landing on sea-ice</p> <p>Using satellite mapping, a potential skiway site was identified, and the location discussed with personnel from the Alfred Wegner Institute to ensure that it did not cut across any of AWI's traverse routes to their port. The site selected is at - 70°38'20"S, 08°15'38"W, making it approximately 4km away from the sea-ice and Emperor colony and a suitable location on the ice-shelf will be used for this season.</p> <p>The location exceeds the minimum guideline requirement that landings within 1/2 nautical mile (~ 930 m) of penguin, albatross or other bird colonies should be avoided and to land at a minimum of 0.75 nautical mile (~ 1km) from colony or seals.</p>	<p>Low</p> <p>Less than Minor Transitory</p>	<p>Location of skiway onto ice-shelf integrated into the design of operations</p>	<p>Measures included in location of skiway</p>

White Desert IEE 2020 Report Final

		Follow aircraft flight heights, preferred flight paths and approach paths contained in the Antarctic Flight Information Manual (AFIM) , in station aircraft operation manuals and on relevant charts, maps and any Wild Life and Low Flying Avoidance Maps		Environmental Information for Pilots Pilot Information And Atka Bay, FD 83 and South Pole Specific Guidance for Pilots	Aircraft Pilots responsible for flight related requirements White Desert logistics team to instate skiway in accordance with f each season
	Potential impact of noise from flight paths of ski-equipped aircraft	<p>Overflying of wildlife is prohibited under measures set out in the Guidelines for the Operation of Aircraft near Concentrations of Birds in Antarctica. Annex to Resolution 2 (2004) are followed and these are reinforced by additional site specific recommendations made by AWI</p> <p>The White Desert guidelines include the following measures set out below (This list is not exhaustive):</p> <p>Penguin, albatross and other bird colonies are not to be over flown below 2000ft (~ 610 m) Above Ground Level</p> <p>Never hover or make repeated passes over wildlife concentrations or fly lower than necessary.</p> <p>Maintain a vertical separation distance of 2000 ft (~ 610 m) AGL and a horizontal separation of 1/4</p>	<p>Unlikely</p> <p>Very high x negligible = less than minor or transient</p>	Environmental Information for Pilots Pilot Information And Atka Bay, FD 83 and South Pole Specific Guidance for Pilots	Aircraft Pilots

White Desert IEE 2020 Report Final

		<p>nautical mile (~ 460 m) from the coastline where possible.</p> <p>Cross the coastline at right angles and above 2000ft (~610 m) AGL where possible.</p>			
<p>Important Bird areas along Dronning Maud Land coastline</p> <p>High value</p>	<p>Potential impact of noise from flight paths</p> <p>Temporary Direct</p>	<p>Plan flight paths take into consideration Important Bird Areas, which are mainly located along the coastlines</p> <p>Follow Guidelines for the Operation of Aircraft near Concentrations of Birds in Antarctica</p>	<p>Low likelihood</p> <p>High x negligible = less than minor or transient</p>	<p>Environmental Information for Pilots</p> <p>Pilot Information And Atka Bay, FD 83 and South Pole Specific Guidance for Pilots</p>	<p>Aircraft Pilots</p>
<p>Human receptors at Neumayer station and SANAE summer camp</p>	<p>Noise impact from aircraft landing and taking off at skiway impacting on human receptors. Noise is normally an issue for humans when it causes annoyance</p> <p>Number of flights is low and spread over 3 month period and combined with distance from stations and overflying requirements it is unlikely that noise would cause nuisance to human receptors</p>	<p>In frequency of flights and distance of receptor from skiway indicates it is unlikely to cause noise issues.</p> <p>Advance notification of stations in the area of proposed flight schedule and continue ongoing liaison</p>	<p>Unlikely</p>	<p>ATKA BAY EMPEROR PENGUIN VISITS</p> <p>Field Guides, Staff and Operatives Information</p>	<p>White Desert Aviation/Logistics team</p>

White Desert IEE 2020 Report Final

Potential presence of birds at Fuel Depot location on Fimbull Ice-shelf due to close proximity of coastline (approximately 10 km away) though site would not provide a habitat	Potential disturbance of birds through physical presence and direct bird strike from aircraft unlikely as skiway is not considered to provide suitable	Ensure food waste is securely stored in order to discourage the presence of birds at skiway Skiway should be checked for presence of birds in advance of aircraft landing or taking off	Unlikely	Waste Management Plan	Site Waste Champion and skiway staff
SCIENTIFIC RESEARCH					
Scientific research being carried out by SANAP and AWI station including monitoring and research equipment	Potential interference/disturbance with monitoring and research equipment or monitoring	Avoidance of sites and areas where monitoring equipment is located to ensure there is no interference	Unlikely	ATKA BAY EMPEROR PENGUIN VISITS Field Guides, Staff and Operatives Information	Aircraft pilots
		Mark out locations of equipment in advance of season			Environmental Manager to ensure compliance with audits
		Skiway and Camp sited away from monitoring / research areas.			

