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HERITAGE IMPACT ASSESSMENT REPORT FOR

PROPOSED CONSTRUCTION OF AN AMMONIA PIPELINE FROM ARANDIS TO FARM 58, NAMIBIA ERONGO REGION, NAMIBIA

7th August 2025

PREPARED FOR:

Environmental Compliance Consultancy (Pty) Ltd (ECC)

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QUALIFICATIONS AND EXPERTISE OF THE CONSULTANT

NAME	Dr Alma Nankela, PhDs
RESPONSIBILITY ON THE PROJECT	Archaeological Field Survey and impact assessment for the proposed construction of proposed construction of An ammonia pipeline from Arandis to Farm 58 as part of EIA by the Environmental Compliance Consultancy (ECC) on behalf of CMB.TECH Namibia (Pty) Ltd (the Proponent).
QUALIFICATIONS	PhDs & Masters Degrees in Quaternary and Prehistory (MNHN and UNIFE) & Bachelor Degree in History and Geography (UNAM).
PROFESSIONAL REGISTRATION	Association of Southern African Professional Archaeologists (ASAPA); Namibia Scientific Society (NSS); the Society of Africanist Archaeologists (SafA).
EXPERIENCE IN YEARS	17 (Field and laboratory)
EXPERIENCE	Dr Nankela worked as an Archaeologist at the NHC for more than a decade where she has conducted extensive archaeological, anthropological and historical research, carried out extensive assessments across Namibia developed and developed heritage policies and systems.
HERITAGE PERMIT NO.	06/2024
REPORTING REQUIREMENT	National Heritage Act, (No. 27 of 2004) and the National Guidelines for Heritage Impact Assessment in Namibia (2021) by the National Heritage Council.

DECLARATION

I, a duly authorised representative of Research Culture Heritage Services (RCHS), hereby confirm my independence as a specialist and declare that:

1. Neither I nor the RCHS CC have any financial or any other personal interests in the construction of ammonia pipeline from Arandis to Farm 58 project other than consultation fees for work performed on the project.
2. The RCHS specialist was appointed on a strictly professional basis to conduct an archaeological field survey and impact assessment in line with the National Heritage Act (No. 27 of 2004) and its Regulations (Government Notice 106 of 2005), guided by the “Guidelines for Heritage Impact Assessment (HIA) of 2021” from the Heritage Council as well as the Environmental Management Act (No. 7 of 2007) and its Regulations (Government Notice 30 of February 6, 2012).



Dr. Alma Nankela,
Archaeologist & Heritage Management Specialist

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EXECUTIVE SUMMARY

The first desk research, archaeological field surveys, and impact assessments were carried out between May 29th, 2024, and June 11th, 2024, as part of the proposed construction of 80 km of ammonia pipeline routes from Farm 58 in Walvis Bay to Arandis, including ancient routes 2 and 3 in the Erongo Region of Namibia. The second archaeological assessment and field survey was conducted on the 1st and 8th of July 2025 along the proposed pipeline deviation route on the south side of the Swakop River crossing and outside the Arandis town boundary. The report therefore presents a baseline description of heritage features located within and around the proposed pipeline and the proposed deviated routes. The initial field survey located a total of eleven ($n = 11$) heritage features, including *two* World War I (ca. April–May 1915) historic regimental insignias; at least *two* late Pleistocene Middle Stone Age artefacts; *six* isolated and a cluster of seed digging sites; at least *one* stone feature; *two* colonial settlements likely from the late 19th to early 20th centuries; and *two* potential grave cairns. The second survey recorded a total number of six ($n=6$) heritage features, such as *one* rock engraving site, *one* serie of stone features and *four* potential burial cairns. All these features have varying degrees of heritage significance, sensitivity and are vulnerable at different ratios. However, their mitigation measures have been devised to managing them. The adoption of the chance-find procedure appended to this report is required to facilitate future discovery of potential heritage features within and along the footprint of the project.

1. PROJECT BACKGROUND

Cleanergy Solutions Namibia (Pty) Ltd., a joint venture between Ohlthaver & List (O&L) Group and CMB.TECH (“**Proponent**”), intends to construct an ammonia pipeline from Arandis to the Farm 58 project in the Erongo Region of Namibia (**Figure 1**). The proposed ammonia pipeline project runs 80 km from the proposed ammonia plant (next phase of the Project) in Arandis to the green ammonia production plant on Farm 58 (near Dune 7). The total distance of the pipeline is ~112 km when adding the ammonia pipeline section between Farm 58 and Walvis Bay North Port for which a separate heritage report is provided. According to the proponent, the ammonia pipeline will transport ~800 metric tonnes of green ammonia per day. At least three different pipeline routes (routings 1, 2, and 3) were proposed, and it is these routes that have been subjected to this feasibility assessment (**Figure 2**). In May 2025, the proponent has decided on a final pipeline route from Arandis to the Farm 58 area (**Figure 3**). The route deviates slightly from the routes that have been assessed during the initial heritage study, with the first route adjusted at the south side of the Swakop River crossing. This adjustment route was concerned with the encroachment of the pipeline into the Nampower servitude. The second deviation route redirects the pipeline from within the Arandis town council boundary and diverts the pipeline away from the town and future development area.

The ammonia pipeline will be an underground infrastructure to minimise possible environmental impacts. Although the ammonia is viewed as highly flammable, various pressure control points, sectioning, and other options will be explored by the proponent to address these concerns such as leakages to which the technical and design standards will be in place to prevent worse case scenarios.

The construction of the ammonia pipeline and its associated infrastructure within the route layout has the potential to cause a significant negative impact on the receiving physical, biological, socioeconomic, and cultural environment. Such activities cannot be undertaken without an Environmental Clearance Certificate (ECC) as per the Environmental Management Act (No. 7 of 2007) and the Environmental Impact Assessment (EIA) and its Regulations (Government Notice 30 of February 6, 2012). To obtain an ECC, the proponent appointed Environmental Compliance Consultancy (Pty) Ltd., as the independent Environmental Assessment Practitioner (EAP) to conduct an Environmental Impact Assessment (EIA) in terms of the environmental legislation for the proposed ammonia pipelines and all its associated infrastructure within the route layout.



Figure 1: A local map indicating the location of three initial routings of the proposed pipelines transverse through various national parks from Farm 58 to Arandis. Source: (ECC, 2024:3).



Figure 2: Edited aerial map indicating the location of the proposed routes for Green ammonia project. Map Credit: (Clean Energy Solution, 2024:15).

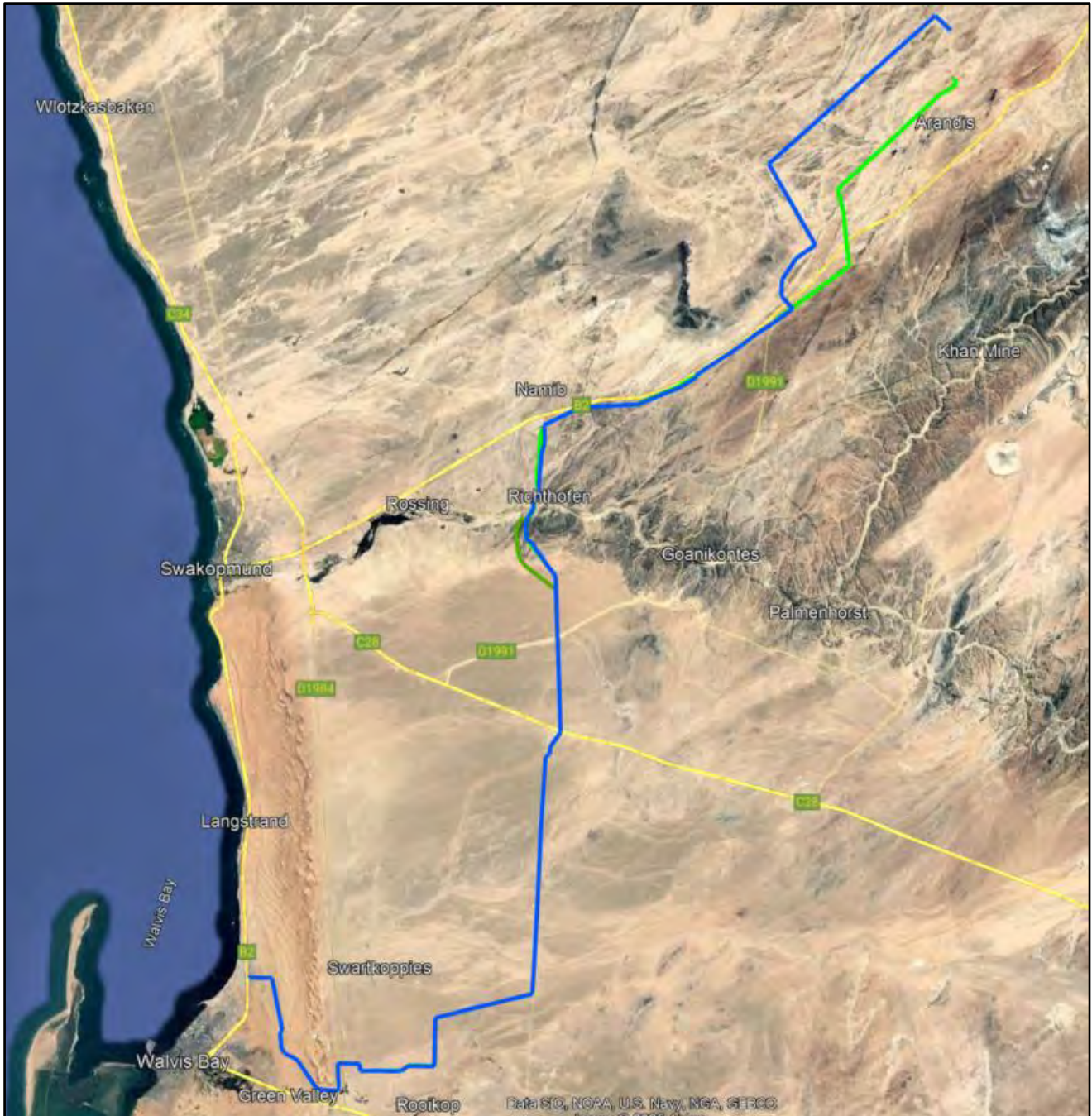


Figure 3: The proposed final green ammonia pipeline in blue in relation to the old pipeline route in green. Image Credits: Google Earth 2025.

