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Environmental and Social Impact Assessment (ESIA) for the Proposed Establishment and Operation of the African Millimetre Telescope on Farm Göllschau, Khomas Region

Scoping Report

ECC Application No.: 251103006603

9 March 2026

Client: Radboud University, Nijmegen, Netherlands

Executive Summary

Introduction

This Scoping Report forms part of the Environmental and Social Impact Assessment (ESIA) process for the proposed establishment and operation of the African Millimetre Telescope (AMT) on Farm Göllschau in the Khomas Region of Namibia. The project is led by Radboud University in collaboration with UNAM, and is intended to contribute to global astronomical research through participation in the Event Horizon Telescope network.

Project Description

The proposed project entails the construction, operation and eventual decommissioning of a 14 m diameter radio telescope dish, associated foundations, prefabricated buildings, access road upgrades and renewable energy infrastructure. The overall development footprint is approximately 80 × 80 m, with a very small permanent disturbance area relative to the surrounding landscape.

Construction is expected to take approximately 15 months and will involve a small workforce. Operational activities will be intermittent, with no permanent on-site occupation. The project is temporary in nature, with the AMT anticipated to be relocated to the Gamsberg plateau within 5–10 years once enabling infrastructure is in place. Decommissioning and rehabilitation of the Göllschau site form an integral part of the project scope.

Alternatives considered include the no-go option and different energy supply options. The no-go option was rejected due to the project's substantial scientific and educational benefits and the absence of significant unmitigable environmental impacts. A photovoltaic-based energy system was selected as the preferred option.

Legislation Relevant to the Project

The project is subject to Namibia's Environmental Management Act and a range of sectoral legislation governing water resources, biodiversity protection, heritage resources, soil conservation and road transport. Relevant international conventions, including the Convention on Biological Diversity and the United Nations Convention to Combat Desertification, have also been considered. Compliance with all applicable legal requirements and permitting processes is a prerequisite for project implementation.

Description of the Receiving Environment

The project site is located within the Khomas Hochland, characterised by semi-arid climatic conditions, shallow stony soils, and rugged highland topography. The biophysical environment

comprises typical Highland Acacia Savanna vegetation, with no unique micro-habitats or highly range-restricted species occurring within the project footprint.

Biodiversity assessments indicate that the site supports common and widespread plant and animal species typical of the region. While several fauna species of conservation concern may occur in the broader area, the very small footprint and limited duration of activities mean that population-level impacts are unlikely.

The socio-economic environment is defined by low population density and land use dominated by commercial livestock farming and associated tourism / hunting. No communal land, settlements or sensitive social receptors occur in the immediate vicinity. Known heritage resources are located several kilometres from the site and will not be affected by the project.

Public Consultation

Public consultation was undertaken in accordance with the EIA Regulations and formed a central component of the scoping process. Two rounds of engagement were conducted between October and December 2025, including newspaper notices, distribution of a Background Information Document, on-site public meetings, and stakeholder briefings in Windhoek.

A total of 62 Interested and Affected Parties (IAPs) were registered, representing government authorities, neighbouring landowners, scientific institutions and members of the public. Key issues raised included potential light interference with the neighbouring HESS telescope array, visual impacts, road safety, water availability, biodiversity protection, rehabilitation, and fire risk management.

The consultation process resulted in several project refinements, particularly with respect to light management, access road alignment, traffic restrictions during night-time hours, and site layout. All substantive comments received have been documented and responded to, and mitigation measures have been incorporated into the Environmental Management Plan.

Impact Assessment

The impact assessment identified a number of potential negative impacts associated with the construction, operation and decommissioning of the AMT. Impacts were assessed using a structured methodology considering extent, duration, magnitude, probability and overall significance, both before and after mitigation.

The most significant potential negative impact relates to light interference affecting the nearby HESS telescopes. Without mitigation, this impact could be of medium significance. However, with agreed mitigation measures—including strict light controls, downward-facing

lighting only, locked access gates at night, and revised road alignments—the residual impact is reduced to low–medium significance with a high degree of confidence.

Other assessed impacts include road deterioration and traffic safety risks, dust generation, soil erosion, disturbance to fauna, pollution risks, waste generation, and water use. All of these impacts are assessed as low to medium significance prior to mitigation, and low to low-medium significance after mitigation, provided that the Environmental Management Plan is fully implemented.

Positive impacts include international scientific recognition for Namibia, skills development and training opportunities for Namibian students and researchers, and limited short-term economic benefits during construction. No fatal flaws were identified.

Overall Conclusion

The scoping assessment concludes that the proposed African Millimetre Telescope on Farm Göllschau is environmentally acceptable and socially feasible, provided that the recommended mitigation and management measures are implemented. The project has a very small physical footprint, limited duration, and substantial scientific and educational benefits. It is therefore recommended that the project be granted an Environmental Clearance Certificate, subject to the conditions set out in the Environmental Management Plan.

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Appendices

Appendix A: Application for Environmental Clearance Certificate

Appendix B: Environmental Management Plan

Appendix C: CVs of EAPs responsible for the Environmental Assessment

Appendix D: Proof of Public Consultation

Appendix D1: List of Interested & Affected Parties (IAPs)

Appendix D2: Copies of newspaper notices placed in the printed media (*The Namibian, The Sun, Allgemeine Zeitung* and *Republikein)*

Appendix D3: Notification email (with the BID) sent to stakeholders (IAPs)

Appendix D4: Printed A2 public poster for public notification and invitation to participate in the EA process

Appendix D5: Proof of Circulation of the draft scoping report to the registered IAPs

Appendix E: Göllschau Flora and Fauna Assessment

Appendix F: Göllschau Archaeological Assessment

Abbreviations and Acronyms

AMT	African Millimetre Telescope
BID	Background Information Document
CITES	Convention on International Trade in Endangered Species
DEAF	Department of Environmental Affairs and Forestry, MEFT
DRFN	Desert Research Foundation of Namibia
DWA	Department of Water Affairs
EA	Environmental Assessment
EAP	Environmental Assessment Practitioner
ECC	Environmental Clearance Certificate
EEAN	Environmental Evaluation Associates of Namibia
EHT	Event Horizon Telescope
EIA	Environmental Impact Assessment
ESIA	Environmental and Social Impact Assessment
EMA	Environmental Management Act
EMP	Environmental Management Plan
GG	Government Gazette
GN	Government notice
HESS	High Energy Stereoscopic System telescope array
IAP	Interested and Affected Party
IT	Information Technology
IUCN	International Union for the Conservation of Nature

MAWLR	Ministry of Agriculture, Water and Land Reform
MEFT	Ministry of Environment, Forestry and Tourism
MME	Ministry of Mines and Energy
NBRI	National Botanical Research Institute
NCE	Namibian Chamber for Environment
NGO	Non-Governmental Organisation
NHC	National Heritage Council
NSA	Namibia Statistics Agency
PV	photovoltaic
RA	Roads Authority
RES	Resilient Environmental Solutions cc
SEA	Strategic Environmental Assessment
SKA	Square Kilometre Array
ToR	Terms of Reference
UNAM	University of Namibia
UNCCD	United Nations Convention to Combat Desertification

Glossary

Cumulative Impacts - in relation to an activity, means the impact of an activity that in itself may not be significant but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area.

Environment - As defined in Environmental Management Act - the complex of natural and anthropogenic factors and elements that are mutually interrelated and affect the ecological

equilibrium and the quality of life, including – (a) the natural environment that is land, water and air; all organic and inorganic matter and living organisms and (b) the human environment that is the landscape and natural, cultural, historical, aesthetic, economic and social heritage and values.

Environmental Management Plan – as defined in the EIA Regulations (Section 8(j)), a plan that describes how activities that may have significant environments effects are to be mitigated, controlled and monitored.

Interested and Affected Party (IAP) - in relation to the assessment of a listed activity includes - (a) any person, group of persons or organisation interested in or affected by an activity; and (b) any organ of state that may have jurisdiction over any aspect of the activity.

Mitigate - practical measures to reduce adverse impacts.

Proponent – as defined in the Environmental Management Act, a person who proposes to undertake a listed activity.

Significant impact - means an impact that by its extent, duration, magnitude or probability of occurrence may have a notable effect on one or more aspects of the environment.

1 Introduction

1.1 Project Background and Location

The project: Radboud University proposes to establish and operate the Africa Millimetre Telescope (AMT) as part of an international research project to see into the 'shadow' of a black hole. To see such an image, there is a need for a worldwide network of radio telescopes, called the Event Horizon Telescope (EHT). This will effectively create a telescope almost the diameter of the earth. The project is being initiated by Radboud University in The Netherlands, in collaboration with UNAM and other Namibian and international institutions. It will place Namibia at the forefront of astronomical research and attract international attention.

Farm Göllschau is approximately 100 km south-west of Windhoek along the C26 road in the Khomas Region. The site is adjacent to an existing astronomy project, the High Energy Stereoscopic System (HESS) telescope array. Figure 1-1 shows the location of the project in the Khomas Region.

The site coordinates are 23.245758˚S, 16.526969˚E.

The proponent: The project is led by Radboud University in the Netherlands, in collaboration with the University of Namibia (UNAM) and other partners.

The Environmental Assessment Practitioner: Resilient Environmental Solutions cc (RES) was appointed by Radboud University to undertake an environmental and social impact assessment (ESIA) for the purpose of applying for an Environmental Clearance Certificate (ECC) for the project.

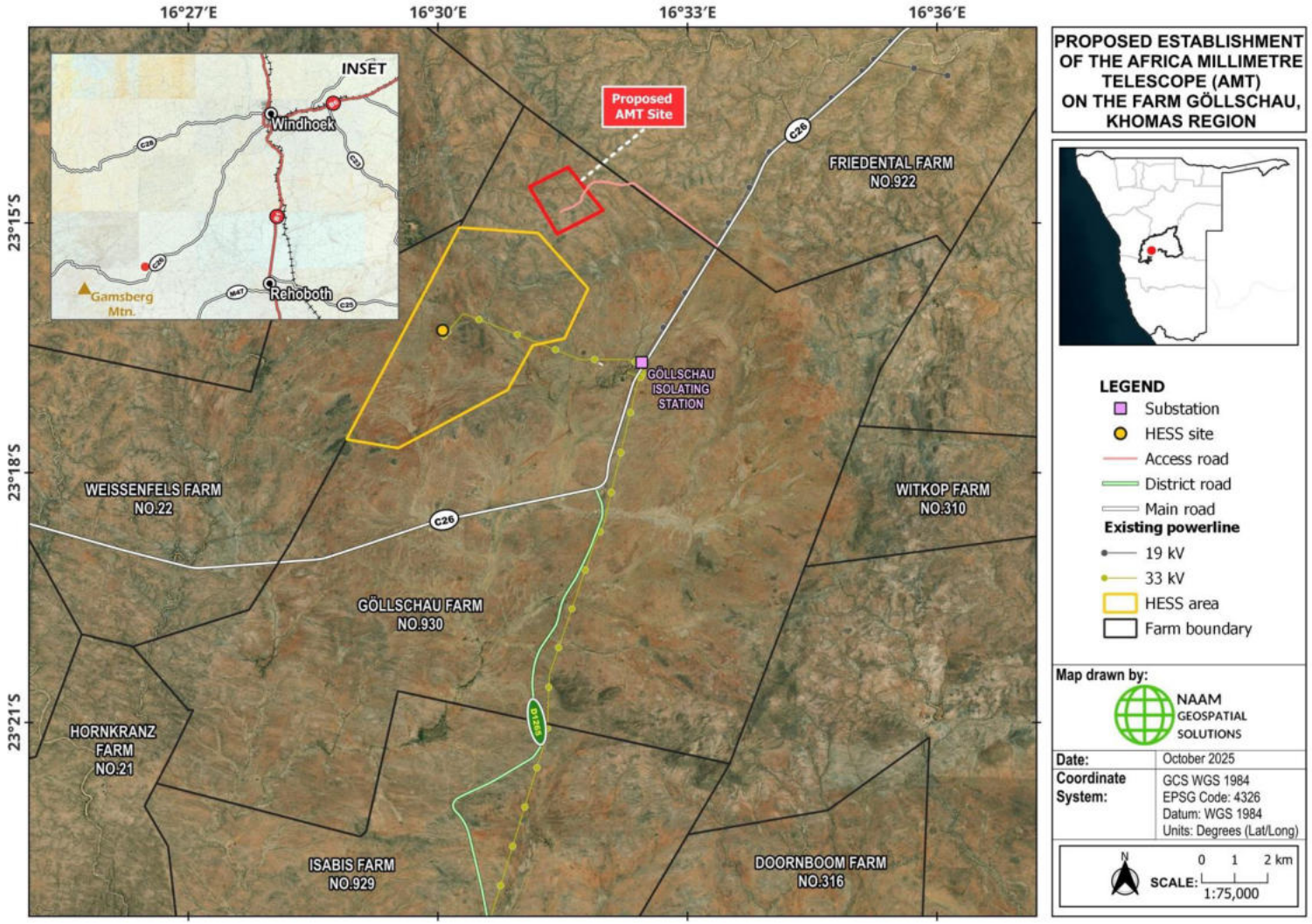

Figure 1-1: Location of the proposed AMT in the Khomas Region

1.2 Project Need and Desirability

Namibia's clear skies, low humidity and low radio-frequency interference provide exceptional observing conditions.