D) GEOGRAPHIC LOCATION FD 83 AND SOUTH POLE VISITS					
PHYSICAL ENVIRONMENT					
RECEPTOR	POTENTIAL IMPACT	MITIGATION MEASURE	RESIDUAL LIKELIHOOD OF IMPACT	IMPLEMENTATION	
SENSITIVITY RECEPTOR	DESCRIPTION	DESCRIPTION	RESIDUAL MAGNITUDE OF IMPACT	WHITE DESERT ENVIRONMENTAL MANAGEMENT PLAN	MONITORING/ IMPLEMENTATION RESPONSIBILITY
Ice and snow at FD 83 skiway and field camp Low value in accordance with assessment tables	Potential contamination of ice and snow through accidental spillage of waste grey water and urine Temporary Direct	Total quantities of grey water would be used due to small team arising would be low and short time spent at FD 83 by clients Disposal of grey water in area outside zone of ablation, ice-flow lines in crevasse in accordance with regulations	Low Low x minor = Less than minor or transitory	Waste Management Plan	Site waste champion nominated at each site
	Potential contamination of ice and snow through accidental spillage or dispersion of fuels, oils, hazardous materials associated with the use of skiway and for the support of logistical operations	Measures for safe storage, handling would reduce magnitude of an impact to minor and likelihood to low-unlikely. Measures are summarised below:	Low Low x minor = Less than minor or transitory	Fuel /Oil Storage and Handling Protocol Fuel/Oil Spill Contingency and Response Plan	Environmental audits carried out by Environmental Manager on periodic basis
		Storage on of fuels, oils and materials on an impermeable base or inside COSSH container unit to reduce likelihood of spillage The use of small containers (1500l IBCs) on the traverse and at the skiway of FD83 will reduce the likelihood of a larger fuel spill.			

White Desert IEE 2020 Report Final

	This can take place during storage, handling and refuelling. Temporary Direct	Use of spill mat/drip tray during refuelling and for plant and equipment			Wolf's Fang Runway Manager and Traverse Manager to monitor
		Ensure that there is adequate snow cover so that any minor /drops do not reach blue-ice directly			
		Ensure oils are stored on a bund unit to store 110% of spillage			
		Refuelling of vehicles takes place with dedicated areas			
		Refuelling to take place with use of drip tray or absorptive mat			
		Pump and snow/oil separator to be available in order to ensure a large spillage can be pumped out. Any spillage would be pumped into a waste oil IBC or other suitable container			
		Adequate quantity of absorptive spill kit available at all locations where fuel is stored as well as on back of vehicles			
ECOLOGY FLORA AND FAUNA					
Flora and Fauna scoped out for FD 83 and South Pole as there is low potential for birds to be present at these locations. Microbial life which may exist beneath the ice, would be protected through the mitigation measures for the physical environment					
NOISE AND VIBRATION					
Human Receptors at South Pole	Noise impact from aircraft landing and taking off at skiway impacting on human receptors. Closest human	Advance notification of stations in the area of proposed flight schedule and continue ongoing liaison would ensure that adverse impacts on human receptors are unlikely to occur	Unlikely	Atka Bay and FD 83 South Pole Environmental Information for Pilots	White Desert Logistics and Aviation team