In Namibia, the heritage and culture component forms part of the required specialist studies to be considered in the overall EIA in an effort to examine whether possible heritage features within the footprint of the project are correctly identified, accurately recorded, reported, interpreted and their significances appropriately estimated in order to fulfil the requirements of the following legislations –the National Heritage Act No. 27 (2004) and the National Heritage Regulation of 106 of 2005 as well as the Environmental Management Act (2007) and Environmental Impact Assessment (EIA) Regulations

(2012), in which the process of review, verification and consent will be required to clear the project. The significance of heritage resources (sites, structures, and artefacts) is determined by means of assessing their archaeological, palaeontological, historical, aesthetic, technological, and scientific value in relation to their uniqueness, condition of preservation, and research potential. These aspects are not mutually exclusive, and the evaluation of each resource is done following the significance criterion ratio outlined in the “National Guidelines for Heritage Impact Assessment in Namibia (2021)” from the Heritage Council. Consequently, Environmental Compliance Consultancy (Pty) Ltd., subcontracted the services of the Research Culture Heritage Services (RCHS) to carry out the heritage surveys and impact assessments.

2. TERMS OF REFERENCE (TOR)

This heritage survey and impacts assessment study aimed for the specialist to:

- a) Assess the nature and degree of significance of heritage resources within the area and immediate surroundings.
- b) Demarcate sensitive heritage sites that will likely be found to guide the development process through establishing thresholds of impact significance.
- c) Determine the nature and degree of significance, sensitivity, and vulnerability of the heritage resources.
- d) Assess and rate any possible impact on the archaeological and other heritage resources within the area emanating from the proposed development activities.
- e) Devise heritage management measures actions for the project to be considered by the authorities for the issuance of Heritage Consent and thereafter the issuance of an Environmental Clearance Certificate.

3. PROJECT DESCRIPTION

Cleanergy Solutions Namibia (Pty) Ltd. is a registered Namibian company and a joint venture between the Ohlthaver & List Group of Companies (Namibia's largest privately held group of companies) and CMB.TECH (a Belgian-owned company working towards the development of large marine and industrial applications for ammonia) in 2021. The joint venture aims to be the first company in Namibia to produce commercial-grade ammonia from water, utilising renewable energy sources. The company is already in the process of constructing a ammonia demonstration plant on Farm 58 outside Walvis Bay. The organisation also intends to construct an ammonia terminal at Walvis Bay as well as the ammonia pipeline from the Walvis Bay North Port area to Arandis (the subject of this assessment) as part of the overall

components of Project (**Figure 4**). The ammonia pipeline project proposes transporting ~800 metric tonnes of ammonia from the proposed ammonia production plant in Arandis via Farm 58 (this assessment) and then travels further from Farm 58 to the Walvis Bay North Port area (ECC Report No: ECC-145-480(A)-REP-30-C). The ammonia pipeline will consist of approximately 8-inch carbon steel pipe with a 75-mm insulation layer (above ground pipeline). The underground pipeline will be painted to prevent corrosion.

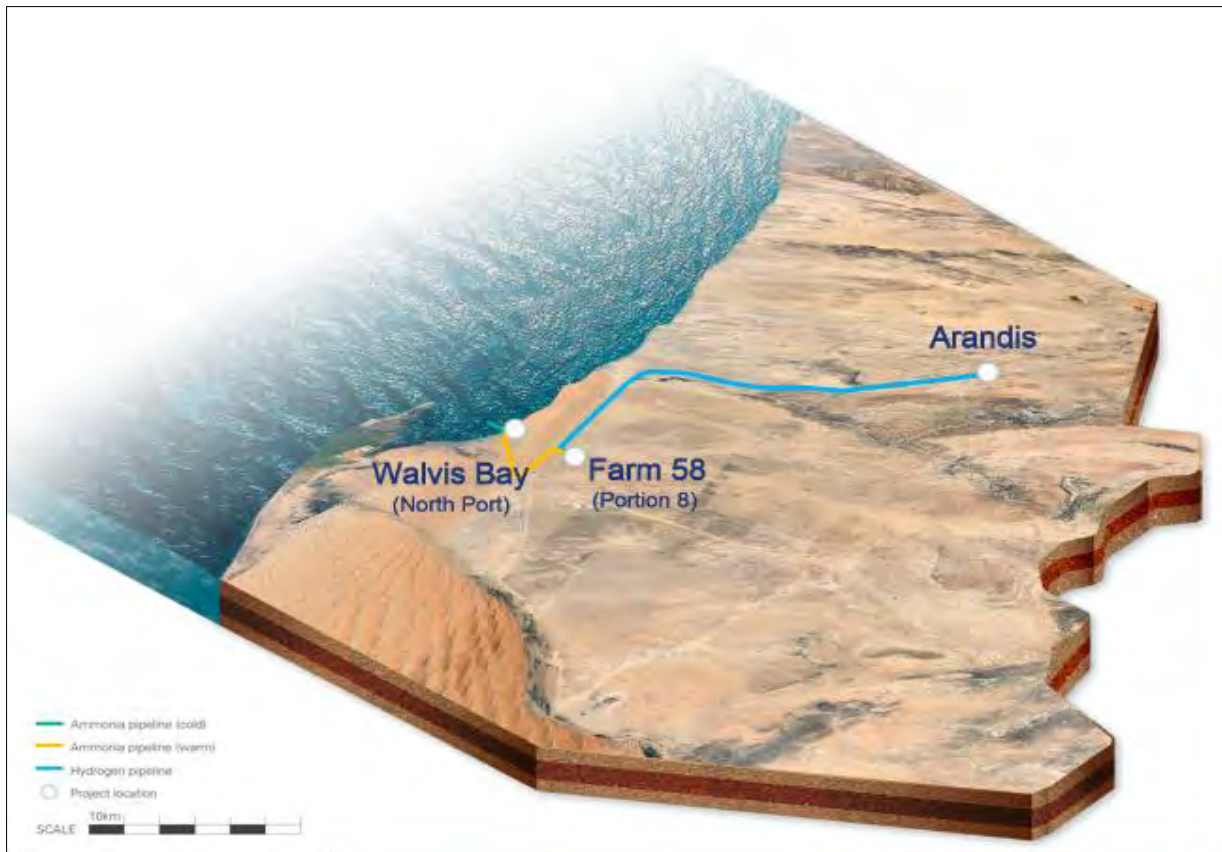


Figure 4: The layout of all ammonia pipeline route (blue line and yellow line) from farm 58 to Arandis in relation to associated component of the project infrastructure development. Source: (Clean Energy Solutions, 2024:8).

The proposed construction and operational phases of the ammonia pipeline and associated infrastructure within the route layout are shown in **Figure 5** and **Figure 6**. For instance, the area outside Arandis Town Council boundary is now the preferred ideal area to build the ammonia production plant and its associated solar plant away from the ocean due to the fog belt and lower solar irradiation. However, due to the rocky areas of Arandis, some parts of the pipeline may likely be constructed above the ground while others are below, although the above-ground option is preferred. This pipeline will then facilitate the storage and transportation of ammonia from this ammonia production plant in Arandis to the ammonia terminal and to the existing jetty for potential exportation.

The following are some of the activities proposed for the ammonia pipeline construction phase:

- Construction of staging areas and storage yards staging areas and storage yards will be strategically located along the planned right-of-way (row) and cleared of vegetation (if required). These areas are used to stockpile the pipes, store fuel tanks, sandbags, silt fencing, stakes, and equipment parts. They will also provide parking for construction equipment and employee vehicles.
- Right-of-way clearing: Once the site has been established, the ROW will be cleared of vegetation and obstacles. Sensitive, rare, and important vegetation may be removed and relocated them to a suitable environment.
- Trench excavation: the trench for the pipeline will be excavated in segments where the pipeline will be buried. If hard rock is encountered, these sections will be blasted, or jackhammers will be used to excavate the trench. When construction is done in the vicinity of existing water pipelines, powerlines and other services, chemical injections may be used as an alternative. Sandbags will be placed within the trench to support the pipe during installation.
- Pipe transport, stringing, and assembly: After trench excavation, 12-metre pipe segments will be transported from the staging area to the ROW. Pipes will be laid either above ground beside the trench or within the trench, supported by sandbags in steep terrain. The final placement will be determined through the ESIA process. Pipe sections will be bent using a pipe bending tool to allow the pipeline to follow the planned route and the terrain. Pipe sections will be welded together, potentially sandblasted, and the weld joints coated to prevent corrosion. For added protection against corrosion, cathodic protection will be applied. Cathodic protection wire must be foreseen in the same trench as the pipeline. X-ray inspection will be used to ensure the quality of each weld joint. Finally, connected pipe lengths will be carefully lowered into the trench.
- Obstacles of roads and streams: the pipeline route crosses existing roads, highways, streams, rivers, and wetlands. Pipelines will be constructed underneath these obstacles using techniques like boring for shallow depth or using horizontal directional drilling (HDD) for deeper placement. Each obstacle requires a unique construction method and order of operations to minimise negative impacts.
- Supporting infrastructure will be required and constructed during the ammonia pipeline project. Compressor stations and valve stations will be built above the pipeline, allowing operators to shut off sections of the pipeline due to either maintenance or emergency response to a potential leakage incident. A fibre optic cable will be following along the pipe route (secured to the pipe) to ensure the monitoring of all parameters such as temperature, pressure, and vibrations. To ensure pipeline integrity, welds must be x-rayed and the pipe hydrotested. This process involves pumping in clean water, pressured above the expected maximum average operating pressure (MAOP). Then, all water is removed, and pipeline intervention gadgets (pigs) are inserted into the pipe to clean it out. Pigs are devices used to inspect and remove dirt and other construction debris while pipelines are being assembled. An intelligent pig will also be used to inspect the underground ammonia pipeline. When the pigs eventually exit the far end of the pipe, the line

will be filled with dry air. Air compressors pump up the air, and the air is run through a drier. The air will be sampled and tested for moisture content. When those parameters get low enough, the complete pipeline is filled with nitrogen to absorb more of the remaining moisture. The pipeline is then deemed fit to transport ammonia. Valve stations and pig senders and receivers will be incorporated for security where required for potential above-ground installations.