The AMT will:

- Enable Namibia to contribute directly to international cutting-edge, black hole research;
- Provide training and research opportunities for UNAM students and staff;
- Strengthen international scientific partnerships; and
- Support Namibia's aspirations to grow a knowledge-based and technology-driven economy.

1.3 Terms of Reference

There were no formal Terms of Reference (ToR) provided by the Proponent for this ESIA. Therefore, the ToR were taken to be the requirements of the Environmental Management Act (No. 7 of 2007) (EMA) and its Environmental Impact Assessment (EIA) Regulations (GN. No. 30 of 2012). See Chapter 4 for the Legislation Relevant to the Project.

This EA has been conducted with the aim to apply for an ECC only. Any additional permits or licenses and/or approvals that are required (see Chapter 4) for the operation of the project should be applied for by the Proponent.

1.4 Environmental Assessment Process

1.4.1 Registration of Application for Environmental Clearance Certificate

The listed activities which the proposed project entails, as stipulated in the 'List of Activities that may not be undertaken without an Environmental Clearance Certificate' (GN. No. 29 of 2012), are as follows.

1. Energy Generation, Transmission and Storage Activities. The construction of facilities for

    a) The generation of electricity

    b) the transmission and supply of electricity

2.1 The construction of facilities for waste sites, treatment of waste and disposal of waste.

8.2 The abstraction of groundwater at a volume exceeding the threshold authorised in terms of a law relating to water resources. (Note: The Water Resources Management Act 11 of 2013

and its Regulations GN 269 of 2023 specify that a permit is needed for abstraction for any use except own, private, domestic use, regardless of volume abstracted.)

10.1. Infrastructure – the construction of

(j) Masts of any material or type and of any height, including those used for telecommunication broadcasting and radio transmission,

Section 32 of the EMA requires that applications for an ECC be submitted to the relevant Competent Authority. The Competent Authority is defined as that authority having the jurisdiction to approve or permit a particular listed activity in accordance with the relevant national legislation. The Ministry of Environment, Forestry and Tourism (MEFT) was identified as the Competent Authority. Therefore, the application for an ECC was launched on the ECC portal of the MEFT, and a hard copy of the ECC application has been submitted to the Environmental Commissioner at the MEFT.

1.4.2 The Scoping Phase

After the ECC application was submitted, the scoping phase commenced, culminating in the production of a draft scoping assessment report (this report). This report includes the following:

- A description of the proposed project in Chapter 3 (including the no-action alternative);
- Legislation relevant to the proposed project (Chapter 4);
- A description of the biophysical and social conditions of the receiving environment (Chapter 5);
- A description of the public consultation process followed (Chapter 6);
- A description and significance assessment of all identified potential impacts (positive and negative) associated with the proposed project (Chapter 7); and
- Management and mitigation measures required to avoid or minimise the potential negative impacts as outlined in the Environmental Management Plan (EMP) (Appendix B).

The purpose of this draft scoping report is to provide all affected authorities and registered IAPs with information on the EA process conducted to date.

1.5 Assumptions

The following assumptions apply to this EA:

- It is assumed that the information provided by the Proponent is correct and that all necessary information has been disclosed.

- It is assumed that there will be no significant changes to the proposed project or the affected environment between the compilation of this report and implementation of the proposed project that could substantially influence findings and recommendations with respect to mitigation and management.
- It is assumed that the proponent will comply with all labour and health & safety laws and regulations. The health and safety of staff were not considered in the scoping process since these aspects are regulated by other legislation.

2 Project Team

The project team for this ESIA consists of John Pallett and Henriette Potgieter both of whom have significant experience conducting scoping and assessment level EAs in the Namibian environmental context.

2.1 John Pallett, lead practitioner

John Pallett is a certified Environmental Assessment Practitioner (EAP), with qualifications in geology (BSc) and zoology (BSc Honours). He specialises in providing environmental advice and evaluating environmental issues, particularly through Environmental Impact Assessments (EIAs) and strategic SEAs, for the benefit of managers, decision-makers and the lay public. He has been affiliated to the Southern African Association for Impact Assessment (SAIEA) since 2008, and the Desert Research Foundation of Namibia – Environmental Evaluation Associates of Namibia (DRFN-EEAN) for 14 years up to 2008. He is currently a Director of Resilient Environmental Solutions cc. His Curriculum Vitae is attached as Appendix C1.

2.2 Henriette Potgieter, practitioner

Henriette is certified Environmental Assessment Practitioner (EAP), with an M.Sc. degree in Environmental Sciences and qualifications in botany and zoology (BSc Honours). She focuses on Environmental Impact Assessments and biodiversity surveys and impact assessments and also compiles Environmental Management Plans for the eco-tourism industry. Her Curriculum Vitae is attached as Appendix C2.

3 Project Description

3.1 Project Overview

The project will comprise the construction of a new antenna (a dish) with a diameter of 14 m, prefabricated buildings and renewable energy systems, plus upgrading of the track leading to the proposed site on the Göllschau farm. The largest part of the telescope is 6.2 metres wide and weighs 40 tons; the track must be adequate to carry this load.

Current plans are that the AMT will be moved to a site on the Gamsberg plateau when the necessary conditions have been met, such as agreement on the route of the access road from the D1278 gravel road, and a significant improvement of the road to the top of the plateau. This is expected to take 5 – 10 years and is dependent on finding the necessary funds. The Göllschau site will therefore be used for only that period of time, unless funds are not found. Decommissioning of the AMT site at Göllschau is included as a component of this project, unless funds are not found in which case the antenna stays at Göllschau.

3.2 Infrastructure

Project footprint

80 x 80 meters.

Telescope

A dish with a diameter of 14 m, a 1 m high foundation and a total height of maximum 15.5 meters.

Other structures

Two prefabricated buildings accommodating control rooms, IT equipment, small meeting and teaching rooms, bedrooms and ablutions. Figure 3-1 and Figure 3-2 show two options for the layout of the site.

Site accessibility

The existing access track from the C26 onto the boundary road and from there an existing farm road to the AMT site.

Perimeter

A 2-meter-high electrified fence for security.

Electricity

A photovoltaic solar plant is being investigated. A back-up system in case of emergency will likely be either a diesel generator or grid electricity.

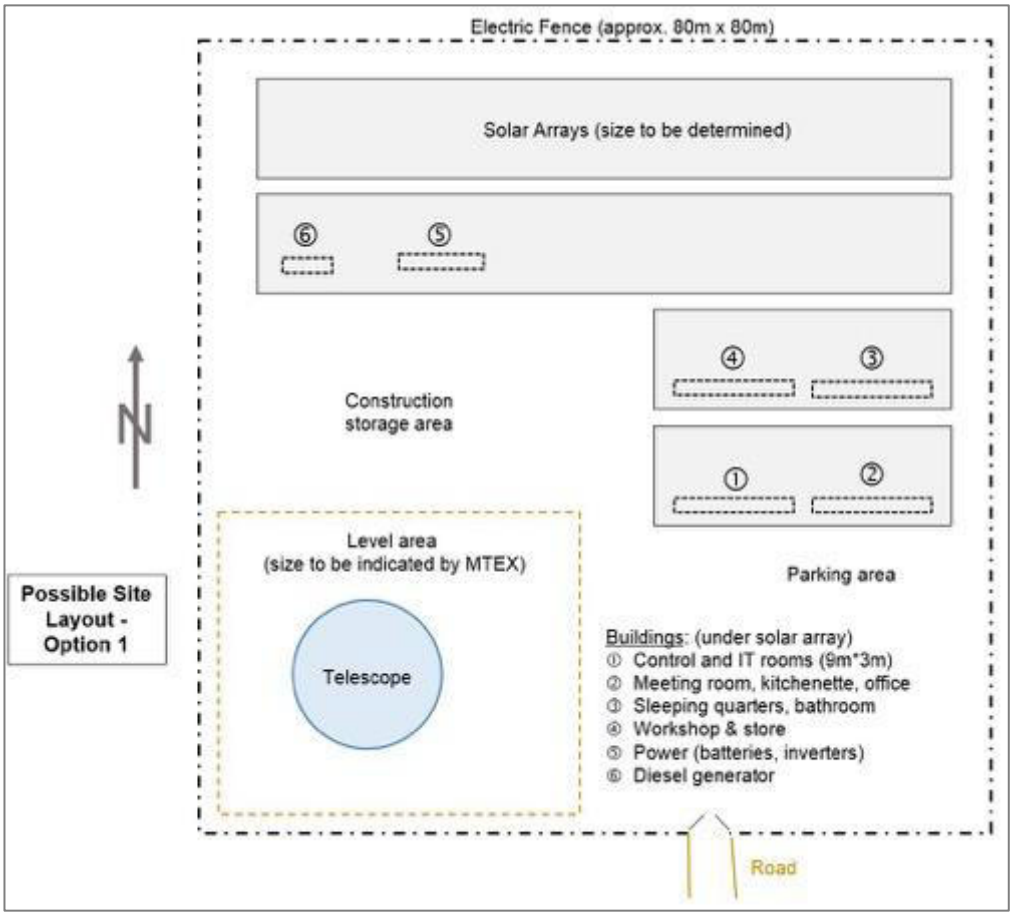

Figure 3-1 Site layout option 1

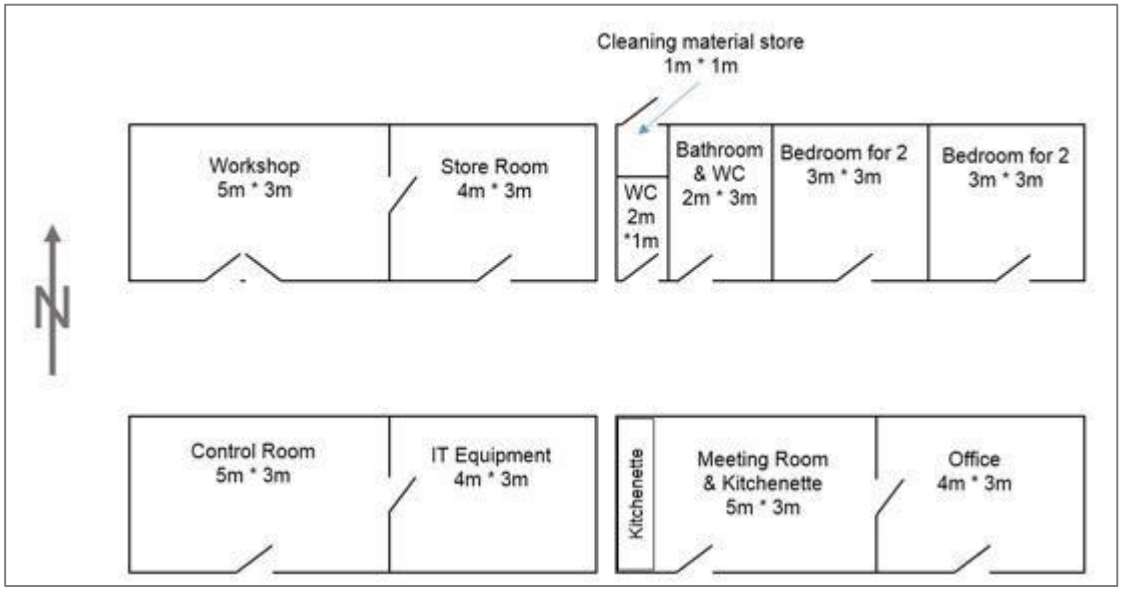

Figure 3-2 Site layout option 2

3.3 Construction Phase

3.3.1 Workforce and Duration

Construction is expected to take 15 months in total. Civil works (earthworks, foundations and buildings) will be undertaken by a workforce of approximately 10 people for about three months. Telescope assembly will follow, and is anticipated to take 12 months. It will be undertaken by a team of about four specialists housed either in a nearby guest house or on-site in the prefabricated buildings.

3.3.2 Services and Utilities

Road access

The existing road from the C26 along the farm boundary, and from there to the AMT site will be upgraded to allow the transport of abnormal loads (largest component is approximately 6.2 m wide and weighs 40 tonnes).

Water supply

The local boreholes do not have the capacity to supply construction activities and the engineering firm will source water in Windhoek and bring pre-mixed concrete to the site. There will obviously be some daily use of water, which is not expected to exceed 10 m^3/month. This will be supplied to existing tanks close to the construction site, sourced from an existing borehole on Göllschau or brought from Windhoek.

Fuel supply

A small amount of fuel (for backup generators) is anticipated to be stored either in a secure mobile storage tank or in a stationary tank on an impermeable bunded surface on-site.

Electricity

Electricity will be provided by generators supplied by the contractor.

Sewerage and sanitation

Portable toilets will be supplied by the contractor, for use until the permanent sanitation system is established. The portable toilets will be removed upon completion of the construction phase.

A standard septic tank system will be installed on site, with a French drain and soak-away for excess wastewater. This will be a standardised system to cope with the expected maximum occupancy levels of the accommodation.

Solid waste management

Solid waste will be collected on site and stored securely as appropriate for the type of waste, e.g. domestic waste in a wind- and animal-proof enclosure. All waste will be removed from the site and from the farm and disposed at an appropriate, registered landfill facility.

3.4 Operational Phase

3.4.1 Workforce

The AMT does not require continuous human presence for its operation. No-one will live on site permanently, except possibly a person to act as security in the capacity of a deterrent. The AMT does not require continuous human presence for its operation, and only during joint observations in the EHT campaigns, during periods of maintenance, and special observations will there be specialists on site.