White Desert IEE 2020 Report Final

Amundsen Scott Research station	receptors are located X km . Noise is normally an issue for humans when it causes annoyance However, number of flights is low and spread over 3 month period and combined with liaison with station unlikely that noise would cause nuisance to human receptors	Landing at South Pole station skiway for NGO		Pilot Information	Aircraft pilots
		Follow specific measures set out in the ASMA Management Plan			
WILDERNESS AND VISUAL IMPACT					
FD 83 Low	Presence of existing plant and facilities associated with the FD83 location in the landscape will be maintained with the continued use of the location Beneficial view of wilderness and natural landscape from the site for the visitors and staff to the Atka Bay site Impacts in relation to wilderness and visual amenity at the South Pole and are considered under polar cultural heritage due to the intrinsic link with this aspect	Footprint (staff accommodation, fuels, plant and equipment store) has been reduced as far as reasonably practical in order to reduce potential impacts on the wilderness and visual amenity of the immediate study area. This has already been incorporated into the design of the site	Adverse visual impacts are unlikely to occur	Fuel /Oil Storage and Handling Protocol Fuel/Oil Spill Contingency and Response Plan	Environmental audits carried out by Environmental Manager on periodic basis
		Ensure that the amount of waste drums and waste tanks stored at FD83 is kept to the minimum required and any disused drums are removed from the site regularly through the traverse			Wolf's Fang Runway Manager and Traverse Manager to monitor
		Maintain a clean, organised and tidy site through appropriate materials and fuels storage and handling			
		It will be ensured that there is no littering off site or on site at FD83 through appropriate enclosed waste storage containers. In the			

		event of accidental dispersal of litter, it would be removed immediately.			
ANTARCTIC HERITAGE AND SCIENCE					
<p>South Pole ASMA 5</p> <p><i>South Pole Ceremonial Flag Mast (HSM1)</i></p> <p><i>Amundsen's Tent site (HSM 80)</i></p> <p><i>Very High Value in accordance with assessment table</i></p>	<p>Beneficial view of South Pole station ASMA, and South Pole Ceremonial Flag Amundsen's Tent site visitors to the site.</p> <p>The visit to the South Pole site provides a unique opportunity for visitors to learn about the cultural heritage and scientific values of the South Pole. This is considered to be beneficial impact for the staff and visitors of the site.</p> <p>This is also in line with the ethos of White Desert eco-tourism activities, and furthering IAATO ambassador programme, which aim to increase environmental awareness of Antarctica.</p>	<p>If measures are followed magnitude reduced to negligible Compliance with the guidelines for visitors set out within the South Pole Station Management Plan ASMA 5, APPENDIX A Additional Guidelines for Non-Governmental Organizations at the South Pole. These include</p> <ul style="list-style-type: none"> ○ Expedition leaders from all other groups visiting the ASMA should ensure that all visitors to the Area are educated on the boundaries, purpose, and entrance prohibition of the Hazardous Zone ○ Tour operators and other non-governmental visitors to the Area should provide visitation schedules to National Program(s) operating in the Area in advance of their visits ○ There are no restrictions on visitation to the Historic Zone. However, visitors must follow guidelines in the management plan and take all appropriate safety precautions ○ Except for emergency situations, unescorted guests are expected to stay within the designated camping area, the NGO parking area, or the area immediately surrounding the Pole markers, unless otherwise authorized by 	<p>Beneficial impact in terms of Antarctic Heritage for visitors</p> <p>Unlikely to have adverse impact on scientific operations</p>	<p>Atka Bay and FD 83 South Pole Environmental Information for Pilots Pilot Information</p>	<p>Aircraft Pilots and field guides</p>

White Desert IEE 2020 Report Final

		the National Program operating in the area			
South Pole ASMA 5	Potential impact on scientific activities such as impact on clean air sector and monitoring	Advance and agreed notification of visits in advance of the season as set out in ASMA 5 Management Plan		White Desert planning and operations	White Desert operations team
		The number of visits to the South Pole is limited by the station to ensure that there are no adverse impacts			

Conclusion and Discussion

Since White Desert obtained permission to manage and operate internal flights in Antarctica and for the operation of Wolf's Fang Runway, we have developed and implemented an internal Environmental Management System, in line with the mitigation measures identified within the original and previous IEE reports.

By preparing this consolidated IEE which sets out the environmental measures across different geographic locations we are able to develop the Environmental Management System further and continue to ensure that impacts are *less than minor or transitory* and that the cumulative impacts are taken into consideration.

This report also identifies the operational environmental measures which have been taken to date and the environmental measures which would be taken forward as part of a five year permit. This enables White Desert to consider measures to improve local air quality emissions, identify plant to improve grey water quality treatment as well as to set targets to reduce greenhouse gas emissions inline with *Net Zero by 2050* policy.

Taking the site specific measures and operational measures into consideration as set out within this report, White Desert activities would continue to have a less than minor or transitory impact.