The following are activities proposed for the ammonia pipeline operational phase:

- The pipeline will transport liquid ammonia with a mass flow between 20 to 60 ton/h for ~112 km from the proposed ammonia production plant on Arandis to the ammonia terminal near the Walvis Bay north port area for storage.
- Trained personnel will continuously monitor operations and ensure safety procedures are followed.
- There will be constant monitoring with a fibre optic cable of possible leakage points, pressure switches, and vibrations (external digging). These systems will be monitored at Arandis and Farm 58. In-field surveys will also be conducted on a regular basis and/or when required.
- Water for construction and operational needs (worker facilities) may be sourced from the local municipality or town council; however, no such agreements have been made as of yet. The project's water requirements are not anticipated to impact local water supplies.
- A waste management plan will be developed and overseen by the engineering, procurement, and construction (EPC) contractor. Temporary waste bins will be available on-site, varying in waste categories such as general household waste, plastic, steel, concrete, and hazardous waste. The waste management plan will include on-site waste separation and collection (general waste, plastic, steel, concrete, and hazardous waste). proper waste disposal procedures. Regular toolbox talks will keep workers informed about waste management requirements. Mitigation measures will be further detailed in the environmental and social management plan (ESMP).

The following are activities proposed for the ammonia pipeline decommissioning phase:

- During the decommissioning phase, the ESMP will outline auditable decommissioning and rehabilitation procedures and actions for the proponent to ensure careful and sustainable management measures are implemented.
- The proponent will have to implement rehabilitation measures at the project decommissioning stage, as outlined in the ESMP.



Figure 5: A typical example of the ammonia pipeline above the ground envisioned for the 80km route between Walvis Bay and Arandis. Image credit: (ECC, 2024).



Figure 6: An example of the ammonia production and associated solar plant envisioned in Arandis. Source: (ECC, 2024).

4. ASSUMPTIONS AND LIMITATIONS

This archaeological heritage study assumes that all background information and layout plans provided by the proponent are accurate and up-to-date. The assessment therefore focused mainly on the proposed ammonia pipeline routes and the immediate vicinity (100 m) of the project. It does not apply to and may not be used for any other future developments and expansions of the project outside the assessed areas. The available heritage records from previous studies of similar projects undertaken in the same general area were used in this study. These records were augmented by a recent comprehensive field survey and assessment carried out in three days between May 29th 2024 until June 11th, 2024 along the proposed ammonia pipeline routes from farm 58 in Walvis Bay until Arandis (**Figure 7**) as well as from the

ammonia routing pipeline 2 and ammonia routing pipeline 3 (**Figure 8** and **Figure 9**). Since archaeological and/or palaeontological heritage surveys largely depend on the indicative value of surface finds recorded during the field surveys, it is always possible that hidden or subsurface remains could be overlooked; therefore, the appended Chance Find Procedure Guidelines should be adopted. Since the proposed ammonia pipelines fall within Dorob and Naukluft Park, an access permit from the Ministry of Environment, Forestry, and Tourism was granted to the RCHS researcher.



Figure 7: Indicated the location of the ammonia demonstration plant being built on Farm 58 where the ammonia pipeline began while right image shows the location of the site where the ammonia production and associated solar plant envisioned in Arandis will be built. Source: (RCHS, 2024g).



Figure 8: The left image indicated the general area where the proposed ammonia pipeline routing 2 began near B2 road and where it end on Farm 58. Source: (RCHS, 2024g).



Figure 9: Left image indicated the general area where the proposed ammonia pipeline routing 3 began near Farm 58 and where it end near an electric sub-station in Naukluft Park. Source: (RCHS, 2024g).

5. LEGAL REQUIREMENT

The National Heritage Act (No. 27 of 2004) is the regulatory authority for the identification, protection, preservation, management, and promotion of Namibia's heritage resources. Part 1 of the Heritage Act defines 'heritage resources' as both *places* and *objects* of archaeological, palaeontological, and rare geological objects, including meteorites, cultural, historical, ethnographical, scientific, technological, and social significance. The significant places also include "the natural or existing condition or topography of land," as well as "trees, vegetation, topsoil, or bodies of water" that maintain the ecological functioning and integrity of the specific area. In these aspects, the Act provides legal protection for both tangible and intangible heritage resources. The newly developed "Guidelines for Heritage Impact Assessment in Namibia of 2021" have been formulated for the implementation of the National Heritage Act, especially Section 51 (3), which outlines requirements for heritage impact assessment in Namibia. The aspect of intangible heritage may include sacred sites: "places to which oral traditions are attached to or which are associated with living heritage, graves and burials, historic settlements, and military sites by means of a building, garden, or tree," which are considered to have heritage significance in Namibia. The significance of the heritage resources (sites, structures, and artefacts) is determined by means of their typological classifications defined in Part 1 of the Act in relation to their uniqueness, condition of preservation, and research potential. Therefore, these aspects are not mutually exclusive, and the evaluation of each resource is achieved following the significance criterion ratio entrenched in the 'Guidelines for Heritage Impact Assessment (HIA) in Namibia of 2021'.

NHC maintains a heritage register in accordance with Part IV of the Heritage Act. The register lists 'significant heritage' places and objects of national importance. The register allows new approved entries to be added based on an assessment of their heritage significance and, thereafter, publication of the sites in the Government Gazette. Consequently, Part V applies immediate legal protection to heritage sites added to the register to prevent unnecessary disturbances or damages to heritage resources as an inevitable result of infrastructure development, unless permitted in terms of Section 48 of the Act. Moreover, aspects concerning the conservation, management, and impact assessment studies of cultural heritage resources for projects such as the proposed general and hazardous waste management facility are also addressed in the Environmental Management Act, 2007 (No. 7 of 2007). The need for environmental impact assessment forms part of the Act, and this requires that Namibia's cultural heritage be protected and respected for the benefit of present and future generations. Other applicable laws and policies relevant to the protection of heritage resources globally are the international standards and protocols expected to be followed to ensure best practice during development activities. For instance, Performance Standard 8 of the International Finance Corporation's (IFC) Performance Standards on Environmental and Social Sustainability (2012) addresses both national and world cultural and natural

heritage. The standards apply whether or not the heritage material is protected, irrespective of whether it may have been previously disturbed. Furthermore, Namibia being a state party to the World Heritage Convention, the country strictly follows and adopts the operational guidelines for the implementation of the convention that aim at facilitating the implementation of the convention concerning the protection of the inscribed world cultural and natural heritage properties on the World Heritage List against any deterioration or disappearance of these most prized assets because of their exceptional qualities, which have been considered to be of “outstanding universal values”.

6. METHODOLOGY AND IMPACT ASSESSMENT

This archaeological survey followed a basic two-phase process of evaluation: the desk study, followed by an assessment based on the field survey. Field investigations included extensive examination of the site surfaces through field transect approaches such as walking across the landscape in parallel lines of about 20 m intervals from the limit of the project

Figure 10 while recording surface artefacts using conventional criteria of physical setting and archaeological affinity through photography, general description, and GPS locations to aid the field survey.



Figure 10: Archaeological field surveys along the proposed ammonia pipelines. Source: (RCHS, 2024g).

It is important to point out that no surface collections were made for analysis during this survey. Additional data were obtained through available records on palaeontological and archaeological data in the project areas. Such data were generated from a series of publications from multidisciplinary research. The objectives of the impact assessment are to identify potential archaeological and other heritage resources within the footprints of the project and its immediate surroundings and to find best practice measures to enhance positive impacts and avoid, minimise, or mitigate the negative impacts, either by recording or preservation. If possible, any form of impact is to be avoided by finding alternatives to

damage or destruction. Actions that cannot be avoided or minimised ought to be mitigated in an effort to reduce the impact as much as possible. This procedure is dependent on the size of the site, its state of preservation, and its values and significance. The principle behind the mitigation is that no final decision on the site's future can be made until it has been demonstrated that all measures to avoid, minimise, and mitigate have been fully explored.

In Namibia, the significance and vulnerability rating of heritage impact assessment follow standard methodology devised by the National Heritage Council with its “Guidelines for Heritage Impact Assessment of the National Heritage Council (2021)” shown in **Table 1** and **Table 2** and those adopted by the Council on the basis of an evaluation developed by the Quaternary Research Services (Kinahan 2012).

Table 1: Heritage Significance rating table with key attributes adopted by the National Heritage Council, 2021.

LEVEL OF SIGNIFICANCE	GRADING	DESCRIPTION
Exceptional/upper higher	5	- Major national heritage resources. - Rare & outstanding example. - Containing unique evidence of high regional & national significance.
Considerable high	4	- Very important to the heritage of the region. - High degree of integrity/ authenticity. - Multi-component site and objects - High research potential
Moderate	3	- Contributes to the heritage of the locality and region - Has some altered or modified elements, not necessarily detracting from the overall significance of the place. - Forming part of an identifiable local distribution or group. - Research potential.
Low	2	- Isolated minor find in undisturbed primary context, with diagnostic materials - Makes some contribution to the heritage of the locality, usually in the combination with similar places or objects.
Little	1	- Makes little contribution to the heritage resources of the locality. - Heritage resources in a disturbed or secondary context, without diagnostic or associated heritage.
Zero/ no significance	0	- Absence of heritage resources - Highly disturbed or secondary context, without diagnostic or associated heritage

Table 2: The vulnerability rating table with key attributes adopted by the National Heritage Council, 2021.

VULNERABILITY RATING
0. Not Vulnerable 1. No threat posed by current or proposed development activities 2. Low or indirect threat from possible consequences of development (e.g. soil erosion)

3. Probable threat from inadvertent disturbance due to proximity of development
4. High likelihood of partial disturbance or destruction due to close proximity of development
5. Direct and certain threat of major disturbance or total destruction

In an effort to measure the sensitivity of archaeological sites considering their significance and vulnerability rating in Tables 1 and 2, the assessment also estimated the extent of the possible impact, the magnitude of the impact, and the duration of these impacts on sensitive heritage resources. The scales of estimation developed by Quaternary Research Services (Kinahan 2012) are replicated below in **Table 3**.

Table 3: Assessment criteria for the evaluation of cumulative impacts on archaeological heritage sites adopted by the National Heritage Council, 2021.