3.4.2 Services and Utilities

Water

Water for human consumption at a domestic scale will be provided by the farm owner. Water supply will be needed only during those occasions when people stay at the AMT accommodation, such as during Event Horizon periods. Estimated consumption will be 10 m^3/month.

Sewerage and sanitation

The septic tank system installed during construction will handle all sewage and waste water.

Solid waste

Waste will be kept in a secure location on site and removed from the farm in accordance with a schedule approved by the landowner.

Fuel

No fuel will be stored on site.

Electricity

A photovoltaic (PV) and battery system with generator for emergency situations.

3.5 Decommissioning Phase

During decommissioning the telescope will be dismantled, prefabricated buildings removed, and the site rehabilitated. Disturbed areas will be reprofiled, and stored topsoil replaced and revegetated. A rehabilitation specialist will be engaged to draw up a rehabilitation plan in cooperation with the proponent, the engineers and the landowner. The objective of the rehabilitation plan will be to return the site to a condition as close as possible to its pre-project state or a state that suits the landowner for their ongoing use of the land.

There are two possible stages in the project lifespan when decommissioning could take place, but the activities, risks, impacts and mitigation measures at the Göllschau site are identical for both scenarios.

3.5.1 Move AMT to Gamsberg

The target scenario is that funds are found in the next 5-10 years for access to Gamsberg (new road). The AMT will then be moved from Göllschau during its operational life, and decommissioning will take place at Göllschau.

3.5.2 AMT remains at Göllschau

The second scenario is if the new road to Gamsberg does not materialize. The telescope will remain at Göllschau for its entire operational life, targeted to be 30 years, and be decommissioned at Göllschau at the end of its life.

3.6 Need and desirability of the project

Alternative location

Initially the telescope was planned for the Gamsberg plateau, being the most ideal place in Namibia for such a telescope. However, budget and timing constraints make that impractical at the moment. Göllschau farm, which presently hosts the HESS telescope, is an established astronomy research site and is a suitable location for the AMT.

No-go option

Advantages of the project include strong scientific and educational benefits, capacity-building for Namibian researchers and students, enhanced international collaboration, and local economic opportunities during construction and maintenance. The project will further consolidate Namibia’s profile as an astronomy hub.

Due to the very small physical footprint and the relatively low ecological sensitivity of the site, biophysical impacts are expected to be of low significance, if mitigation measures are implemented, and the no-go option was discarded.

Based on the above, the “no-go” alternative is not favourable to the international academic and social environment.

Electricity options

Two options were considered:

1) A photovoltaic (PV) and battery system with generator for emergency situations, and

2) Main grid electricity with generator for emergency situations.

The farm owner objected to the construction of a power line on his land. The PV system was chosen because it is renewable energy and the telescope is designed to function fully on the battery bank that is part of the solar PV system.

4 Legislation Relevant to the Project

4.1 National Legislative Requirements

The legal framework for EA in Namibia and national sectoral legislation pertaining to various environmental aspects are listed in Table 4-1 below.

Table 4-1: Legislation applicable to the project

Statute	Provisions	Project Implications
Environmental Assessment Legal Framework		
The Namibian Constitution (1990)	Article 95 (l) states that "*the State shall actively promote and maintain the welfare of the people by adopting, inter alia, policies aimed at… maintenance of ecosystems, essential ecological processes and biological diversity of Namibia and utilization of natural resources on a sustainable basis"*	The project should support the provisions of the Namibian Constitution with respect to ecosystems, biological diversity, and natural resources.
Environmental Management Act (No 7 of 2007)	Section 3(2) of the EMA provides a set of principles that give effect to the provisions of the Namibian Constitution for integrated environmental management. Section 27(3) stipulates that no party, whether private or governmental, can conduct a listed activity without an ECC obtained from the Environmental Commissioner. Section 40(1) stipulates that an ECC remains valid for a period not exceeding three years, subject to cancellation or suspension.	- The project should adhere to the principles provided in the EMA. - An ECC should be obtained for the proposed project. - The Proponent should renew the ECC every three years.
National Sectoral Legislation (Including Approvals/ Permits)		

Statute	Provisions	Project Implications
Water Resources Management Act No. 11 of 2013 and its 2023 Regulations	Provides for the management, development, protection, conservation, and use of water resources.	- The Proponent should prevent any potential pollution of groundwater. - Water should be used in a sustainable way. - Water abstraction and use should be done in a responsible and sustainable manner and compliant with any permit/license requirements of the Department of Water Affairs.
Forestry Act (No. 12 of 2001)	Part IV of this Act provides for the general protection of the environment. Permits are required for the removal of protected plant species.	- Harvesting Permits should be obtained if there will be any removal of or damage to protected plant species (identified in Annexure 2) - A bush clearing permit should be obtained for clearing areas larger than 15 ha.
Nature Conservation Ordinance No. 4 of 1975 (as amended)	Makes provision for the protection of indigenous flora and fauna. Permits are required for the removal of protected plants species.	- A permit should be obtained for picking or transporting any protected plant species (identified in Schedule 9), but the permit is waived if this is for any development which necessitates the removal of vegetation. i.e. no permit is required.
Soil Conservation Act No. 76 of 1969	Provides for the prevention and combating of soil erosion; conservation, improvement and	- Any earthmoving should be done so that soil erosion on slopes is not exacerbated.

Statute	Provisions	Project Implications
	manner of use of soil and vegetation, and protection of water sources.	
Public Health Act No. 36 of 1919 (as amended)	Provides for the prevention of pollution of public water supplies. Section 119 of this Act prohibits the existence of a 'nuisance' on any land owned or occupied by any person.	- A general obligation not to pollute the water bodies in the area. - Care should be taken to limit dust and noise pollution.
National Heritage Act (Act 27 of 2004)	Provides for the protection of cultural and archaeological sites.	- Any protected heritage resources that are discovered on site need to be reported immediately to the National Heritage Council (NHC), and they require a permit from the NHC before they may be relocated or removed.
The Road Traffic and Transport Act (No. 22 of 1999)	The Act provides for the establishment of the Transportation Commission of Namibia; for the control of traffic on public roads, the licensing of drivers, the registration and licensing of vehicles, the control and regulation of road transport across Namibia's borders; and for matters incidental thereto.	- Should the Proponent wish to undertake activities involving road transportation or access onto existing roads, the relevant permits will be required.

4.2 International Treaties and Conventions

The international treaties and conventions applicable to the project are listed in Table 4-2.

Table 4-2: International Treaties and Conventions applicable to the Project

STATUTE	PROVISIONS	PROJECT IMPLICATIONS
The United Nations Convention to Combat	Addresses land degradation in arid regions with the purpose to contribute to	Activities should not be such that they contribute to desertification.

STATUTE	PROVISIONS	PROJECT IMPLICATIONS
Desertification (UNCCD)	the conservation of biodiversity and the mitigation of climate change.	
Convention on Biological Diversity 1992	Regulate or manage biological resources important for the conservation of biological diversity whether within or outside protected areas, with a view to ensuring their conservation and sustainable use. Promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings.	Removal of vegetation cover and destruction of natural habitats should be avoided and, where this is not possible, minimised.
Square Kilometre Array (SKA) partnership context	Though not a treaty, Namibia's engagement with radio astronomy research frameworks influences considerations about radio quietness and electromagnetic protection.	

5 Description of the Receiving Environment

5.1 Biophysical Environment

5.1.1 Climate

Göllschau lies within the central highlands of Namibia, characterised by semi-arid conditions with variable seasonal rainfall. Long-term regional datasets show average annual rainfall between 250–300 mm (

Figure 5-1), concentrated from December to March[1]. Interannual variability is high, consistent with national climate assessments for the Khomas Region (Figure 5-2).

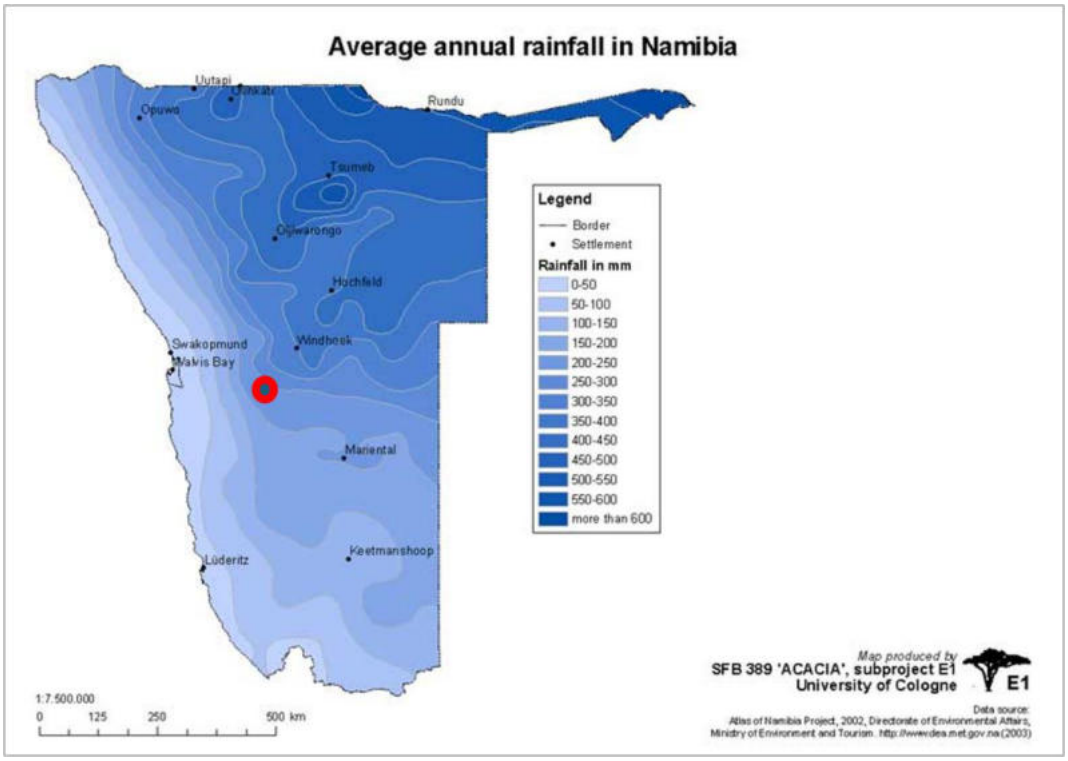

Figure 5-1: Average annual rainfall in Namibia (mm). The red dot indicates approximate position of Göllschau. Source: Atlas of Namibia Project (2002).

[1] https://www.worldweatheronline.com/windhoek-weather-averages/windhoek/na.aspx

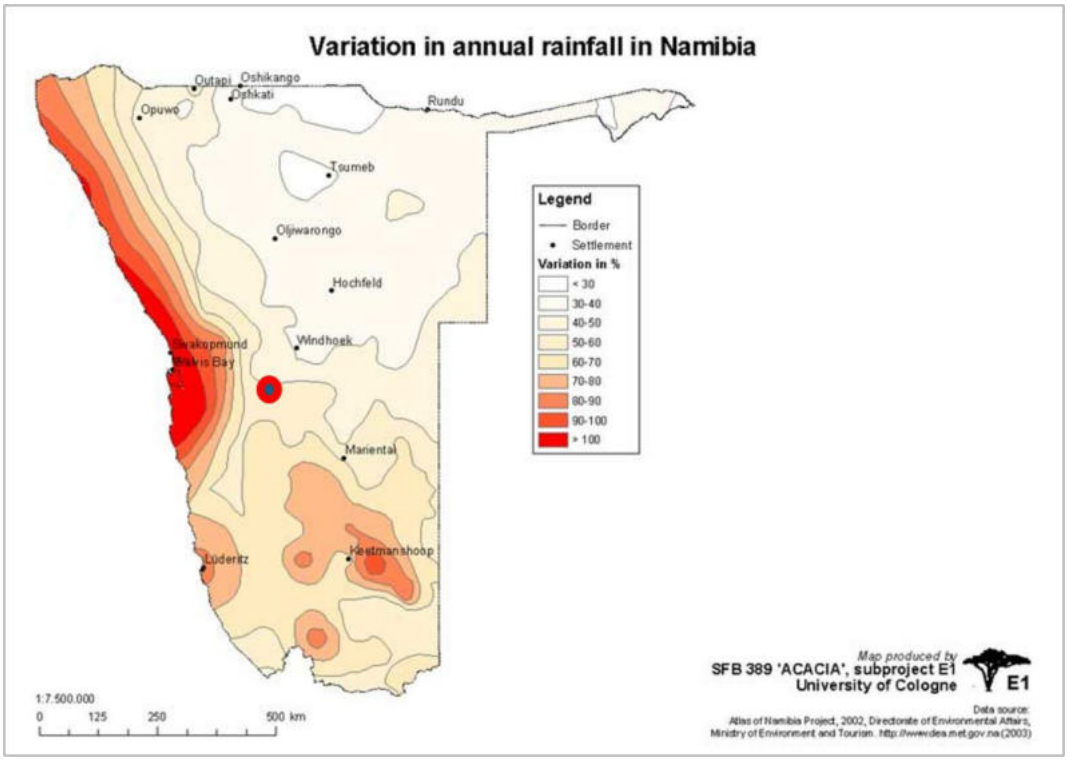

Figure 5-2: Variation in annual rainfall in Namibia (%). The red dot indicates approximate position of Göllschau. Source: Atlas of Namibia Project (2002).