Appendix I

Table 18.0 General Guidance Developed for Assessment Process

General Guidance Developed for Assessment Process	
Value or sensitivity of environmental element	Description of criterion and examples relevant to assessment
Very High-High	Very high importance and rarity, international scale and very limited potential for substitution
	Designated sites Antarctic Special Protected Areas (ASPA), Antarctic Special Management Areas (ASMA) Historic Sites and Monuments (HSM) Ecosystem Monitoring Programmes (CEMP) sites
	Area of international or continent importance, loss would be significant for overall environment and ecology in Antarctica and on a wider scale (fauna)
	Very high wilderness and aesthetic value with absence of manmade structures or infrastructure
Medium	Habitat suitable for flora and fauna such as breeding, nesting or feeding sites such as freshwater lakes, coastal areas, ice-free ground and mountainous regions
	Area of regional wide importance and rarity, limited potential for substitution
	Areas which are of high sensitivity in terms of impacts on human activity such as research stations, infrastructure and traverse routes (human receptors)
	Area of high wilderness and aesthetic value
Low	Area does not provide a habitat suitable for flora and fauna. Natural environment across Antarctica is protected under Protocol
	Area of local importance
	Area of medium wilderness and aesthetic value reduced by presence of human activities such as abandoned sites

Table 19.0 Guidance for description of magnitude

Guidance for description of magnitude	
Magnitude	Description
Negligible	No discernible impacts or impacts of very limited extent or duration, very minor loss to one or more characteristics, features or elements
Minor	Temporary short-term disturbance to the physical status, dynamics or function of the receptor. A reduction in the receptor, but no significant habitat loss. Minor loss or alteration to one or more feature or element
Moderate	Partial loss of, temporary damage to or medium-term disruption to physical status, dynamics or function of the receptor. Loss of resource but not adversely affecting integrity
Major	Complete loss of, permanent damage to, degradation of or long-term disruption to integrity, physical status, dynamics or function of the receptor

Professional judgement is used to determine the overall significance of impacts, the table below has been developed as a general guideline or basis.

Table 20.0 Determining overall significance of impacts

Determining Overall Significance of Impacts					
VALUE / SENSITIVITY ENVIRONMENTAL ELEMENT RECEPTOR OR RESOURCE	MAGNITUDE OF IMPACT (DEGREE OF CHANGE)				
		Negligible	Minor	Moderate	Major
	Very High	<i>Less than minor or transient</i>	<i>Minor or transient</i>	<i>More than minor or transient</i>	<i>More than minor or transient</i>
	High	<i>Less than minor or transient</i>	<i>Minor or transient</i>	<i>More than minor or transient/ Minor or transient</i>	<i>More than minor or transient</i>
	Medium	<i>Less than minor or transient</i>	<i>Minor or transient / Less than minor or transient</i>	<i>Minor or transient</i>	<i>Minor or transient</i>
	Low	<i>Less than minor or transient</i>	<i>Less than minor or transient</i>	<i>Less than minor or transient Minor or transient</i>	<i>Minor or transient</i>

Source: Above tables developed by Eleni Antoniades Environmental Ltd for Antarctica projects

Description of risk /likelihood of impact occurring	
Rare	Extremely unlikely
Unlikely	Minor change that the activity will results in the impact
Possible	The impact may occur but is not expected to be the outcome of the activity (e.g. person dependent-human errors)

White Desert IEE 2020 Report Final

Likely	There is a good chance that the impact will occur as a result of this activity, however it will not always be the case
Certain	The impact will be the outcome of the activity

Source Wolf's Fang Runway IEE

These best practice guidelines include the UK Amended Circular on Environmental Impact Assessment, the Explanatory Memorandum to the EIA Regulations, IEMA Guidelines for EIA, DMRB Assessment and management of Environmental Effects and the European EIA Directive 2011/92/EU.