CRITERIA	CATEGORY	DESCRIPTION
Extent or spatial influence of impact	National Regional Local	Within Namibia Within the Region On site or within 200m of the site impact
Magnitude of impact (at the indicated spatial scale)	High Medium Low Very Low Zero	Social and/or natural functions and/ or processes are severely altered Social and/or natural functions and/ or processes are notably altered Social and/or natural functions and/ or processes are slightly altered Social and/or natural functions and/ or processes are negligibly altered Social and/or natural functions and/ or processes remain unaltered
Duration of impact	Short Term Medium Term Long Term	Up to 3 years 4 to 10 years after construction More than 10 years after construction

7. COMMUNITY CONSULTATION

The public participation process is a critical and integral part of the HIA process, and it was deemed necessary that affected local communities, authorities, and interest groups in Walvis Bay are engaged on heritage matters with respect to the proposed ammonia pipeline routes to provide their input into the planned development as the impacts may directly or indirectly affect them. These consultations provide stakeholders with the opportunity to provide input on issues related to the project on matters of heritage in an effort to supplement secondary data and bridge gaps in heritage knowledge of the area by identifying key heritage features, elements, or aspects that the present-day communities living near the proposed development value, such as tangible and intangible heritage resources, in an effort to safeguard them.

The EIA public consultation on the proposed ammonia pipeline and its associated infrastructure development was commissioned by ECC and commenced in March 2024 with the community directly affected and/or interested and key stakeholders. Public meetings and focus group meetings were held in Walvis Bay, Swakopmund, and Arandis. Additional notices advertising the public meetings were also published in national newspapers and in the media. For heritage aspects, the Ministry of Environment, Forestry, and Tourism office in Swakopmund, which manages Dorob and Naukluft National Park, was engaged on May 27, 2024. However, only two heritage features were pre-identified, namely the historic regimentals (insignias) created in the Namib desert belonging to the second battalions of three of South Africa's fighting units, namely the Durban Light Infantry, the Transvaal Scottish, and the Kimberley regiments, that were likely posted to guard duty on the rebuilt railway line between Swakopmund, Omaruru, and Windhoek during WWI in 1915 between the Allied Forces and German Forces (Schutztruppe). Therefore, although significant, the sites are fortunately not vulnerable to the proposed ammonia pipelines and will not be directly affected by this development.

8. THE RECEIVING ENVIRONMENT

The proposed ammonia pipeline will be located between Arandis and Farm 58, which covers at least 3,000 hectares (ha) east of Dune 7, an area designated and rezoned for industry. The entire environment surrounding the pipeline is characterised by different environmental settings, with overall elevation increasing towards the east, where Arandis lies. Such environmental features include dune fields, sandy gravels, drainage systems with ephemeral streams, and river systems of the Swakop, Khan, Zawichab, and Tumas Rivers, as well as deeply incised tributaries feeding these rivers. Mountain landscapes, hill saddles, dolerite dykes, and isolated outcrops are also common. These features are easily identifiable from various mappings (hydrological, geological, topographic, etc.) of the project, thus allowing them to be easily mapped through geospatial analysis (see ECC Report No.: ECC-145-480-REP-31-C).

Vegetation cover along the ammonia pipeline from Farm 58 to outside Arandis, including alternate routes 2 and 3, varies considerably, typical of the Namib Desert's biotic communities. The endemic shrubs like Hummock dune species such as *Sasola nollothensis* shrub, *Zygophyllum clavatum*, *Psilocaulon salicomioides*, *Salsola nollothensis*, and *Salsola aphylla* (Giess, 1971) cover mainly the gravel plains within the Dune Belt area near Farm 58, while sparse grassland and dwarf shrubland are commonly found along small ephemeral drainage lines. A rich compendium of local flora endemic to this desert environment, such as *Aloe asperifolia* (sand paper aloe), *Arthroa leubnitziae* (pencil bush), *Zygophyllum stapfii* (dollar bush), *Adenia pechuelii* (Elephant's foot), and *Stipagrostis* grasses, predominate the Namib plains, hill saddles, and rocky outcrops in the area (**Figure 11**), while endemic species such as *Acacia reficiens* (Reb umbrella thorn) and *Parkinsonia africana* (green-hair tree) are confined along the major river

systems such as Swakop and Khan Rivers (Henschel et al., 2005; Burke, 2005). The only living fauna species observed during the field survey was *Antidorcas marsupialis* (springbok) within the Swakop River Canyon area of the moon landscape in close proximity to the proposed ammonia pipeline alternative route 2 and the skeletal remains of *Struthio camelus* (ostrich) near the dune belt along the proposed ammonia pipeline route near farm 58 (

Figure 12). However, the distribution of species occurring in this part of the Namib Desert varies a great deal according to the season. The most obvious of these species are *Ovyx gazella*, *Oreotra-gus oreatragus*, *Xerus inauris*, etc., according to Stuart (1975).



Figure 11: Various plant species within and along the proposed ammonia pipeline and alternate routes 2 and 3. Source: (RCHS, 2024g).



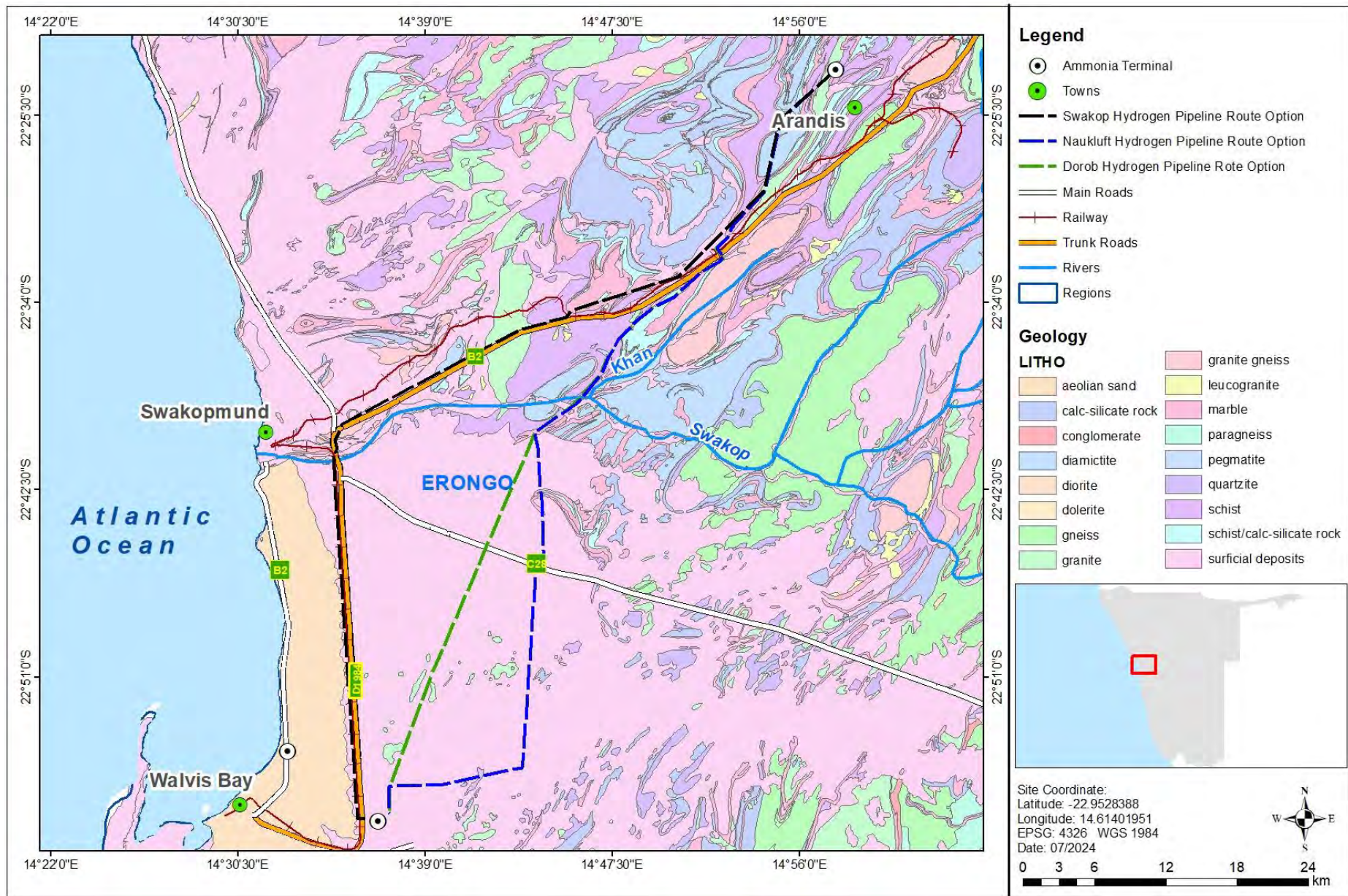
Figure 12: Left image show a resting springbok within Swakop River while the right image are the skeletal remains of ostrich specie along the proposed ammonia pipeline route near the dune field. Source: (RCHS, 2024g).

9. GEOLOGICAL SETTING

According to the geological map (**Figure 14**), the main lithological sequences that underlie the footprint of the project vary. These consist of aeolian sand deposits along the dune fields belonging to the Namib Sands and the Swakop Group. The Swakop Group is underlain by the predominantly coarse-clastic Nosib Group, which represents the oldest part of the Damara succession with surficial deposits of granite gneiss, quartzite, calcrete, and pegmatite as shown in (**Figure 13**) below:



Figure 13: Above and below is the varied geological settings of the proposed ammonia pipeline project. Images source: (RCHS,2024g).



10. HERITAGE SETTING

Owing to the extensive archaeological investigations of the western Central Namib carried out by the Namib Desert Archaeological Survey as part of the environmental compliance requirements for prospection- related projects and mining, and the efforts of the Namibian heritage authorities to mitigate the negative impact of modern development on archaeological heritage resources, a wealth of archaeological evidence associated with hunting and gathering and nomadic pastoralist which declined and collapsed in the aftermath of historic contact exists. This provides a comprehensive understanding of detailed archaeological record and pattern of archaeological and historic site distribution reflecting a number of highly specific human adaptations to this arid environment from the late Pleistocene, Holocene and to the early colonial (late 19th century) (**Figure 15**).