Temperature regimes follow a typical Khomas Hochland profile with hot summers and cool, dry winters (Figure 5-3). Average maximum summer temperatures in October to December, the hottest months of the year, is 30°C, and summer maximum temperatures occasionally exceed 35°C. The coldest month of the year based on average minimum temperatures is July with 7°C, and minimum temperatures in June to August get a few degrees below zero with occurrence of frost[2]. The elevated plateau and relatively stable atmospheric conditions are advantageous for astronomical observations, providing low humidity and reduced atmospheric turbulence, consistent with the identification of Göllschau as an optimal astronomy site.

[2] https://www.worldweatheronline.com/na.aspx

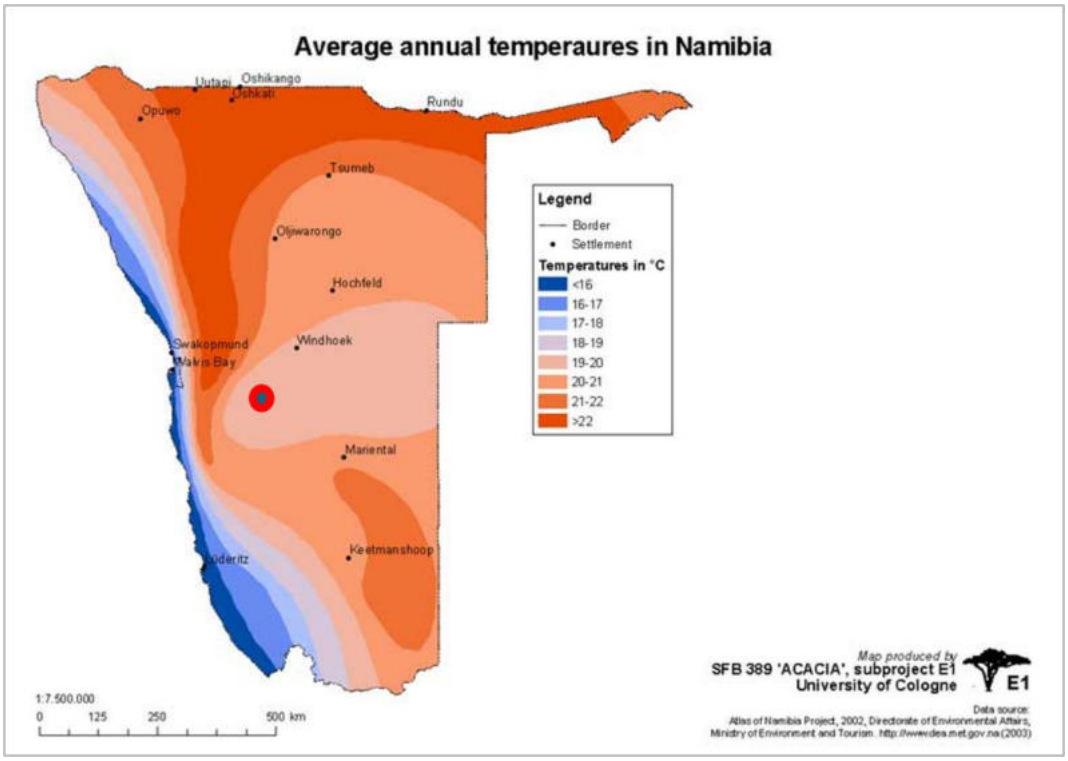

Figure 5-3: Average annual temperatures in Namibia (°C). The red dot indicates approximate position of Göllschau. Source: Atlas of Namibia Project (2002).

Winds

The central high plateau of Namibia experiences pronounced diurnal heating, strong afternoon turbulence, and relatively calm nighttime conditions. Wind speeds in the Khomas Region generally range between 3 and 25 km/h, and typically follow a daily cycle, with calmer conditions during the night when the land surface cools, and less vertical air movement occurs. Daily variation trends are shown in the table below.

Table 5-1: Summary for morning, afternoon and evening winds in the Khomas Region.

Local Time	Typical Speed (km/h)	Dominant Direction	Notes
08h00	8–13 km/h	NNE → ESE	Gentle, consistent morning flow; calm periods more common in winter.
14h00	15–25 km/h	ENE → SE	Strongest winds of the day due to convective mixing; dust & dispersion peak.

Local Time	Typical Speed (km/h)	Dominant Direction	Notes
20h00	5–10 km/h	ESE → SE or calm	Evening stabilisation reduces speeds; directions more variable.

The dominant wind directions are from the east to south-east, particularly in winter, with secondary morning components from the north-east. In the winter months (May to August) there is a more easterly airflow. Wind direction in summer tends to be more variable, with occasional shifts from the north and west, especially in the afternoons.

The windier time of the year is generally from May to early December, with peak wind speeds typically observed from August to October. The calmer period lasts from December through May. However, thunderstorms – a summer phenomenon - can create short-lived powerful gusts.

5.1.2 Landscape and Topography

The proposed AMT site is located on broken highland topography dominated by low ridges, shallow valleys, and rocky outcrops. The locality map (Figure 1-1) shows the site positioned north of the existing HESS facility – this is on elevated terrain but sited low enough to not be visible from the HESS site and the C26 road. This natural screening is desired to minimise visual disturbance and avoid unwanted visitors, as highlighted by the landowner during public consultation.

Surrounding landforms consist of schistose ridges shaped by differential erosion. Slopes are generally moderate, with localised small steep rock faces. These natural features provide opportunities to discreetly position infrastructure and the access road from the boundary to the site, while also influencing drainage and erosion-control factors.

The altitude of the AMT site is approximately 1,860 m.a.s.l.

Figure 5-4: View towards the northwest at the approximate site of the AMT, showing general topography and stony regolith soil, and vegetation of grass cover with scattered shrubs and trees.

5.1.3 Geology and Soil

Geologically the AMT site lies in the Damara Supergroup (Figure 5-5), dominated by schist, marble and quartzite rocks. These have been subjected to erosion since the breakup of Gondwana, resulting in the rugged and undulating landscape that characterizes the Khomas Hochland. Where the schists are interrupted by marble, quartzite and occasional quartz veins, these harder rocks stand out as positive relief.

The site is close to the contact with granites of the Gamsberg Suite, lying to the southwest and west of the AMT site.

The abundance of quartz stones and fragments in the schists produces very stony and generally shallow, weekly developed soil, called regolith. The soil depth is typically <30 cm, with low organic content. These soils are highly susceptible to erosion if disturbed.

Local experience from the existing HESS operations suggests that careful topsoil management during construction will be necessary for effective rehabilitation, a point reinforced by the landowner during the 18 November 2025 public meeting

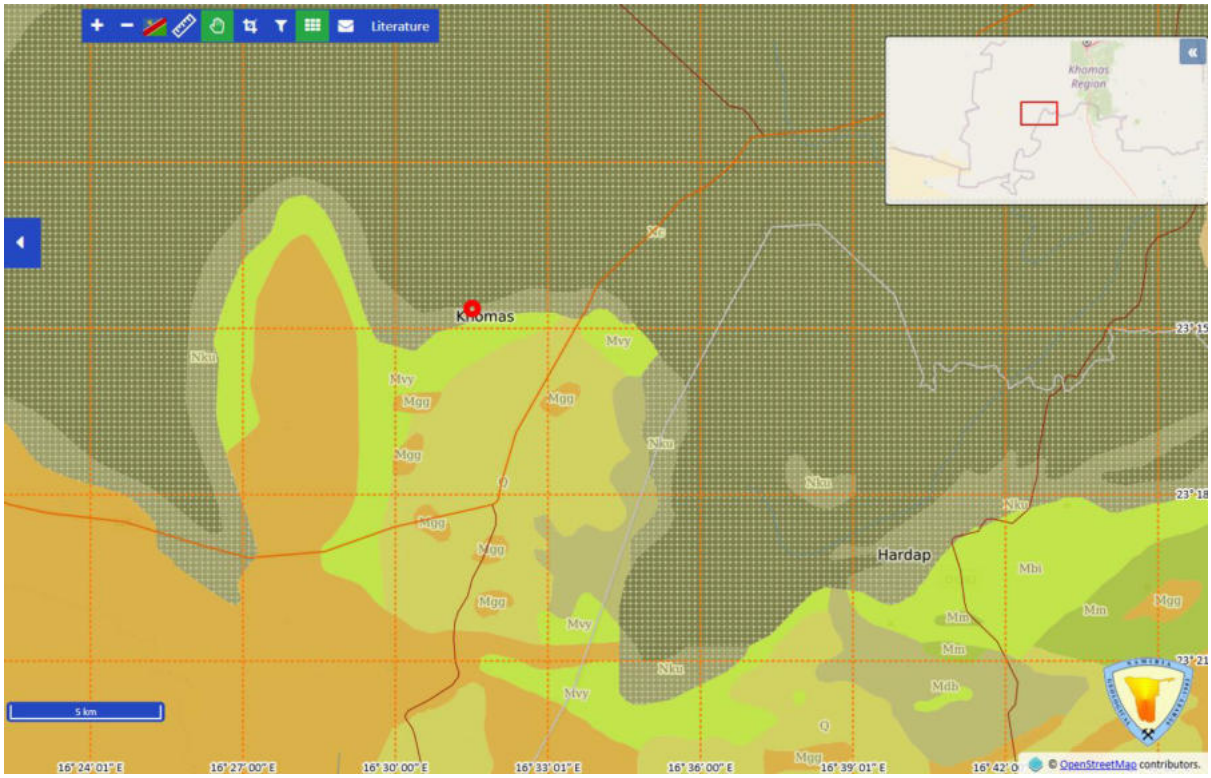

Figure 5-5: Geology of the Göllschau area; red dot indicates approximate position of the AMT site.

Legend: Nku, Nc and Mvy – Damara Supergroup rocks, comprising schist, marble, quartzite rocks. Mgg – Gamsberg Suite granites. [3]

5.1.4 Biodiversity

5.1.4.1 Flora

This part of Namibia lies at the boundary between the Nama Karoo and the Acacia Tree-and-shrub Savanna biomes. Vegetation comprises species characteristic of Dwarf Shrub Savanna and Highland Shrubland. In brief, the area comprises mainly low shrubs and grass, with scattered trees, and greater concentration of trees in the valleys and patches of relatively deeper soil. Rocky outcrops in the wider area may locally support a greater abundance of plants and animals, but there are no such outcrops in the AMT footprint itself (Figure 5-7).

[3] EDN Geological and Mineral Information System Namibia; https://www.mme.gov.na/edn/

Plant species recorded in the area on the NBRI database are listed in Appendix E, with notes on endemicity and threatened status. There are no species which have strongly restricted ranges that overlap the AMT site.

Figure 5-6: View west and southwest towards Gamsberg, from the approximate AMT site. Vegetation comprises grasses with scattered shrubs and trees.

- The vegetation community existing on the site of the AMT and immediate surrounds is typical of the Highland Acacia Savanna that covers most of the Khomas Hochland, an area greater than 18,000 km^2.
- On the AMT site and surrounds within a 1 km radius of the site, there is no specialised topography such as a deep gorge or rocky outcrop that might support plant or animal species specific to that micro-habitat.
- Plant species lists for Quarter Degree Squares 2316 BA and BC obtained from the NBRI contained 203 species altogether. Of these species, 17 were listed as endemic and 13 as near-endemic to Namibia. The list included no species with a high level of range-restrictedness.

- For species restricted to the Khomas Hochland, the loss of habitat would represent less than 10^{-3} percent of their total distribution and would not have a significant impact on any species populations. The same holds for the near-endemic species, for which the potential loss of habitat is an even smaller proportion of their total range.

5.1.4.2 Fauna

Farm Göllschau is run as a commercial cattle farm, and there is free-roaming wildlife on this and neighbouring farms. Specific mammals, birds and reptiles occurring in the area are listed in Appendix E, and briefly described below.

The footprint of the proposed AMT (only 8 ha) and the associated irregular human activities are so small that there is no threat to any priority mammal, bird or reptile species in the area.

Mammals

There is medium mammal diversity in the Khomas Hochland area, including farm Göllschau, with at least 44 species known or expected to occur. This includes the following groups:

- Shrews, elephant shrews, rodents, hare, rabbit, dassie – 14 species
- Baboon – 1 species
- Pangolin, Aardvark – 2 species
- Bats – 3 species
- Ungulates – 9 species
- Carnivores – 15 species

The full species list is shown in Annex E2. Mammal species of conservation priority (following Griffin & Coetzee (2005), IUCN and CITES listings, and NCE *et al.* 2022) are listed in the **Error! Reference source not found.**.

Table 5-2. Conservation priority species of mammals expected to occur on Farm Göllschau. Red Data status follows IUCN (2025) listings, unless the Namibian listing (NCE et al. 2022) is a higher category. CITES status from CITES (2025).

Common name	*Scientific name*	Endemic to Namibia	Red Data and CITES status
Namibian pygmy rock mouse	*Petromyscus collinus*	X	Least Concern
Chacma baboon	*Papio ursinus*		Least Concern CITES Appendix 2
Pangolin	*Manis temminckii*		Vulnerable

Common name	*Scientific name*	Endemic to Namibia	Red Data and CITES status
			CITES Appendix 2
Hartmann's mountain zebra	*Equus zebra hartmannae*	Near-Endemic	Vulnerable CITES Appendix 2
African wild cat	*Felis lybica*		Least Concern CITES Appendix II
Caracal	*Caracal caracal*		Least Concern CITES Appendix II
Leopard	*Panthera pardus*		Vulnerable CITES Appendix I
Cheetah	*Acinonyx jubatus*		Vulnerable CITES Appendix I
Brown hyaena	*Parahyaena brunnea*		Near-Threatened CITES Appendix I
Spotted hyaena	*Crocuta crocuta*		Least Concern by IUCN, but Vulnerable by NCE 2022
Bat-eared fox	*Otocyon megalotis*		Least Concern CITES Appendix II

Baboons occur throughout the Khomas Hochland. Their curiosity and destructive behaviour needs to be taken into account with regard to the safety and robustness of the telescope and associated apparatus such as solar power equipment. Water infrastructure such as tanks and pipes, and solar equipment, will also be vulnerable to their attentions.