Appendix II: IEE Update Report Figures

Figure 1.0 White Desert Antarctic Camps

Figure 2.0 Wolf's Fang Runway Area

Figure 3.0 Wolf's Fang Staff Camp and Main Camp Indicative Layout

Figure 4.0 Wolf's Fang Satellite Camp Indicative Layout

Figure 5.0 Whichaway Camp Indicative Layout

Figure 6.0 Whichaway Camp Skiway Indicative Layout

Figure 7.0 Atka Bay Indicative Layout

Figure 8.0 Depot Indicative Layout

Figure 9.0 FD 83 Indicative Layout

Figure 10.0 Protected Areas and Sites in Dronning Maud Land Study Areas

Figure 11.0 Protected Areas and Sites in FD 83 and South Pole Study Area

Figure 12.0 Wolf's Fang Runway Environmental Features

Figure 13.0 Whichaway Camp Environmental Features

Figure 14.0 Atka Bay Environmental Features

Applicable legislation

ⁱ Physical Environment and Air Quality

- Protocol on Environmental Protection to the Antarctic Treaty (1991), Article 3 Environmental Principles, (2) (b) "activities in the Antarctic Treaty area shall be planned and conducted so as to avoid (ii) significant adverse effects on air or water quality (iii) Significant changes in the atmospheric, terrestrial (including aquatic) glacial or marine environments

Fuel Management Plan Regulations:

- Antarctic Act 2013
- Protocol on Environmental Protection to the Antarctic Treaty, Regulation XVIII-1 Tourism and Non-governmental Activities
- Article 3 of the Environmental Protocol to the Antarctic Treaty which requires that activities in the Antarctic Treaty area shall be planned and conducted so as to limit adverse impacts on the Antarctic environment
- Annex IV to the Environmental Protocol on Prevention of Marine Pollution
- Protocol on Environmental Protection to the Antarctic Treaty (1991) Annex III Waste Disposal and Waste Management.

Flora and Fauna

- Antarctic Treaty (1959) Protocol on Environmental Protection to the Antarctic Treaty (1991) Annex II Conservation of Antarctic Fauna and Flora. This is the key legislation in relation to the protection of the environment. It prohibits harmful interference by flying aircraft in a manner that disturbs concentrations of birds, wilfully disturbing breeding or moulting birds or concentrations of birds by persons on foot.
- Protocol on Environmental Protection to the Antarctic Treaty (1991) Annex V Area Protection and Management, Environmental Protection
- The Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR) (1982)
- Important Bird Areas in Antarctica
- Protocol on Environmental Protection to the Antarctic Treaty, Regulation XVIII-1 Tourism and Non-governmental Activities
- At the 2011 Antarctic Treaty Consultative Meeting (ATCM XXXIV, Buenos Aires), Treaty Parties adopted new general guidelines for visitors to the Antarctic (Resolution 3).

IAATO Guidelines

- Guidelines for Visitors to the Antarctic which include recommended measures to Protect Antarctic Wildlife, Respect Protected Areas, Respect Scientific Research, Be Safe, Keep Antarctica Pristine
- IAATO General Information for Wildlife Watching, updated October 2016
- IAATO Bird Watching Guideline, updated October 2016
- IAATO Emperor Penguin Colony Visitor Guidelines, updated 2016
- IAATO Cetacean Watching Guidelines (updated 2016)
- IAATO Seal Watching Guidelines (updated 2016)
- IAATO Bird Watching Guidelines (updated 2016)
- IAATO Leopard Seal Watching Guidelines (updated 2016)

Bio security

- Committee for Environmental Protection (CEP) ,Non-Native Species Manual Revision 2017
- ATCM XXXIV - WP 53 (SCAR) 2011 - Measures to reduce the risk of non-native species introductions to the Antarctic region associated with fresh foods.

-
- Boot, Clothing and Equipment Decontamination Procedures for Small Boat Operations International Association of Antarctica Tour IAATO

Waste Management

- Protocol on Environmental Protection to the Antarctic Treaty (1991) Annex III Waste Disposal and Waste Management

Aviation

- Resolution 4 (2018) Annex 4 Environmental Guidelines for operation of Remotely Piloted Aircraft Systems (RPAS)¹ in Antarctica (v 1.1)²
- Guidelines for the Operation of Aircraft near Concentrations of Birds in Antarctica. Annex to Resolution 2 (2004)

Protected areas

- Management Plan for Antarctic Specially Protected Area (ASP) No 163 Dakshin Gangotri Glacier, Dronning Maud Land
- Management Plan for Antarctic Specially Managed Area (ASMA 5) Amundsen-Scott South Pole Station, South Pole (updated in 2017)
- ASMA 5: Amundsen -Scott South Pole Station, South Pole. Measure 2 (2007) -Annex A, in order to carry out the client site visits.

Additional sources of information

The Antarctic Protected Areas databaseⁱⁱ and Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) websiteⁱⁱ has been searched in order to identify the location of the ASPA, ASMA, CCAMLR sites, as well as IBA at Atka Bay and the wider study area