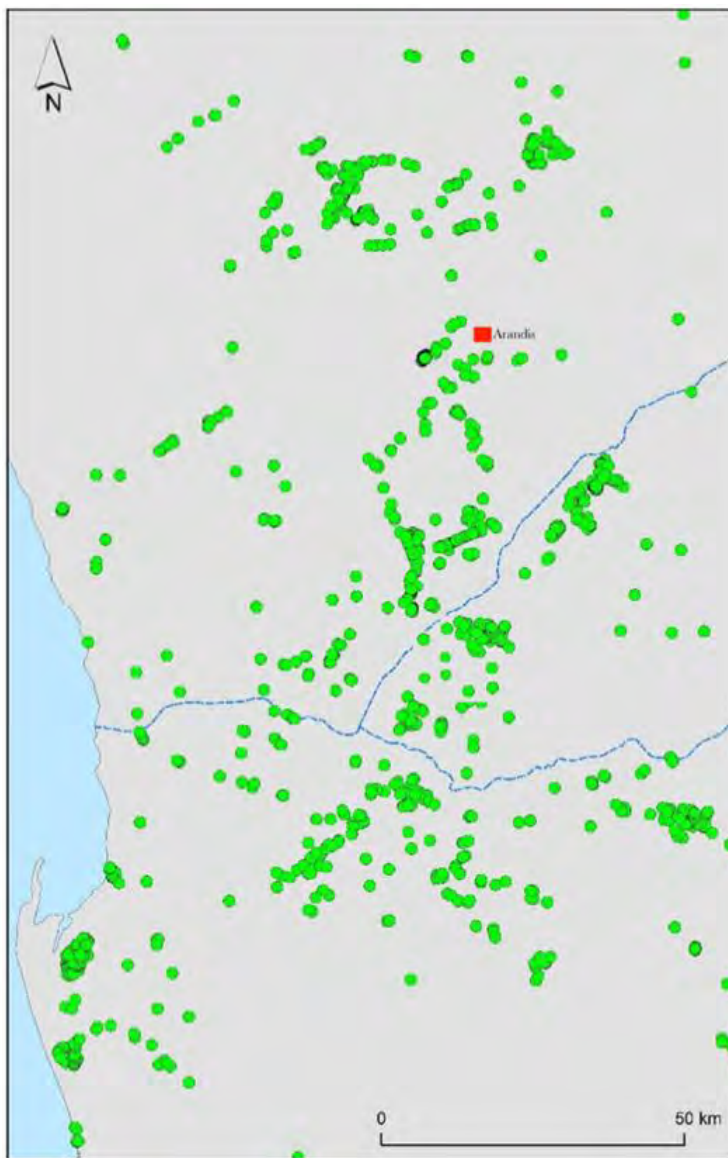


Figure 15: The edited map of distribution of archaeological sites in western Central Namib Desert in relation to ammonia pipelines. Source: (J. Kinahan April 2021: 9).

During the late Pleistocene and Holocene periods human occupation of the central Namib has been recorded mainly in isolated granite outcrops, dolerite dykes, drainage basins, hill saddles, sand gravels with few more sites concentrated along the coast as attested by the presence of local occurrences of lithic raw materials for artefact production (Kinahan 2022). The small basecamps were occupied by the small hunter-gatherer and pastoralists groups who exploited wild grass seed which they dug from the underground caches of harvester ants (*Messor* spp) (Kinahan 2022). The archaeological evidence related to the exploitation of wild grass seeds has been extensively studied, with available records from du Pisani (1983); Steyn & du Pisani (1984); Kinahan (1986, 2000); Sullivan (1999); and more especially by Kinahan (2010 and 2005) being more useful. The distribution and high density of these sites are reportedly clustering in the vicinity of water and other resources occurring on the eastern margins of the Namib desert, at the foot of the interior escarpment, and predominantly on the gravel plains of the central Namib, between the Khan and !Huiseb Rivers, and their association with particular terrain conditions is reportedly dating to the late first millennium and early second millennium AD (Kinahan 1986).

Ethnographically, the seed gathering economy is associated with nomadic pastoralists and, in particular, Khoekhoegowab-speaking communities that harvested varieties of *Stipagrostis* grasses during the last five hundred years to supplement the diet (Steyn & du Pisani 1984; Kinahan 2000; 2010). The seeds were apparently ground in the pestle and used to make porridge and sometimes beer, fermented with wild honey (Sullivan, 1999; Kinahan, 2010). According to Kinahan (2005), seed digging subsistence activity coincides with the severe ecological constraints when rainfall patterns become significantly reduced in the Namib Desert. Consequently, diminishing food resources such as hunted wild game prompted occupants to travel to remote locations and exploit harvester ant caches of seed where water sources were reliable, which caused a heavy reliance on wild grass seed. Most of the excavated seed digging sites in the Namib Desert have not yielded any material culture due to the fact that some stored seed germinates after a short rainfall event but does not reach the harvesting stage as it dries up. Furthermore, these seed caches also attract rodents and a range of other animals as a valuable source of food for them.

Regrettably, the sites are often poorly preserved, which not only reduces their scientific value but also makes them less understood. Therefore, grass seed exploitation should be viewed as incredibly unique and confined to the Namib Desert only. Such records therefore provide significant evidence for the evolution and development of food storage for food security that promote population growth of hunter-gatherers during the late pre-colonial period (Kinahan 2020). Further, a number of colonial heritage features from the late 19th and early 20th centuries have been recorded in the Namib desert in surrounding areas of the proposed ammonia project. Buildings, mainly related to farming and general commercial activities, WWI battlefield grounds, i.e., around Trekkopje, Husab plains, Pforte, Jakalswaters, and historic railway lines, historic routes, regimental insignias, and a number of surfaces, including finds of colonial bottle glass and related debris discarded at different base camps occupied by the European

merchants and activities related to the Allied Forces and German Schutztruppe in 1915, are recognisable sections of the historical legacies of the Namib desert.

11. ASSESSMENT FINDINGS

The initial field survey and assessment have located at least twelve ($n = 12$) heritage features along and immediately surrounding the proposed ammonia pipeline from Farm 58 to Arandis, as well as along and directly within the ammonia pipeline routing 2 and 3. These are presented in **Table 4** and in Figures 19 to 30, respectively:

- One (1) World War I (ca. April – May 1915) regimental insignia by the Durban Light Infantry and the Kimberley regiments of the second battalions fighting units laid in stones on Rossing Mountain on Farm 58 by the second Durban Light Infantry, dating from 1915, and declared a national monument in 1915 (
○ **Figure 19**).
- One (1) late Pleistocene Middle Stone Age artefact made from chert of a yellowish brown colour, which forms an important component of stone artefact assemblages associated with the gravel plains of the area in hydrothermal vein quartz and crystalline quartz geological settings, indicates that they were likely locally sourced (
○ **Figure 20**).
- One (1) isolated seed digging site in a disturbed setting along a small tributary in the gravel plain measuring 58 m (
○ **Figure 21**).
- One (1) regimental insignia badge, a thistle 'button' of eight feet in diameter, overlooking Rossing Mountain, detailed in brown and white stone and gravel, located on a hill saddle built by the second Transvaal Scottish. The fort was likely surrounded by barbed wire supported by steel posts, whose remnants are still visible (
○ **Figure 22**).
- One (1) stone features on a dolerite ridge, which may likely contain important material evidence of desert subsistence strategies or a burial cairn (
○ **Figure 23**).
- One (1) colonial settlement likely from the late 19th to early 20th century was directly within the proposed ammonia pipeline routing 2, east of the Swakop River, at the foot of an imposing mountain along a small tributary (
○ **Figure 24**).

- One (1) potential seed digging site located 128.15 m from the proposed ammonia pipeline routing 2, forming a group of nine other seed digging sites along a river course (**Figure 25**).
- One (1) isolated heap of discarded debris materials of rusted tins and broken glass bottles located 79.59m from the proposed ammonia pipeline routing 2 in a gravel plain (**Figure 26**).
- Two (2) potential grave cairns are located about 97 m from the proposed ammonia pipeline routing 2 within a small river course (**Figure 27**).
- Four (4) groups of four digging sites directly within the proposed ammonia pipeline alternate routes 2 and 3 on a gravel plain (**Figure 28**).
- One (1) isolated surface MSA unifacial point, silcrete directly within the proposed ammonia pipeline, alternate routings 2 and 3 (**Figure 29**).
- One (1) potential seed digging site located 137.23m m from the proposed ammonia pipeline routing 3 between two powerlines (**Figure 30**).

The second field survey and assessment have located at least six ($n = 6$) heritage features (**Figure 17**) along and immediately within the surroundings of the proposed deviated ammonia pipeline from Farm 58 to Arandis. This brings together an overall total number of eighteen ($n=18$) heritage features recorded along the green ammonia pipeline (**Figure 18**).

Heritage features recorded during the second field survey are presented in **Table 4** and in Figures 33 to 35, respectively:

- One (1) series of 87 small stone features with a diameter of 90cmx1.2m along a small hill located about 112m from the proposed final ammonia pipeline route to Arandis (**Figure 31**). These were likely gathered during the construction of the historic railway line adjacent to the outcrop.
- Four (4) potential burial cairns located along the proposed final ammonia pipeline route to Arandis from 30.9m, 25.56m and 3.46m respectively (**Figure 32, Figure 33, Figure 34 and Figure 35**).
- One (1) rock engraving site was discovered on a diabase outcrop that spreads horizontally (west-east) (**Figure 36 and Figure 37**) among one of the small tributaries of the south side of the Swakop River crossing, approximately 15.50 meters from the proposed final ammonia pipeline route.

Table 4: Present the list of potential archaeological sites and historic heritage resources within and around the proposed project.