Pangolin are expected to occur in the area but are naturally rare.

Carnivores surprisingly are the group with the highest diversity at Göllschau, including species which are probably resident in the area even if only rarely seen (e.g. leopard, aardwolf, slender mongoose) to others which wander widely over large distances and probably occur in the project area only sporadically or as vagrants (e.g. cheetah, brown hyena). The project will lead to fragmentation of habitat for these carnivores and possibly noise and physical

disturbance which will deter them from the area, with a small but insignificant negative impact on their populations.

Birds

A total of 104 bird species are recorded from the Project Area in the SABAP2[4] database. Seven species in the bird list are classified as Red Data species and listed in the table below. A further seven species are migrants in Namibia, for which the disturbance or small loss of habitat is insignificant.

Table 5-3. Red data bird species with ranges that overlap the project area.

Bird species	Red Data status
Kori Bustard	Endangered
Maccoa Duck	Near-Threatened
Tawny Eagle	Endangered
Verreaux's Eagle	Near-Threatened
Lappet-faced Vulture	Endangered
White-backed Vulture	Critically Endangered
Secretarybird	Vulnerable

AMT activities are unlikely to add to the threats to any of the threatened or migrant species; nevertheless any disturbance to birds, roosts and nesting sites is prohibited, and the management measures as set out in the EMP must be implemented.

Reptiles and amphibians

The reptile diversity in the Göllschau area is reasonably high, with 46 species altogether, comprising the following groups:

- Tortoises and terrapins – 3 species
- Geckos, lizards, monitors – 25 species
- Snakes – 18 species

[4] Southern African Bird Atlas Project

- Frogs – 5 species

The species classified as endemic to Namibia (at least 75% of their distribution is in Namibia) or carrying IUCN-based threatened status or CITES status, are listed in the table below.

Table 5-4. Reptile conservation priority species likely to occur in the AMT project area. Namibian and IUCN and CITES status from Becker (2021) and Namibia Biodiversity Database (Irish 2025).

Common name	*Scientific name*	Endemic to Namibia	IUCN and CITES status
Leopard tortoise	*Geochelone pardalis*		Least Concern CITES Appendix II.
Serrated tortoise	*Psammobates oculiferus*		Near Threatened CITES[5] Appendix II.
Namibian dwarf burrowing skink	*Scelotes capensis*	X	Least Concern
Namibian snake-eyed skink	*Panaspis namaquae*	X	Least Concern
Western sand lizard	*Pedioplanis undata*	X; range < 50,000 km^2	Least Concern
Namibian sand lizard	*Pedioplanis inornata*	X	Least Concern
Namibian girdled lizard	*Karusasaurus jordani*	X	Least Concern CITES Appendix II
White-throated Monitor Lizard, or Veld Leguaan	*Varanus albigularis*		Not assessed CITES Appendix II
Namibian worm snake	*Namibiana occidentalis*	X	Least Concern
Namibian dwarf python	*Python anchietae*	X	Least Concern CITES Appendix II

Common name	*Scientific name*	Endemic to Namibia	IUCN and CITES status
Southern African python	*Python natalensis*		Not assessed CITES Appendix II

Reptiles and frogs are affected by human activities through mortality during road building and site clearing activities, loss of habitat and direct disturbance. This is particularly the case for snakes and large lizards such as monitor lizards (leguaans) which are usually – unnecessarily – killed on sight.

The most important conservation priority reptiles are tortoises, with the Serrated (Kalahari Tent) Tortoise classified as Near Threatened. Tortoises are easily picked up when encountered, and either traded illegally, or kept as pets (where they invariably die early), or are cooked and eaten. It is quite possible that tortoises will be encountered on site, so site managers should be vigilant for this. Taking tortoises from the area must be strictly prohibited. Individual tortoises and other reptiles that are found during the construction works should be relocated to a distant (~2 km away from the project area), undisturbed part of the farm.

Another notable species is the White-throated Monitor (also called Veld Leguaan) which is also usually killed on sight because it looks 'dangerous', or it may be captured and removed for its value in the illegal pet trade. This species and the tortoises are all listed on CITES Appendix II (i.e. trade in them is illegal, unless specific permits are obtained).

Eight species of reptiles that are listed to occur at Göllschau are endemic to Namibia, but only one of them has a distribution range less than 50,000 km^2. The potential loss of habitat for this species, and for all the Namibian endemics, is insignificant.

There are five species of frogs likely to occur in the project area, and all of them are categorised as Least Concern. Frogs are unexpected and rare in this semi-arid habitat, but those that are recorded for the area spend most of the time buried underground and emerge only for short periods to feed and breed when there is rain that collects in surface puddles or rock pools. None of the frog species are likely to be influenced in any significant way by the project.

Invertebrates

Invertebrates such as insects, spiders, scorpions and myriapods (centipedes and millipedes) will be affected within the area of AMT activities. These animals are expected to exist in populations that are widespread across the similar habitat and climate regime of the Khomas Hochland and surrounds. Therefore, the direct loss of individuals of these species is considered insignificant in the context of their wider populations.

Summary of Biodiversity

The absence of any micro-habitat that might support plant or animal species specific to that habitat, and the absence of any tightly range-restricted species in the biodiversity lists for plants and vertebrate animals recorded and expected in the project area, lead to the conclusion that the project will not have a significant negative impact on any species occurring in the footprint and immediate surrounds.

Project activities that might negatively affect plants and animals, such as clearing of the site and generation of dust along the access road, will have a very localised negative impact. Prevention and mitigation recommendations to minimise direct and indirect damage to plants, animals and the ecosystem are included in Section 7 and the EMP.

5.2 Socio-Economic Environment

5.2.1 Regional Demographic Overview

The Khomas Region is Namibia's most populous region, though rural areas such as Göllschau host extremely low population densities (<1 person/km²). Economic activity in the area is dominated by livestock farming, often complemented with tourism such as guest farms, hunting and overnight accommodation, and scientific research associated with HESS.

5.2.2 Constituency

Göllschau lies within the Windhoek Rural Constituency, which features dispersed freehold farms, private reserves, and small scattered settlements. According to NSA data (2014), the main income sources in the constituency include wages, farming, and small-scale enterprises. Scientific initiatives provide a niche but growing contribution.

5.2.3 Land Use

The dominant land use is commercial livestock farming. No communal land or commercial conservancies occur in the immediate surroundings.

5.2.4 Archaeology and Heritage Resources

An archaeological assessment of the project was conducted in accordance with the National Heritage Act (Appendix F). No known heritage sites occur within the proposed AMT footprint. There are grave sites of cultural significance, and a rock shelter with rock paintings from the archeological record, approximately 3-5 km south of the AMT site. They will not be affected at all by the AMT project.

Should any artefacts or sites be discovered on site during excavation, then the National Heritage Council must be notified immediately according to the protocol given in the EMP.

6 Public Consultation

Public consultation is an important aspect of an Environmental Assessment. Consultation with interested and affected parties (IAPs), both state and non-state, help to identify impacts that the project may have on the receiving environment, and enables transparent decision-making.

This chapter describes the details of the public consultation process that was followed and the IAPs who were notified of the ESIA being undertaken. It also includes the main issues and concerns raised during the public consultation process.

6.1 First Round of Public Consultation

The engagement with IAPs as part of the first round of public consultation ran from 20 October to 5 December 2025. During the first round of consultation, IAPs (including authorities) were given an opportunity to register and submit comments on the proposed project.

6.1.1 Public Consultation Activities

In order to ensure effective and adequate IAP involvement, the following activities were undertaken:

- A total of 62 public stakeholders were registered as IAPs. The list (Appendix D1) included representatives from national, regional and local government institutions, traditional authorities, non-governmental organisations (NGOs) and some members of the public.
- Public notices announcing the commencement of the ESIA and an invitation to register as an IAP were placed in newspapers, namely *The Namibian* (dated 22/10/2025 and 5/11/2025) and in *Die Republikein, Algemeine Zeitung* and *The Sun* (24 and 31/10/2025) (Appendix D2)
- A Background Information Document (BID, Appendix D3) was compiled and shared via email with all registered IAPs, from 30/10/205 to 3/12/2025.
- Printed A2 posters were pasted at the gates of the Göllschau farm on 17/11/2025. These posters contained information on the project and contact details for the public to submit comments, concerns and issues about the proposed project as part of the EA. The poster is attached as Appendix D4.
- A public meeting was held at Farm Göllschau on Tues 18 November 2025. The attendance register is available in Appendix D5a.
- A second public meeting, addressing both the background science to the project and the ESIA, was held in Windhoek at the Namibian Scientific Society on Thurs 4 December. The attendance register is available in Appendix D5b.

6.2 Outcome of First Round of Public Consultation

Comments raised by IAPs during the consultation period are shown in the Table below.

6.3 Outcome of the Second Round of Public Consultation

The draft scoping report, a draft EMP and the associated appendices were circulated to the registered IAPs for final review and comments. The final review period ran from 17 Feb to 6 March 2026.

The only feedback pointed out a small omission in the EMP; this was corrected. No substantive issues were raised.

This version of the scoping report is now the Final Draft.

Table 6-1. Comment and Response register

PERSON	COMMENT	RESPONSE
John telephone conversation 13 Nov.		
Christo Loubser, owner of neighbouring farm Groot Geduld (Friedental)	He intends to build on a high point on his farm, and this should be considered as a factor for placement of the AMT. He can see HESS from that point and will be able to see the AMT. He's not worried about the impact on his own view, but wondered if the night lights from his high point would interfere with the AMT.	
	He wants the proponent to consider the use of precast building at the AMT site. He offered assistance from Tutungeni, manufacturer of precast materials in Windhoek.	Relayed to proponent
	He is willing to discuss use of water from his farm. In the past there was a ~15 km pipeline from an old borehole of his to Göllschau.	Relayed to proponent and Joachim Krantz
	When HESS was constructed, they used rock material from his farm. That offer still stands.	Relayed to proponent
PUBLIC MEETING 18 NOV 2025. FARM GÖLLSCHAU		
PARTICIPANTS:	Representing Proponent and Consulting Engineer: Zandre Duvenhage, Richard Laborn	
	Representing RES: John Pallett, Hoens Potgieter	
	Landowner: Joachim Crantz	
	IAPs: Tony Hanke, Frikkie van Greunen, Clyde Foster, Uschi Kirchner, Maaike Pirek.	
Zandré Duvenhage (Radboud University)	Antenna and its base will be 15.2 m high but this is not a final measurement.	
	During short periods in year people will be on site to ensure the smooth operation of the scope during horizon events, rest of time not although someone may live on site for maintenance. Observations are done by computer, HESS observations are human.	
	Will not be a tourist site, currently no visitor's centre is planned. Will accept special interest groups to visit the site on request and with prior arrangement.	
	Horizon view is also important, not only view from road. Proponent has to make sure that the dish can link to the other dishes in the sytem as the earth turns.	

PERSON	COMMENT	RESPONSE
Joachim Crantz (owner of farm Göllschau)	2 farms use border road: Weissenfels North and Friedental.	
Richard Laborn (Lithon Consulting Engineer)	Better to start construction after the rainy season to avoid delays.	
Zandré	Assembling the scope after the site preparation phase will take approx 12 months and during that time accommodation for 4 people will be arranged, preferrably in the guest house, otherwise in the project site facilities.	
Richard	Concrete will be mixed in Whk and hauled to site. Water, sand, gravel and quality of concrete can be controlled better in Whk.	
Joachim	There will be enough water available for the operational phase but for the construction phase it is unsure. There will also be enough water for a domestic sewerage system.	
Clyde Foster (resident on farm Göllschau)	Sewage treatment?	Richard: probably septic tanks and French drain system. Tony: that works well at HESS.
Richard	Energy: Not sure if solar is viable, the options are still under investigation.	
Joachim	If powerlines will be erected there will be impacts that concern me and that need to be assessed separately. I was under the impression energy provision would be a solar system.	John & Hoens need details of the electricity supply system so we can assess it.
	I have aesthetic concerns if the scope is visible from the main road, and I also do not want a sign up on the C26 that would attract cars and sightseers onto the farm.	Zandre: we plan to build the scope out of sight of the C26.
Uschi Kirchner (farm Hakos)	Botanical issues	John & Hoens will get advice from the NBRI about plant species of concern.
	Rehabilitation should be done after construction. Do not leave mounds of earth. If topsoil is removed, store it separately from other soil so it can be put back. Place removed soil where you can use it for road building.	John & Hoens: rehabilitation measures will be in the EMP which is a legally binding document.
Joachim	Who is responsible for managing fire risk and activities from construction camp.	Zandre: There are 2 types of obligations. 1) Contractual obligations between AMT &

PERSON	COMMENT	RESPONSE
		Joachim, and 2) statutory obligations - the EMP between AMT and MEFT. Hoens: Joachim can include the EMP in his contract with the proponent.
Tony Hanke (IAP from HESS). His verbal comments are given here. He also submitted a letter with concerns and recommendations, included verbatim in Appx D.	Indirect light reduces our efficiency massively and causes a loss of data and research time. That includes any light shining up. The project will have to reduce stray and incidental light.	
	HESS has extremely sensitive instruments that are made to work in really dark skies. Even a torch shining on our instruments will blow them. A minimum distance of 3.5 km between any light source and our instruments is needed to prevent damage. The mirror system and cameras are custom made and not quickly or easily replaceable and they can be damaged or destroyed by any direct light that shines on them, incl green laser pointers.	
	Indirect light: For the time a vehicle drives up the hill (from the border track to the site) there is a "light dome" that will interfere with HESS.	Note: "Border track" refers to the road from the C26 along the border between Göllschau and Friedental.
	Direct light: The access road down the hill to the scope - a car driving down will shine directly on the HESS site. This is the same road as in the previous comment, only a bit further on where the road goes downhill.	
	<u>Tony proposes the following management measures</u>	
	・Locked gates. Put in 2 gates and lock them between dusk and dawn. At the site access and just before the ridge that blocks light from reaching HESS.	Zandre: Richard and I will go to the site with Tony and Frikkie to locate the gates and road.
	・Locate the scope downhill and on the north side of the road.	

PERSON	COMMENT	RESPONSE
	・Is it possibe to investigate moving the access road so it does not run along the top of the ridge where it is at the moment. In other words, bring the road (that runs from the border track to the site) lower and behind the ridge where vehicle lights will be hidden. ・Construction activities: no traffic from 30 min after sunset until dawn. ・Only drive on dim. ・No spotlights on construction vehicles.	Joachim: no objection. Zandre: Will investigate.
Clyde	There is also astronomical activity at the Göllschau farmhouse and all the minimising of light measures are valid for me.	
PUBLIC MEETING 4 DECEMBER 2025. SCIENTIFIC SOCIETY, WINDHOEK		
AMT representatives	Marc Klein Wolt. Michael Bakkes. Zandre Duvenage.	
Marc	Move to Gamsberg in 6 years at the earliest. Getting funds for road construction is a challenge.	
Lady	What are the socio-economic benefits for Namibia	Marc: 1) Use it as a teaching tool. 2) Technology becomes outdated and new challenges arise all the time. Namibian and international companies are influenced by these changing needs to constantly push the limits of research and development, and to come up with new solutions.
Roger Swart	A comment on the geology is that the underlying geology may be different to HESS, maybe on schist, so they need to make sure their foundations are better than at HESS. If the engineers have done all the geotesting already, they would know this.	

7 Impact Assessment

The proposed project is expected to have varied impacts on the receiving socio-economic and biophysical environment. This chapter provides a description and assessment of potential impacts stemming from the project. Mitigation measures relevant to the construction and operational phase of the project as appropriate are recommended. These measures are aimed at avoiding, minimising or mitigating negative impacts while maximizing potential benefits. The significance of potential impacts without and with mitigation is provided.

7.1 Assessment Method

The identified impacts are assessed according to a synthesis of criteria required by the integrated environmental management procedure. This entails consideration of each impact's duration (time scale), extent (spatial scale), magnitude (intensity), probability, and status, in combination providing the expected significance (see Table 7-1).

Table 7-1: Criteria applied to each potential impact

Criteria	Category	Score
Nature **Identifies the type of impact.**	*Positive:* The activity will have an environmental (social or biophysical) benefit. *Neutral:* The activity will have no effect. *Negative:* The activity will have an environmentally (social or biophysical) harmful effect.	
Extent **Describes the area affected by the Impact.**	*Site Specific:* Extending only as far as the activity itself (on-site) *Small:* Restricted to the site's immediate environment within 1 km of the site (limited) *Medium:* Within 20 km of the site *Large:* Approx 20 – 100 km of the site *Widespread:* Regional, national, international	1 2 3 4 5
Duration **Predicts the lifetime of the Impact.**	*Temporary:* < 1 year *Short-term:* 1 – 5 years *Medium term:* 5 – 15 years *Long-term:* >15 years (impact will stop after the operational or running life of the activity, either due to natural causes or by human interference)	1 2 3 4

Criteria	Category	Score
	Permanent: Impact will not end.	5
Magnitude **Describes the intensity of the Impact.**	*Very low:* Affects the environment in such a way that natural and/or social functions/processes are not affected. *Low:* Natural and/or social functions/processes are slightly altered. *Medium:* Natural and/or social functions/processes are notably altered in a modified way. *High:* Natural and/or social functions/processes are severely altered and may temporarily or permanently cease. *Very high:* Natural and/or social functions/processes are disastrously affected, with extremely harmful consequences.	1 2 3 4 5
Consequence	The average of Extent, Duration and Magnitude. = (E + D + M) / 3	0-5
Probability of Occurrence **Describes the probability of the Impact actually occurring.**	*Improbable:* Not at all likely. *Possible:* Moderate probability *Probable:* Distinct possibility. *Highly probable:* Most likely to happen. *Definite:* Impact will occur regardless of any prevention measures.	1 2 3 4 5
Significance **Describes the overall severity of the Impact, the amount of change to the affected social or biophysical environment.**	Combination of Consequence and Probability. C x P = Significance score, from 1 to 25. No significance: The impact is so tiny it is not noticeable and it is fully acceptable. It does not require any mitigation action. Low significance: The impact is of little importance, but may require some small mitigation measures to improve the overall outcome. Monitoring may be required to ensure that the impact is maintained at this level. Low-Medium: The impact is of low order and will have limited real effect. Mitigation measures are advised to bring about some improvement in the overall outcome.	 1 – 2 2.1 – 4.9 5 – 9.9

Criteria	Category	Score
	Medium: The impact is important and carries a noticeable effect. Mitigation is required to reduce the impact to acceptable levels. Medium-High: The impact is substantial and getting close to unacceptable. Mitigation measures must be implemented and/or the design of the project must be adjusted to avoid or reduce the impact. High: The impact is so high it potentially makes the project unacceptable if it is not mitigated. Without mitigation the impact is unacceptable, it is a fatal flaw to the project. Fatal flaw	10 – 14.9 15 – 19.9 20 – 23 23.1 - 25
Degree of Confidence in Predictions **Based on availability of information and specialist knowledge**	This criterion does not alter the significance, but it gives an indication whether further assessment is required, particularly if the impact is assessed with Medium to High Significance. *Unsure/Low:* Little confidence regarding information available. *Medium:* Moderate confidence regarding information available. *High:* High confidence regarding information available.	

Each impact is first assessed without any mitigations in place. The recommended mitigation measures are explained, and these will be reviewed with respect to their practicality and implementation by the Proponent and their engineering team. Then the impact is assessed again, to show the significance of the impact with the mitigation measures in place.

The above procedure is followed for negative impacts. For positive impacts the process is similar: each impact is rated against the criteria, namely extent, duration, magnitude and probability to arrive at the significance of the benefit. Then, recommendations on how to optimise or secure this benefit are given. A post-optimisation assessment against the criteria is not done, since the main focus of an ESIA is on managing the negative aspects of the project.

7.2 Key Impacts Identified

The potential impacts associated with both the construction and operations of the AMT are listed below:

Negative

- Potential light interference from the AMT, negatively affecting the HESS telescopes.
- Deterioration of the C26 road, increasing the risk of traffic accidents.
- Generation of dust along the C26 road.
- Site clearing and earth moving, increasing the risk of soil erosion.
- Disturbance to fauna, both livestock and wild animals.
- Soil and water pollution.
- Pollution from generation of waste.
- Risk of reducing local groundwater availability.
- Risk of accidents such as veld fire, vehicle accidents.
- Risk of injuries to personnel from occupational hazards.
- Risk of damage to archaeological and cultural heritage items.

Positive impacts

- International recognition
- Opportunity for raising capacity and expertise
- Opportunity for educational outreach

The following sections give a description and assessment of each potential impact expected during the construction and operational phases. Mitigation measures are presented in the tables below and in the Environmental Management Plan (Appendix B).

7.3 Negative impacts

7.3.1 Light interference from AMT onto nearby HESS site

The nearby HESS telescopes depend on an almost complete absence of artificial light to function effectively. Any night light emanating from AMT activities, that shines directly onto the HESS apparatus or that gives a glow on the horizon, will interfere with operations of the HESS telescopes and could severely damage them.

Table 7-2: Assessment of light interference from the AMT, negatively impacting the HESS telescopes

CRITERIA	DESCRIPTION	SCORE
Nature	**Negative impact**.	

CRITERIA	DESCRIPTION	SCORE
Extent	Medium	3
Duration	Medium-term	3
Magnitude	High	4
Consequence		(3+3+4)/3=3.3
Probability	Highly Probable	4
Significance (no mitigation)	**Medium**	3.3 x 4 = 13.2
Mitigation	- Adjust the route of the access road to the AMT so that no lights from that route can shine onto the HESS telescopes. -Install locked gates along the access track to prevent vehicles from moving over the hilltop and shining their lights towards the HESS telescopes. - The adjusted route of this track, and the placement of locked gates has been agreed on between HESS and AMT management. No upward-facing lights to be installed at the AMT. If any night lights are needed on site, they must be directed downwards.	
Significance (with mitigation)	Extent = small. Duration = temporary, if at all Magnitude = very low Consequence = Probability = Highly probable **Significance = Low - Medium**	2 1 1 (2+1+1)/3 = 1.3 4 1.3 x 4 = 5.2
Confidence level	High	

A concern over lights used on neighbouring farms, such as the use of spotlights by hunters at night, was raised at the Göllschau meeting. This is out of the control of the AMT ESIA, but it considered under cumulative impacts in section 7.5.1 below.

7.3.2 Deterioration of local roads, and increased risk of traffic accidents

The project site is accessed from the C26 gravel road heading southwest from Windhoek. For the first three months of construction, concrete, building materials and the telescope components will be transported from Windhoek to the site. This will increase the volume of traffic, and there will be an increase in heavy trucks, with some carrying abnormal loads. Greater corrugations and other deterioration of the road surface can be expected, and combined with increased dust generation (assessed separately below), could lead to an increase in traffic accidents.

Table 7-3: Assessment of road deterioration and traffic safety impact

CRITERIA	DESCRIPTION	SCORE
Nature	**Negative impact**. The frequent movements of heavy vehicles may lead to deterioration of the roads, and might negatively impact road traffic safety along the routes.	
Extent	Large	4
Duration	Temporary	1
Magnitude	Low	2
Consequence		(4+1+2)/3 = 3.3
Probability	Highly Probable	4
Significance (no mitigation)	**Medium**	3.3 x 4 = 12
Mitigation	-For as long as there is increased traffic along the C26, and particularly an increase in heavy loads, due to the AMT project, the project should contribute to increased frequency of blading of the road surface that is routinely carried out by Roads Authority. -All drivers of the project vehicles should be in possession of valid and appropriate driving licenses to operate such vehicles, and should adhere to standard road safety rules. -Project vehicles should be in a roadworthy condition and serviced regularly in order to avoid accidents as a result of mechanical faults. -No heavy trucks or project-related vehicles should be parked outside the designated project site boundaries.	

CRITERIA	DESCRIPTION	SCORE
Significance (with mitigation)	Extent = large Duration = temporary Magnitude = very low Consequence = Probability = Highly probable **Significance = Low-Medium**	4 1 1 (4+1+1)/3 = 2 4 2 x 4 = 8
Confidence level	Moderate It might be beaurocratically and administratively difficult to arrange extra blading by RA along the C26, and it is probably illegal for a private entity to blade a road that is the responsibility of RA. Therefore there is no guarantee that the mitigation measures will be implemented, even with the best intentions of the Proponent.	

7.3.3 Dust impacts

Movements of vehicles on the gravel roads, especially in the dry season, will generate significant amounts of dust. Dust generated may reduce visibility on the C26 road. Increased dust in the atmosphere is also a concern for HESS, as this can reduce their visibility of the night sky, having a negative impact on their observations.

Table 7-4: Assessment of dust impacts

CRITERIA	DESCRIPTION	SCORE
Nature	**Negative impact**. Dust in the atmosphere near the site may reduce the visibility of the night sky for the HESS telescopes.	
Extent	Large, extending along the C26 road from Windhoek, with about 75 km that is gravel.	4
Duration	Temporary	1
Magnitude	Medium	3
Consequence		(4+1+3)/3 = 2.7
Probability	Highly probable	4

CRITERIA	DESCRIPTION	SCORE
Significance (no mitigation)	**Medium**	2.7 x 4 = 10.8
Mitigation	-Where dust becomes problematic along the C26 road, dust suppression methods should be employed to minimise dust generation. This should be especially applied along the C26 near the AMT + HESS site	
Significance (with mitigation)	Extent = medium Duration = temporary Magnitude = low Consequence = Probability = Highly probable **Significance = Low-Medium**	3 1 2 (3+1+2)/3 = 2 4 2 x 4 = 8
Confidence level	Moderate. It might be beaurocratically difficult to arrange water tankers to do dust suppression along the C26, as that is the jurisdiction of a parastatal and any 'interference' in their responsibilities might be resisted (even if it is helpful interference). Therefore there is no guarantee that the mitigation measures will be implemented, even with the best intentions of the Proponent.	