Site Coordinates	Description	Typology	Distance from the proposed ammonia development	Vulnerability Rating	Significance Rating	Recommended Measures
22° 34' 29.562" S 14° 45' 17.292" E Site 01	World War I (ca April –May 1915) regimental insignia of 2nd Batt. Kimberley Regt. and Durban Light Infantry.	Declared Historic Site, in 1978.	284.49m from the proposed ammonia pipeline route to Arandis	0	5	No-Go-Zone and no further mitigations required.
22° 32' 40.338" S 14° 50' 39.978" E Site 02	Superficial find of lithic artefacts on gravel plain	Archaeological	74.06m from the proposed ammonia pipeline route	2	3	No-Go-Zone and erection of a buffer zone of 50m
22° 32' 25.8" S 14° 51' 1.578" E Site 03	Isolated seed digging site	Archaeological material	72.20m from the proposed ammonia pipeline route	2	2-3	No-Go-Zone and erection of a buffer zone of 50m
22°29'13.14"S 14°54'33.91"E Site 04	World War I (ca April –May 1915) regimental insignia of 2nd Batt. Kimberley Regt. and Durban Light Infantry.	Historic Site early 20th century	607.71m from the proposed ammonia pipeline route	0	5	No-Go Zone and no further mitigations required.
22°24'56.88"S 14°55'54.38"E Site 05	Stone features on crest of ridge	Archaeological	6.41m from the proposed ammonia pipeline route	4	1	No-Go-Zone and create a buffer zone of 20m and 50m
22°40'11.16"S 14°43'50.83"E Site 06	Colonial settlement of 120m	Historical, late 20th century	Directly within the proposed ammonia pipeline alternate routing 2	5	1-2	Avoid and deviate at least 50m from the site

22°53'45.40"S 14°38'6.72"E Site 07	A potential seed digging site	Potential archaeological	128.15m from the proposed ammonia pipeline alternate routing 2	0	3	No-Go-Zone and create a buffer zone of 20m and 50m
22°53'49.04"S 14°38'7.06"E Site 08	Isolated heap of discarded debris materials	Potential Historic Site	79.59m from the proposed ammonia pipeline alternate routing 2	0	0-1	No further mitigations required
22°55'53.47"S 14°37'10.38"E Site 09	Two potential burial cairns	Potential Historical	353.97m from the proposed ammonia pipeline alternate routing 2	0	3	No-Go-Zone and create a buffer zone of 20m and 50m
22°56'6.10"S 14°37'21.37"E Site 10	A group of 4 seed digging site	Archaeological	Directly within the proposed ammonia pipeline alternate routing 2 and 3	5	3	Tests excavate or deviate 20m and 50m from the localized group of seed digging sites.
22° 57' 10.962" S 14° 37' 22.662"E Site 11	Isolated MSA unifacial point, silcrete	Archaeological	Directly within the proposed ammonia pipeline alternate routing 2 and 3	5	3	Surface collection of the tools
22°55'58.00"S 14°39'14.25"E Site 12	Potential seed digging site	Potential archaeological	137.23m from the proposed ammonia pipeline alternate routing 3	0	1	No further mitigations required
22° 29' 26.178" S /14° 53' 53.448" E Site 13	Stone features on crest of a ridge	Potential historic	112m from the proposed final ammonia pipeline route	0	1	No further mitigations required
22° 28' 17.508" S /14° 53' 14.718" E Site 14	Potential burial cairn	Archaeological	30.9m from the proposed final ammonia pipeline route	4	4	GPR survey and Tests excavate to confirm identification of the cairn a burial site. Or deviate 50m from the site to avoid the entire site with a buffer zone of 50m.
22° 28' 26.25" S/ 14° 53' 19.992" E Site 15	Potential burial cairn	Archaeological	25.56m from the proposed final ammonia pipeline route	4	4	GPR survey and Tests excavate to confirm identification of the cairn a burial site. Or

						deviate 50m from the site to avoid the entire site with a buffer zone of 50m.
22° 27' 3.012" S 14° 52' 27.192" E Site 16	Potential burial cairn	Archaeological	3.46m from the proposed final ammonia pipeline route	5	4	GPR survey and Tests excavate to confirm identification of the cairn a burial site. Or deviate 50m from the site to avoid the entire site with a buffer zone of 50m.
22°21'48.56"S 14°58'43.85"E Site 17	Potential burial cairn	Archaeological	52.3m from the proposed final ammonia pipeline route	3	4	Deviate and erect a buffer zone of 10m, 20m, 30m and 50m
22° 39' 58.932"S/ 14° 42' 50.682" E Site 18	Rock Engraving site		15.50m from the proposed final ammonia pipeline route	4	4	Deviate behind the outcrop and erect buffer zones at 10m and 20m from the pipeline

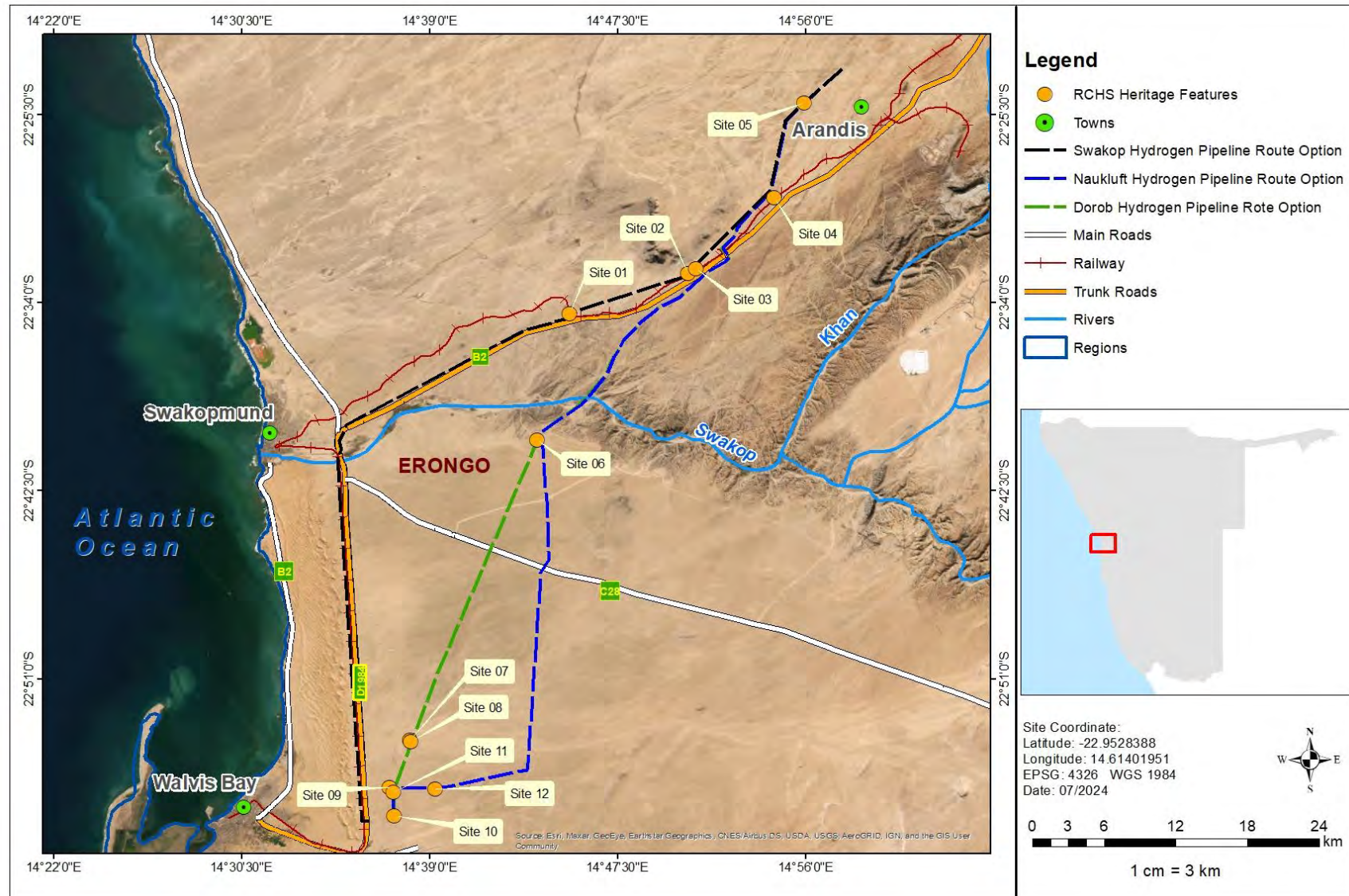


Figure 16: The distribution of all heritage resources located within and around the project footprint of the proposed ammonia pipelines including routing 2 and during the initial survey and assessment. Cartographer: (Maria Sigopi at (RCHS, 2024g).