7.3.4 Clearing of vegetation, plus earth moving and risks of soil erosion

Clearing the site of soil and vegetation can exacerbate growth of weeds, especially alien invasive plants such as Mexican Poppy, Wild Tobacco, Datura and others. These plants tend to become a nuisance on any patch of disturbed soil, and are toxic to livestock. Earth moving activities on a sloped site carries risks of causing soil erosion. The regolith soils on site are susceptible to erosion when disturbed. Soil, stones and detritus gets carried downslope during rain events, and can lead to increased sedimentation of ephemeral washes, as well as weed growth on the disturbed patch and in the river beds.

Table 7-5: Assessment of site clearing, removal of vegetation, risks of soil erosion

CRITERIA	DESCRIPTION	SCORE
Nature	**Negative impact**	

CRITERIA	DESCRIPTION	SCORE
Extent	Small, restricted to the immediate environment around the site	2
Duration	Short-term, mainly during construction, possibly extending for one or two seasons after construction has ended.	2
Magnitude	Low	2
Consequence		(2+2+2) / 3 = 2
Probability	Probable	3
Significance (no mitigation)	**Low-Medium**	2 x 3 = 6
Mitigation	- Site levelling and landscaping should only occur where required by the designs, inside the 80x80 m project site and on the access road. No construction activities may take place outside the defined infrastructure footprint areas. - Preparation and laydown area must be located in an area that is already disturbed, or where development will take place. It should be demarcated. - Minimise earth moving to what is required, and prevent unnecessary soil disturbance and grading. Wherever trenches or holes must be dug, this should be done in such a way to minimize the chances of erosion. - Separate top soil when site clearing begins, and keep this aside for use when the site needs to be rehabilitated. If possible, keep this material on a flattish surface so that it won't be carried downslope by rains. - If any additional fill is required, do not create a new borrow pit on or near the AMT site. If it is suitable for purpose, use the soil that is heaped next to the C26 road close to the Göllschau farm house. - If a borrow pit needs to be created, it should be as shallow as possible and all the sides should have slopes with a gentle gradient, to minimise gullying on the sides. - If local rocks and sand will be used for construction, they must be sourced from predefined and already impacted	

CRITERIA	DESCRIPTION	SCORE
	areas. These sites must be pre-approved by the land owner and demarcated. - All project-related vehicles should be limited to existing tracks and defined development areas. No off-road driving is allowed under any circumstances. - Trees near the site should be clearly marked as untouchable (eg encircled with hazard tape) so they are not accidentally damaged. This is to save any nearby trees which add to the natural beauty of the site and their roots help hold the soil to prevent erosion. - Where tracks need to be upgraded, ensure water is directed away from the track at regular intervals and dispersed into natural vegetated veld so that erosion is prevented. - Gathering of firewood from the veld should be prohibited. Fuel for cooking should be provided to the construction team at their accommodation place, to deter workers from wandering on the farm for firewood. - Identify and demarcate protected plants within and near the AMT footprint with hazard tape during construction, to prevent any damage to them. - Use only indigenous plant species as part of the landscaping at the site. - Earth-moving machines (e.g. bulldozers, back-actors) should be washed and free of soil remains from the previous job, so they do not carry seeds of problem plants to the new site. - Careful management during construction will help with effective rehabilitation when the AMT is moved to the Gamsberg plateau. - Once construction work is completed, all remaining work sites (e.g. laydown areas, temporary construction facilities, construction tracks) must be rehabilitated to a state as close as possible to their pre-construction condition. The site must be rehabilitated using only indigenous vegetation.	
Significance (with mitigation)	Extent = Site-specific, almost zero if mitigation measures fully implemented	1 1

CRITERIA	DESCRIPTION	SCORE
	Duration = temporary, almost none if mitigation measures done properly Magnitude = very low if mitigation measures done properly Consequence = Probability = Probable **Significance = Low**	1 (1+1+1)/3 = 1 3 1 x 3 = 3
Confidence level	Moderate. There are many mitigation measures that need to be implemented to minimize the potential damage caused by site clearing and earth-moving. Effective implementation of all the suggested measures is required to achieve the desired reduction in significance of this impact.	

7.3.5 Disturbance to fauna

Wildlife and livestock in the project area may be disturbed by the noise and activities of construction and operations. There may be attempted snaring and poaching of animals by construction workers, or they may facilitate such illegal activities by other parties. Animals such as snakes and reptiles may be killed when seen on site. These activities may result in a potential loss of valuable wildlife and livestock.

Table 7-6: Assessment of impact associated with disturbance of wild animals

CRITERIA	DESCRIPTION	SCORE
Nature	**Negative impact**	
Extent	Medium	3
Duration	Short-term	2
Magnitude	Low	2
Consequence		(3+2+2) / 3 = 2.3
Probability	Probable	3
Significance (no mitigation)	**Low-Medium**	2.3 x 3 = 6.9

CRITERIA	DESCRIPTION	SCORE
Mitigation	- Movement of vehicles and machinery should be restricted to existing roads and tracks, and should be restricted to daylight hours only, to prevent unnecessary disturbance to animals. - Movements of people associated with the AMT should be prohibited beyond the AMT access road and footprint. People staying at the construction accommodation should not be allowed to move around unauthorised on the rest of the farm. - Site personnel should be prohibited from killing, poaching or snaring or intentionally disturbing any local animals that may be found on and around the site. Any contravention should be quickly dealt with, and offenders should be immediately dismissed from site, and charged. Penalty charges to the Contractor should be imposed if any snaring or poaching occurs. - The greater area around the site and road should be searched for snares during the construction phase and after construction is complete. - Contractor staff housing should be randomly checked for any signs of poaching, animal parts and/or products. - The Proponent should work together with local farmers and anti-poaching units in the area, if they exist, to combat any poaching or illegal activities. - Snakes should be removed from the site by an experienced person. Staff should be educated in the ecological value of snakes and how to avoid them.	
Significance (with mitigation)	Extent = Site-specific, almost zero if mitigation measures effectively implemented Duration = temporary, can be reduced to zero Magnitude = very low if mitigation measures done properly Consequence Probability = Probable **Significance = Low**	1 1 1 (1+1+1)/3 = 1 3 1 x 3 = 3
Confidence level	Moderate.	

CRITERIA	DESCRIPTION	SCORE
	There are many mitigation measures that need to be implemented to completely prevent any poaching or disturbance, and some measures may be more effective than others.	

7.3.6 Soil and water pollution

Construction activities will be associated with potential pollution sources such as lubricants, fuel and wastewater, which may contaminate surrounding soils and surface- and groundwater. Surface water pollution could occur through run-off of polluted water into water bodies and ephemeral washes. Groundwater pollution could occur through leaching of liquid wastes into the soil and infiltrating into aquifers deeper underground. Water, polluted from contact with above-mentioned contaminants, may accumulate in depressions or borrow pits and from there infiltrate underground or overflow and potentially contaminate groundwater and surface flows.

Table 7-7: Assessment of soil and water pollution

CRITERIA	DESCRIPTION	SCORE
Nature	**Negative impact**	
Extent	Small, within a limited distance of the site.	2
Duration	Short-term. The small scale of the operation makes the likelihood of a large or long-lasting polluting event, unlikely.	2
Magnitude	Low	2
Consequence		(2+2+2)/3 = 2
Probability	Probable, a distinct possibility	3
Significance (no mitigation)	**Low-medium**	2 x 3 = 6
Mitigation	- All precautions should be taken to prevent contamination of the soil, surface and groundwater. - Proper training of construction workers wrt appropriate prevention measures is essential. - The mixing and use of concrete and cement must only take place in designated areas so as not to contaminate the site.	

CRITERIA	DESCRIPTION	SCORE
	- Hydrocarbons and chemicals must be stored, handled and dispensed over an impermeable surface and in a manner that prevents spillage and contamination. - Any spillage on site should be cleaned up within 24 hrs of occurrence. The resulting waste must be sealed in an appropriate container and disposed of in accordance with recognised discharge standards at a recognised authorised landfill site. - Portable toilets should be used until the septic tank sanitation system is established. Toilet water should be periodically emptied out before reaching capacity and transported to a wastewater treatment facility. - Effluent from septic tanks and the French drain must be dispersed in such a way that polluted water does not reach aquifers or springs, and it must not be allowed to accumulate on the surface. - Washing and servicing of equipment and vehicles should not take place on the site. - An emergency preparedness plan should be compiled and all personnel appropriately trained.	
Significance (with mitigation)	Extent = Site-specific, almost zero if mitigation measures effectively implemented. Duration = temporary. Magnitude = low if mitigation measures done properly Consequence Probability = Probable **Significance = Low**	1 1 2 (1+1+2) / 3 = 1.3 3 1.3 x 3 = 4
Confidence level	Moderate. Penalty clauses should be included in the contract to emphasise the importance of preventing pollution.	

7.3.7 Pollution from generation of waste

Various types of wastes will be generated during construction and operations, including domestic, general, construction and hazardous wastes. Improper handling, storage and

disposal of wastes may cause environmental degradation/pollution including visual pollution, contamination of soil and groundwater, decline in the health of wildlife, mortality of animals that ingest waste, and habitat deterioration.

Table 7-8: Assessment of potential environmental pollution

CRITERIA	DESCRIPTION	SCORE
Nature	**Negative impact**	
Extent	Small. The small scale of the project makes the scale of potential waste problems also small.	2
Duration	Short-term	2
Magnitude	Low to Medium	3
Consequence		(2+2+3) / 3 = 2.3
Probability	Probable	3
Significance (no mitigation)	**Low-Medium**	2.3 x 3 = 6.9
Mitigation	- All personnel should be sensitized to dispose of waste in a responsible manner and not to litter. - The project sites should be equipped with different waste bins for each waste type. No waste should be left scattered on site; all should be disposed of in allocated waste bins and thereafter transported to the nearest authorised waste management facility. - All waste receptacles should be animal-proofed so the contents are not scavenged or dispersed by animals such as crows and jackals. - All general waste produced on a daily basis should be contained until such that time it will be transported to designated waste sites on a weekly basis or as required. - A waste holding cage that is bird and animal proof should be used to store solid waste before it is transported to a municipal waste facility. - No burying or burning of waste is allowed on site or anywhere else throughout the project lifecycle.	

CRITERIA	DESCRIPTION	SCORE
	- All waste that can be recycled should be kept separate and handled so that recycling is achieved. - Building rubble should be consolidated in one suitable location, removed from the area, and disposed of at an official waste facility. - In the construction phase, portable toilets should be provided for human waste. - In the operational phase, the sewage should be treated with chambered septic tank systems designed according to recognised standards (e.g. South African National Standards). - All ablutions should be regularly serviced and the sewage disposed of at a designated location and in an environmentally appropriate manner. - There should be regular monitoring and maintenance of the ablution and sewerage system. The source of any odours should be investigated and rectified within 24 hours.	
Significance (with mitigation)	Extent = Site-specific, almost zero if mitigation measures effectively implemented Duration = temporary, can be reduced to zero Magnitude = very low if mitigation measures done properly Consequence Probability = Probable **Significance = Low**	1 1 1 (1+1+1) / 3 = 1 3 1 x 3 = 3
Confidence level	Moderate. Efficient, effective waste management is simple and economical but it is easily neglected, with the consequence that the suggested mitigations are not as effective as they should be. Penalty clauses should be included in the contract to emphasise the importance of thorough waste management.	

7.3.8 Water availability

Water provision at the AMT site will be from a local borehole on Göllschau. This carries a risk that unsustainable and excessive water abstraction could negatively affect the local farming livelihoods and environment that depend on the same aquifer in the area.

During construction, the concrete will be sourced in Windhoek, thus avoiding the need for large amounts of Göllschau water required for this purpose. Estimated demand at Göllschau during the construction and operational phases of the project is ~10 m^3/month.

Table 7-9: Assessment of water abstraction for the AMT

CRITERIA	DESCRIPTION	SCORE
Nature	**Negative impact**	
Extent	Small. The relatively low quantities of water required by the AMT suggest that any impact would be limited in extent.	2
Duration	Short term, since the construction period is estimated to be 15 months.	2
Magnitude	Medium. Scarcity of groundwater in the area suggests that any excessive use would be problematic for local farmers.	3
Consequence		(2+2+3) / 3 = 2.3
Probability	Possible; just a moderate probability that the low predicted demand would be exceeded.	2
Significance (no mitigation)	**Low**	2.3 x 2 = 4.6
Mitigation	- Water use should be monitored which would require installation of a water meter for the AMT. - The boreholes should be pumped at a rate that is agreed on and managed by the farm owner, so that excessive water use or wastage at the AMT site is prevented. - Water savings measures such as flow restricters, taps with automatic shut-off and dual-action toilets should be installed.	
Significance (with mitigation)	Extent = Site-specific, almost zero Duration = temporary Magnitude = very low if mitigation measures done properly Consequence	1 1 1 (1+1+1) / 3 = 1

CRITERIA	DESCRIPTION	SCORE
	Probability = Probable **Significance = Low**	3 1 x 3 = 3
Confidence level	Moderate. The estimate of demand is just an estimate, so we have rather low confidence in that figure. Nevertheless, the mitigation measures are straight-forward and simple to implement, so reducing any negative impact to low significance is readily achievable.	

7.3.9 Risk of accidents and emergencies, such as veld fire, vehicle accidents

The introduction of a team of people on site comes with the risk of accidents from human error. Veld fires can destroy grazing and animals, and present a risk to life and health of humans. Vehicle accidents can also cause disruption, injuries and death to both project personnel and to the public.

Table 7-10: Assessment of accidents and emergencies such as veld fire

CRITERIA	DESCRIPTION	SCORE
Nature	**Negative impact**	
Extent	Large; potentially a veld fire could affect a wide area around the project site.	4
Duration	Short-term, as the construction period itself is short.	2
Magnitude	Medium	3
Consequence		(4+2+3)/3 = 3
Probability	Possible	2
Significance (no mitigation)	**Low-Medium**	3 x 2 = 6
Mitigation	- Induction training should be provided for all staff coming to site, with emphasis on work safety and prevention of accidents. - Take precautions to prevent the outbreak and spreading of fires and ensure all employees are aware of the precautions. - Adequate firebreaks must be made around the work sites.	

CRITERIA	DESCRIPTION	SCORE
	- Fire extinguishers and other firefighting equipment should be strategically located throughout the work sites, and staff trained in their usage. - Project vehicles should be in a roadworthy condition and serviced regularly, and drivers should be licenced and trained for their tasks. - An emergency management and medical evacuation plan should be in place and all employees trained in its procedures.	
Significance (with mitigation)	Extent = Site-specific Duration = temporary Magnitude = very low if prevention measures properly implemented Consequence Probability = Probable **Significance = Low**	1 1 1 (1+1+1) / 3 = 1 3 1 x 3 = 3
Confidence level	Medium. Human error happens. Penalty clauses should be included in the contract to emphasise the importance of preventing a fire or other types of accident.	

7.3.10 Occupational health and safety impacts

Activities associated with the project have the potential to cause accidental injury to the staff and contractors. On-site safety of all personnel is the responsibility of the Proponent and should be adhered to as per the requirements of the Labour Act (No 11 of 2007) and the Public Health Act (No. 36 of 1919). Examples of potentially hazardous equipment include heavy vehicles, mobile crane, and large components of the telescope.

Table 7-11: Assessment of occupational health and safety impacts

CRITERIA	DESCRIPTION	SCORE
Nature	**Negative impact**	
Extent	Small	2
Duration	Short-term	2

CRITERIA	DESCRIPTION	SCORE
Magnitude	Medium	2
Consequence		(2+2+2)/3 = 2
Probability	Possible, moderate probability	2
Significance (no mitigation)	**Low**	2 x 2 = 4
Mitigation	- The Labour Act's Health and Safety Regulations should be complied with. - All personnel should be sensitised to the potential health and safety risks associated with their respective site jobs. - First aid kits should be readily available on site and staff trained in how to use the contents. Enough people on site should be trained in medical protocols to deal with an emergency. - Prior to operating and using site machines and equipment, personnel involved in different project tasks should be trained on how to properly and correctly use these, if not familiar. - Appropriate personal protective equipment should be provided to personnel. - Heavy vehicle, equipment and fuel storage site should be properly secured and appropriate warning signage placed where visible. - An emergency preparedness plan should be compiled and all personnel appropriately trained. - Train all employees and contractors on environmental awareness, the company's Environmental Health and Safety Policy, and the Environmental Management Plan.	
Significance (with mitigation)	**Low**	
Confidence level	Medium.	

7.3.11 Risks of damage to heritage items

There is a small risk that construction activities might damage or destroy artefacts of cultural significance. The archaeology assessment for this ESIA found no evidence of heritage items at or close to the AMT site. Nevertheless, construction excavations could potentially expose something unexpected. There are sites of heritage significance approximately 3 – 5 km south of the AMT site on farm Göllschau.

Table 7-12: Assessment of damage to heritage items

CRITERIA	DESCRIPTION	SCORE
Nature	**Negative impact**	
Extent	Site-specific	1
Duration	Temporary	1
Magnitude	Medium	2
Consequence		(1+1+2)/3 = 1.3
Probability	Possible, moderate probability	2
Significance (no mitigation)	**Low**	1.3 x 2 = 2.6
Mitigation	- Report any find that may be of cultural or archaeological value to the National Heritage Council.	
Significance (with mitigation)	**Low**	
Confidence level	High.	

7.4 Positive impacts

7.4.1 International recognition

The AMT, with its situation in southern Africa, will be a key component of the international Event Horizon Telescope. Until now there has not been a radio telescope on the African continent which can collaborate with others in the world to create a telescope that is the

diameter of the Earth. The AMT does that. The establishment of the AMT at Göllschau will raise the profile of Namibia as a player in international astronomy. Namibia has ideal conditions for astronomy: clear skies, low levels of artificial light, little dust in the air and low humidity, at relatively high altitude. The selection of Namibia for the African component of the Event Horizon Telescope is a confirmation that Namibia offers real potential for international astronomy.

The placement of the AMT at Göllschau also helps the Radboud Radio Lab take the first step towards the AMT's ultimate situation on Gamsberg. This is a necessary step to secure the funding for the AMT. The Göllschau AMT will help to prove to international funders that Namibia is a politically stable country for international investment, which will help the eventual goal of moving the AMT to the Gamsberg.

The funding enables local Unam staff and Namibian students to contribute to this international endeavour, which helps to raise local capacity and skills. There are a number of Unam post-graduates connected to the Radboud Radio Lab programme, who will continue to be involved in the international work of the AMT. This exposure helps to raise the profile of Unam and Namibian scientists on the international stage.

Table 7-13: Assessment of impact associated with employment creation and associated opportunities

CRITERIA	DESCRIPTION	SCORE
Nature	**Positive impact**	
Extent	Widespread, international	5
Duration	Long term	4
Magnitude	Very high; international reputation is significantly raised	4
Consequence		(5+4+4)/3 = 4.3
Probability	Definite	5
Significance	High	4.3 x 5 = 21.5
Recommendations for further optimisation	- Unam should strengthen its collaboration with Radboud Radio Lab and other international astronomy institutions, so that the ultimate prize of establishing Gamsberg as the premier astronomy site in southern Africa is achieved. - Namibian political leaders should actively support this initiative and facilitate the processes that are necessary for AMT establishment.	

CRITERIA	DESCRIPTION	SCORE
Confidence level	High	

7.4.2 Opportunity for raising capacity and expertise in Namibia

As mentioned above, Unam and astronomy students are involved in the AMT. This places a responsibility on this local academic institution to show its worth, and on the students to prove themselves in the international arena. With the responsibility comes the opportunity to build capacity in the teaching staff and the student body in physical astronomy. Staff and students will get opportunities to travel internationally to collaborate with the other millimetre telescope teams in Europe, Asia, and North and South America.

At the same time, the capacity of the implementing engineers and scientists in Namibia will also be strengthened. Consulting engineers, communication specialists, environmental scientists and other professionals will have the opportunity to build their own experiences and capabilities. This benefit will diffuse and spread further into the Namibian economy.

Table 7-14: Assessment of raised Namibian capacity in astronomy, engineering and related fields

CRITERIA	DESCRIPTION	SCORE
Nature	**Positive impact**	
Extent	Widespread, affecting all aspects of the Namibian economy	5
Duration	Medium to long term	3
Magnitude	Low	3
Consequence		(5+3+3) / 3 = 3.7
Probability	Definite	5
Significance	**Medium-High**	3.7 x 5 = 18.5
Recommendations for further optimisation	- Namibian institutions such as Unam and the professional bodies involved in planning and construction of the project should continue to collaborate with international astronomy institutions, so that the skills base for astronomy projects is strengthened.	
Confidence level	High	

7.4.3 Opportunity for educational outreach

A key element of the AMT project is the creation of a mobile planetarium to help raise awareness and excitement about astronomy in Namibian children and learners. The mobile planetarium is managed by the AMT project, and manned by Unam students when they do shows at schools and events. It is inspirational!

Table 7-2. Assessment of impact of educational outreach

CRITERIA	DESCRIPTION	SCORE
Nature	**Positive impact**	
Extent	Widespread, over the whole country	5
Duration	Medium term, but could easily be extended to long term	3
Magnitude	Medium; social capabilities are notably improved	3
Consequence		(5+3+3)/3 = 3.7
Probability	Highly Probable	4
Significance	**Medium**	3.7 x 4 = 14.8
Recommendation	- Outreach activities of the mobile planetarium should continue and be expanded	
Confidence level	High	

7.5 Cumulative Impacts

Cumulative impacts are defined as “those that result from the successive, incremental, and/or combined effects of developments when added to other existing, planned, and/or reasonably anticipated future ones” (International Finance Corporation, 2013).

A potential scenario for the next 5 years is bulleted below:

- Development of tourism establishments on the neighbouring farms and in the wider area. These will be illuminated at night with lights, and activities such as night hunting might be done which would involve vehicle lights and spotlights moving around at night. They will also add to increased traffic load along the C26, and more generation of dust. Establishment of a new tourism facility on the farm Groot Geduld, a direct neighbour to Göllschau, was confirmed during the public consultation process.

- Establishment of additional astronomy sites on Göllschau and other farms in the area. Local landowners are capitalising on the natural features of the area, notably the dark night sky, clear air and the proximity to Windhoek, which make this area ideal for astronomy tourism. Astronomy facilities are already established at Hakos and Rooisand, and additional small-scale units are planned on Göllschau.

The impacts identified in 7.3 above are re-evaluated here in the light of combined effects from the above possible developments in the area.

7.5.1 Light interference affecting astronomy sites in the wider area

Night lights in the area surrounding the HESS telescopes carry increased risks of light interference, which could negatively impact the operations at HESS.

Recommendation:

Discussions between HESS and neighbouring farmers should be initiated, to understand what is envisaged and what issues might arise. Possibly this could be done through the existing Grootberg Farmers Association, or through a small and focussed 'landscape association' to consider issues of shared concern.

7.5.2 Deterioration of the C26 road, added dust generation

As developments grow in the area, the C26 road will experience more traffic. This is likely to lead to deterioration of the road surface, and more generation of dust. This could lead to higher vehicle costs for road users, and increased risk of accidents.

Recommendation:

Collaboration and open communications with Roads Authority, as the institution responsible for maintenance of the country's roads, should be maintained. This is probably best taken up by an existing local organisation such as the Gamsberg Farmers Association.

7.5.3 Disturbance to fauna, reduction of wildlife, increased incidence of stock theft

Growing numbers of people in the area, with construction teams, vehicle deliveries, higher incidence of service teams such as communications service providers, and growing numbers of tourist vehicles such as self-drives, will add to the impact on local wildlife and livestock. Road kills can be expected to rise, illegal activities such as poaching are likely to occur, and animals mistakenly caught in the road reserve are likely to die before they can be safely helped back into safer grounds. All these consequences are likely to combine to reduce wildlife populations, and increase stock losses of local farmers.

Recommendation:

Collaboration amongst local land-owners should be facilitated, possibly through an existing organisation such as the Gamsberg Farmers Association, to address this growing threat. For instance, anti-poaching efforts might need to be stepped up, which would benefit from a 'landscape approach' where responsibilities could be shared.

8 Conclusion and Recommendations

8.1 Summary and conclusion

This study was conducted to assess the potential environmental and social impacts associated with the establishment and operations of the African Millimetre Telescope (AMT) on Farm Göllschau.

The project entails the construction, operation and decommissioning of a 14 m diameter radio telescope dish, associated foundations, prefabricated buildings, access road upgrades and renewable energy infrastructure. The overall development footprint is approximately 80 × 80 m, with a very small permanent disturbance area relative to the surrounding landscape.

Construction is expected to take approximately 15 months and will involve a small workforce. Operational activities will be intermittent, with no permanent on-site occupation. The project is temporary in nature, with the AMT anticipated to be relocated to the Gamsberg plateau within 5–10 years once enabling infrastructure is in place.

Based on the findings of this assessment, the following impacts can be expected on the social and biophysical environment:

- Light interference affecting the nearby HESS telescopes. Without mitigation, this impact could be of medium significance. However, with the agreed mitigation measures, the residual impact is reduced to low-medium.
- Increased deterioration of gravel roads and tracks, and dust.
- Soil erosion and proliferation of weeds from earth-moving and soil disturbance.
- Disturbance to fauna, through construction activities as well as possible illegal activities such as snaring and poaching.
- Pollution risks from contaminants and waste generation.
- Possible excessive water use from Gollschau boreholes.
- Risk of accidents and emergencies such as veld fire.
- Risks of accidents in the labour force.
- Risks of damage to heritage items.

All of these impacts are reduced to acceptable significance provided that the Environmental Management Plan is fully implemented, as summarised in the table below.

Impact	**Significance before mitigation**	**Significance with implementation of mitigation measures**
Light interference on HESS	Medium	Low-Medium

Road deterioration	Medium	Low-Medium
Dust	Medium	Low-Medium
Site clearing	Low-Medium	Low
Disturbance to fauna	Low-Medium	Low
Soil and water pollution from contaminants	Low-Medium	Low
Pollution from waste	Low-Medium	Low
Water availability	Low	Low
Accidents and emergencies	Low-Medium	Low
Occupational health and safety	Low	Low
Damage to heritage items	Low	Low

The implementation of management measures given in the EMP will mitigate negative impacts. It is the responsibility of the Proponent to ensure that all mitigation measures are adequately implemented and monitored for effectiveness.

8.2 Recommendations

It is recommended that an ECC be issued for the proposed establishment and operations of the AMT telescope on farm Göllschau, subject to the implementation of mitigation measures set out in this report and the EMP. The construction contractor should sign off on the EMP. The Proponent should also be fully familiar with the requirements of the EMP.

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