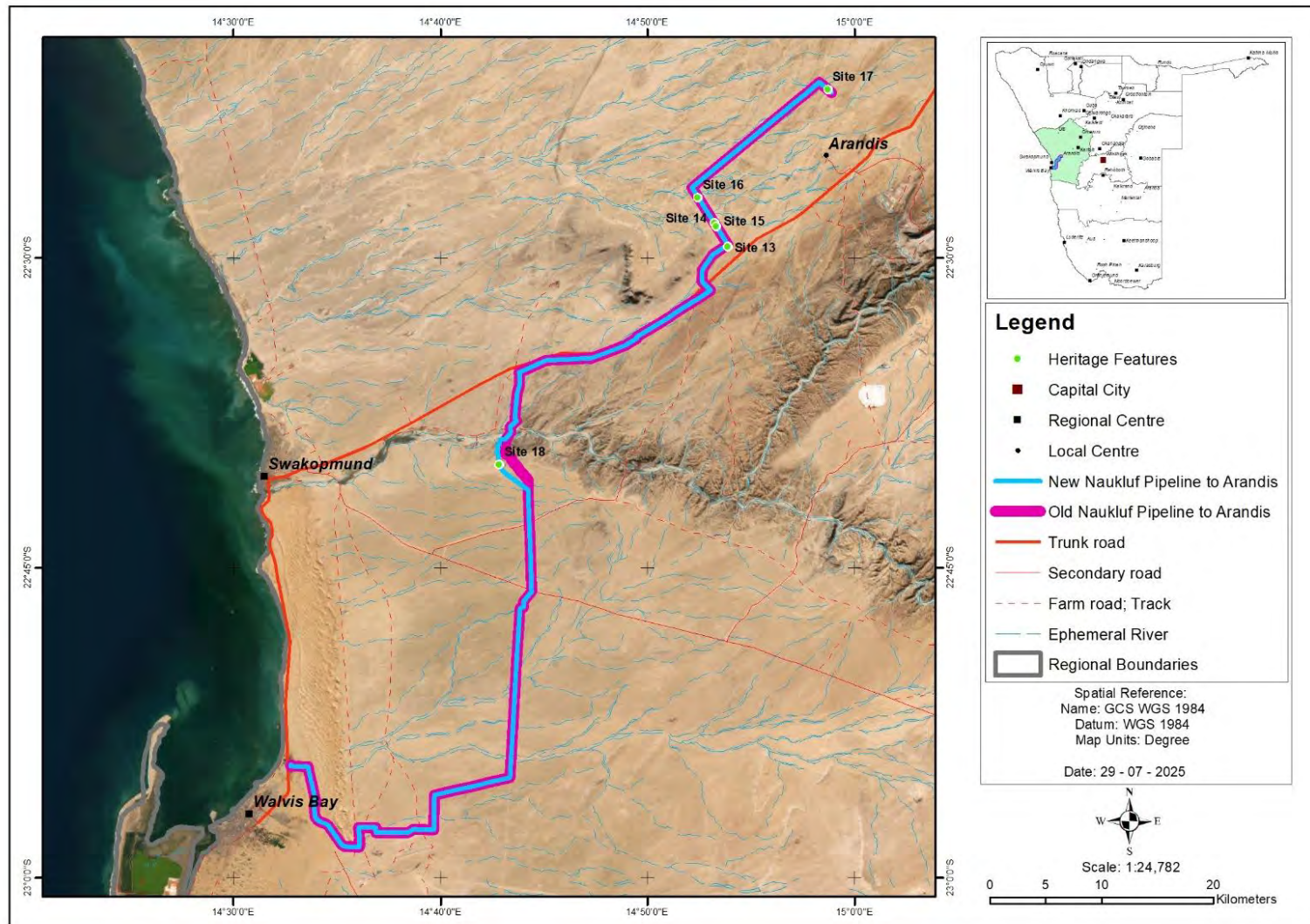


Figure 17: Location of heritage features recorded during the second field survey and assessment. Cartographer: (Maria Sigopi at RCHS, 2025c).

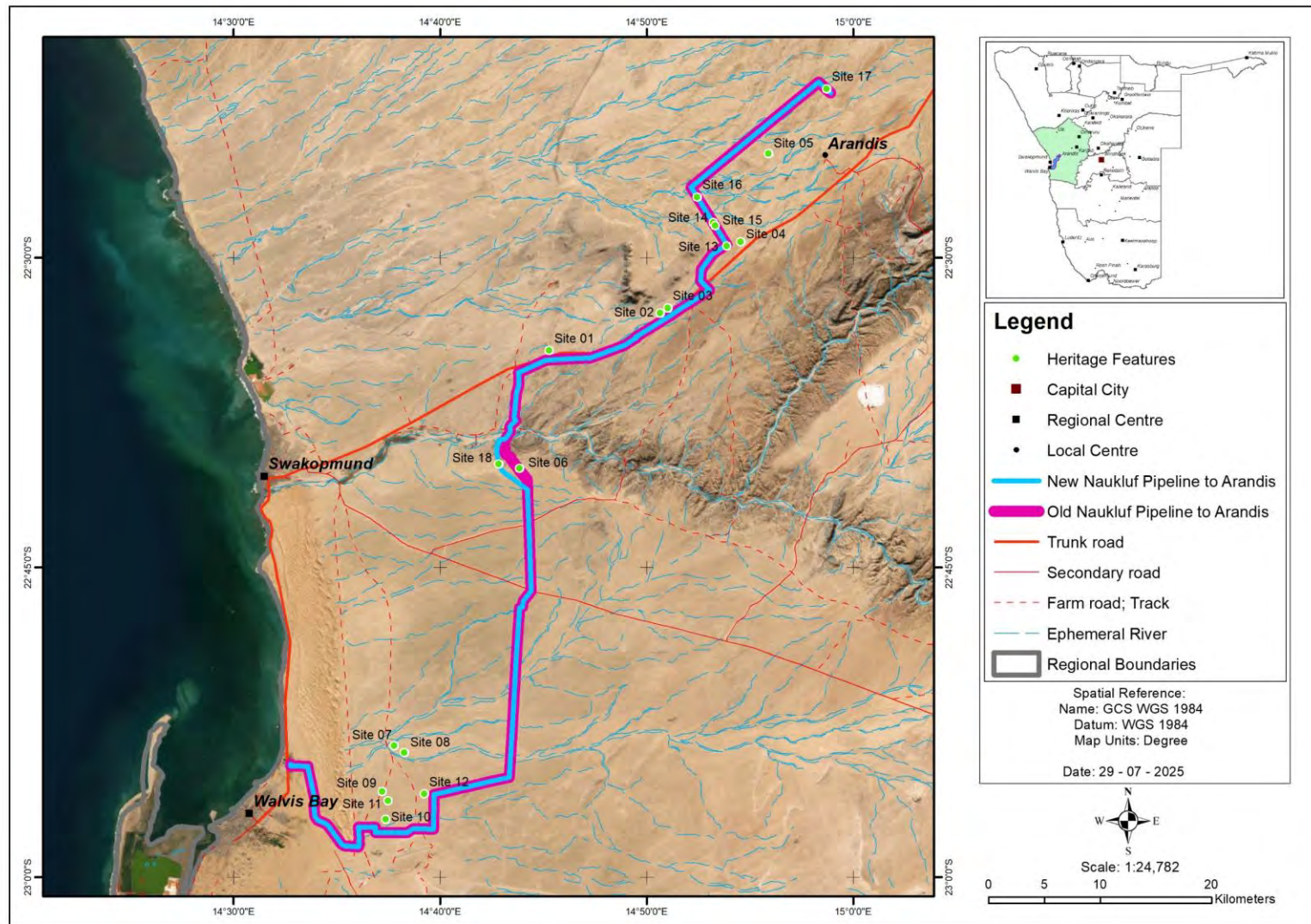


Figure 18: An integrated map of all heritage features recorded along the green ammonia pipeline routes from Farm 58 to Arandis. Cartographer: (Maria Sigopi at RCHS, 2025b).

As revealed by numerous field surveys, the Namib Desert has a number of key historic features related to the used as a station on the narrow gauge railway line between Swakopmund and Karibib, have been recorded, especially within and around the battlefields recorded in the Husab Plains at Reit, Pforte, and Trekkopje and at Jakalswaters (Kinahan and Stejskal 2011). One of the well-known World War I (ca. April–May 1915) regimental insignia by the Durban Light Infantry and the Kimberley regiments of the second battalions fighting units is laid in stones on Farm 158 and was declared a national monument in 1915, as shown in

Figure 19. The site is significant in terms of the National Heritage Act (27 of 2004), but it is not vulnerable nor will it be directly impacted by the proposed ammonia pipeline as it is located 284.49 m away from it.



Figure 19: Above and below is the World War 1 regimental insignia on a hill saddle declared as national monument site in 1915. Source: (RCHS, 2024g).

These late Pleistocene Middle Stone Age artefacts made from chert appear to be in primary context, thereby elevating the information potential of the site as they form part of an important component of stone artefact assemblages associated with the gravel plains of the area in hydrothermal vein quartz and crystalline quartz geological settings in the Namib (

Figure 20). The site is significant (rated 3) in terms of the National Heritage Act (27 of 2004); its vulnerability rating is 2 although it will not be directly impacted by the proposed 74.06 m away from the ammonia pipeline, a buffer zone of 50 m from the pipeline is required while its locality be designated as a no-go zone.



Figure 20: Left image is the location of the site where the MSA chert tool has been record. Right image are some of the actual tools at the site. Source: (RCHS, 2024g).

The isolated seed digging site (

Figure 21) is likely related to the short-term occupation of the area by small hunter-gatherer groups exploiting wild grass seed that they dug from the underground caches of harvester ants (*Messor* spp.). The seed digging is in close proximity to a river course, and its slightly eroded reducing its scientific value. Hence, its significant ratio stands at 2 in terms of the National Heritage Act (27 of 2004), while its vulnerability rating is 2 on a scale of 5. The site will not be directly impacted by the proposed ammonia pipeline as it lies 74.06 m away from it. However, a buffer zone of 50 m from the pipeline is required while its locality is designated as a no-go zone.



Figure 21: The isolated seedling site along a river course. Source: (RCHS, 2024g).

This World War I (ca. April–May 1915) regimental insignia (

Figure 22) was also created by the second Battalion Kimberley Regiment and Durban Light Infantry. The site is outside the boundaries of the proposed ammonia pipeline and should not be directly affected by this project. Its historic significance is linked to other WWI historic features in the Namib desert.





Figure 22: Shows the WWI second regimental badge in the imposing Rossing Mountain laid out in stones by the Kimberley Battalion Regiment and Durban Light Infantry. Source: (RCHS, 2024g).

A series of at least four well-preserved stone features along the crest of the dolerite ridge, comprised of slightly disturbed cairn features (

Figure 23). The sites lie at least 6.41 m from the proposed ammonia pipeline towards Arandis, making them vulnerable to the project. However, if a buffer zone of 5–10 m is erected, the sites can be protected while their immediate surroundings area be designated as a no-go zone. The site is significant in terms of the National Heritage Act (27 of 2004); hence, due to its vulnerability ratio of 4, it will be directly impacted by the proposed ammonia pipeline if mitigation measures devised are not implemented.



Figure 23: A serie of stone cairn features on a dolorite ridge along the proposed ammonia pipeline. Source: (RCHS, 2024g).

Historic sites located within and surrounding the Swakop River are linked to a number of colonial settlements (

Figure 24) related to farming and general commercial activities in the Goanikontes area. Some of these sites were important staging posts that allowed the rapid movement of troops and supplies to the interior of the country. The site contains a number of surface finds, such as remnants of colonial buildings, colonial bottle glass, water tanks, and other scrap rusted metal debris discarded around the area. The site occupies a surface area of about 120 m², but its significant ratio is very low, between 1-2, due to the fact that the area is quite disturbed with off-road tracks, the construction of large powerlines, and various biking routes. Although its vulnerability ratio is rated 5 because it will be directly impacted by the proposed ammonia pipeline routing 2, no further mitigation measures are required.



Figure 24: A historic settlement along the proposed ammonia pipeline alternate routing 2 in a d very disturbed setting. Source: (RCHS, 2024g).

This potential seed digging site (

Figure 25) appears to be disturbed either by passersby due to its proximity to a track road or because the cache might have attracted rodents and a range of other animals as a valuable source of food for them. It is for this reason that the site is relatively poorly preserved, which reduces its scientific value. However, the site forms part of a group of other sites in the locality, but they are located beyond 200 m from the proposed ammonia pipeline routing 2. The site is neither vulnerable as its rating stands at 128.15 m away, but it is still significant as it provides significant evidence for the evolution and development of food storage for food security that promoted population growth among hunter-gatherers during the late pre-colonial period.



Figure 25: A potential disturbed seed digging site in the gravel plain towards Farm 58. Source: (RCHS, 2024g).

This potential historic site (

Figure 26) lies in the gravel plain along a river course. It contains heaps of discarded debris materials indicating an old post (settlement, industrial or trading area), with remnants of rusted metal drums and copper wires, rusted corrugated sheet, or rusted car parts, car tires. It appear to be related to the 17th to

19th centuries trading activities between European merchants and indigenous trading communities. The site is located 79.59 m from the proposed ammonia pipeline alternate routing 2, hence it is not vulnerable. The site is not significant in terms of the National Heritage Act (27 of 2004), as its significance ratio is rated at 0-1. Besides, it will not be directly impacted by the proposed ammonia pipeline, and no further mitigation measures are required.



Figure 26: A potential historic site within the calcite gravel plain in proximity to a river course. Source: (RCHS, 2024g).

Two potential burial cairns (

Figure 27) located at these GPS coordinates (Lat: 22°55'53.47"S and Long: 14°37'10.38"E) have been identified within a small river course approximately 353.97 m from the proposed ammonia pipeline alternate routing 2. The cairns are well preserved, consist of an oval-shaped mound slightly elevated off the ground to approximately 12 cm, and appear to be covered with isolated loose stones. The cairns do not bear any headstone or stele but appear to be in primary context. Based on the grave topping, it is

possible that such potential graves might date from the historic period. Fortunately, like all the heritage resources recorded within the project, the potential graves do not require further mitigation as they are not directly impacted by the proposed infrastructure development. If they were directly affected, a ground-penetrating radar scan (GPRS) would have likely been used to confirm if they were truly graves or not. If they are graves, they are protected under the Burial Places Ordinance (27 of 1966) and the National Heritage Act (27 of 2004) if they are older than 50 years.



Figure 27: The environmental setting of potential burial cairns within a river course. Images source: (RCHS, 2024f).

A cluster of at least four seed digging sites (**Figure 28**) located at these GPS coordinates (Lat: 22°56'6.10"S and Long: 14°37'21.37"E) have been recorded directly within the proposed ammonia pipeline alternate routing 2 and 3 within the calcite gravel plain. With 1–2 m in diameter, the sites appear to relate to the short-term occupation of the area by small hunter-gatherer groups who likely exploited wild grass seed that they dug from the underground caches of harvester ants (*Messor* spp.) in the nearby river courses and small tributaries. The sites are well preserved and scattered within 5 to 10 m of each other and are quite visible from satellite mapping. The only associated remains were a superficially rusted small drum that appeared to be in secondary deposition. The sites are relevant in terms of the National Heritage Act (27 of 2004) with a significant ratio of 3, but are highly vulnerable. Since they are directly affected by the proposed ammonia pipeline alternate routings 2 and 3, management measures may include test excavations to confirm if they are seed diggings or if the project can deviate at least 50 m from these localised group seed diggings, and the area can be demarcated as a no-go site.



Figure 28: A cluster of seed digging sites along the proposed ammonia pipeline routing 2 and 3. (RCHS, 2024f).

An isolated surface occurrence of late Pleistocene Middle Stone Age unifacial point (**Figure 29**) made from cherted onyx of a yellowish colour has been recorded 10 m before where the proposed ammonia pipeline alternate routings 2 and 3 project ends. The tool is in secondary context and appears to have been carried over considerable distances through the nearby river course or aeolian winds, as there is no associated archaeology. The tool is relevant in terms of the National Heritage Act (27 of 2004) with a significant ratio of 3, but is highly vulnerable. Therefore, the recommended mitigation measure is the surface collection of the tool at the local museum in Swakopmund to allow the project to proceed.



Figure 29: Left image is the environmental setting of where the tool was discovered. Right image is the tool itself directly in the proposed ammonia pipeline routing 2 and 3. (RCHS, 2024f).

The last site recorded in the initial phase of the project is a potential isolated seed digging site (**Figure 30**) located at these GPS coordinates (Lat: 22°55'58.00"S and Long: 14°39'14.25"E) and lies about 137.23 m from the proposed ammonia pipeline alternate routing 3 and recorded between two powerlines. Its physical setting is disturbed by activities related to the construction of the powerlines and off-road vehicles around the area. Nevertheless, the site is neither vulnerable nor has a significant ratio of 1 in terms of the National Heritage Act (27 of 2004). Therefore, no further mitigations are required.



Figure 30: A potential seed digging site in a disturbed setting. Source: (RCHS, 2024f).

Site 13 is the first recorded site in the second phase of the project. It is another group of gathered stone features on the eastern side of the dolerite ridge (**Figure 31**). These features measure 90 cm x 1.2 m while overlooking the railway line and flat plains. The site is not vulnerable to the proposed final pipeline route to Arandis, as it's located approximately 112 m from it. The stones are not of heritage value, as they were likely gathered, collected, and then crushed as ballast stone for the construction of the historic railway between 1897 and 1902 that runs between Swakopmund and Omaruru. No cultural items were observed on or near this site.



Figure 31: A serie of stones that were likely gathered, collected and crushes as ballast stones for the railway line in the foreground of the top image. Source: (RCHS, 2025c).

Site 14 recorded in the project is a potential burial cairn that is made with loose diabase fragments in roughly circular arrangements with a diameter between 1.2 m and 1.6 m (**Figure 32**). The site is located along a small dry stream with a scatter of small bushes. Only one late Pleistocene Middle Stone Age

artefact made from chert, likely in secondary deposition, is the associated cultural item observed at the site. Some of the diabase fragments of the potential cairn are standing in a vertical position with a heap of soil in the middle that was likely eroded by rainfall while some fragments appear to have been fallen due to water erosion. Furthermore, the cairn gives the impression that it was hand-sorted fragments and is therefore considered as a possible burial cairn. The site is located approximately 30.9 m from the proposed final ammonia pipeline route; hence, it has a vulnerability rating of 4. This potential burial feature is significant in terms of the National Heritage Act no. 27 of 2004. On the basis of these strands of evidence, the site is considered to be an important burial site until proven otherwise through a GPR survey and then test excavation to confirm its identification as a burial site.



Figure 32: Image above and below present a potential burial cairn and associated tool at Site 14. Source: (RCHS, 2025c).

Site 15 is second potential burial cairn similar in morphology to the previous site, 14. It is also made of medium sized loose diabase stone fragments in roughly circular arrangements with a diameter of 1.4 m and 1.7 m (**Figure 33**). The site is located on a flat plain with shallow dry grass. No associated cultural materials have been observed in its immediate surroundings, but it's about 500 m from the previous site. Unlike the previous site, this one is moderately preserved, with vehicle tracks observed 20 m from it—giving an impression that it may have been slightly disturbed by onlookers, hence the displacement of some stones toward the northern side of the circle. The site is located about 25.56 m from the proposed ammonia pipeline route. It's therefore considered to be highly vulnerable to this proposed development. A deviation of about 50 m from the site to avoid potential encroachment and disturbances is required, and/or a GPR survey and test excavation to confirm its identity as a cairn as a burial site.



Figure 33: Presents a secondary potential burialm cairn found in vicinity of the proposed project. Source: (RCHS, 2025c).

Site 16 is the third potential burial cairn that was recorded during this field campaign. Unlike the previous cairns, this one has small loose quartzite stone fragments in a perfect circular arrangement with a diameter between 1.3 m and 1.5 m (**Figure 34**) with large stones placed in the middle of the circle as well as two long stone arrangements attached to it facing east. Half of the site is covered with dry grass cover, while the other appears to have been recently cleaned. No other associated cultural materials were observed in its immediate surroundings, but vehicle tracks and human footprints were observed. All the quartzite fragments vertically lay flat to the ground in a horizontal position with a heap of soil in the middle. Furthermore, the potential cairn was hand-sorted and well designed and is therefore considered as a possible burial cairn. The site is located about 3.46 m from the proposed final ammonia pipeline route; hence, it is highly vulnerable with a rating of 5. This potential burial feature is significant in terms of the National Heritage Act no. 27 of 2004 until proven otherwise through a GPR survey and then test excavation to confirm its identification as a burial site.



Figure 34: Above and below present Site 16 with its content. Source: (RCHS, 2025c).

Site 17 is the fourth and final potential burial cairn that was recorded in this field campaign. It is made out of diabase fragments in roughly elliptical arrangements, ranging from 0.8 to 1.6 m in diameter (**Figure 35**). No associated cultural items were observed at the site. The stone arrangement is somehow poorly preserved as a result of surface erosion, but many remain partially buried. Dry grass covers and camouflages the site; hence, it has a low visibility in the landscape. All the diabase fragments lay flat to the ground in a vertical position, with some infilled in the middle. Although disturbed, the potential cairn appears to be hand-sorted as well and is consequently considered as a possible burial cairn. The site is located about 52.3 m from the proposed final ammonia pipeline route; hence, its vulnerability rating stands at 3. A buffer zone of 10 m, 20 m and 50 m could potentially save the site from any possible encroachment.



Figure 35: Present the physical setting of Site17 in its natural and cultural setting from different views. Source: (RCHS, 2025c).

Site 18 is a rock engraving site located on the diabase ridge, overlooking east while standing at 350 m above sea level, in the vicinity of the Richthofen in Naukluft National Park. The site is accessible by a vehicle by driving directly to the outcrop located in one of the large tributaries of the Swakop River (**Figure 36**). The engravings are housed on an upright panel facing up but with little patina, making it difficult to see for an untrained eye. Here, at least ($n=5$) rock engraving figures comprising a zoomorph in the form of a fish, abstract forms – one resembling an arrow and the other an elliptical figure resembling figure 34 – and two indetermined lineal figures have been recorded (Figure 36 and **Figure 37**). All the figures are quite large in morphology, measuring between 20 cm x 1.4 m, and have been executed in light pecking and abrasion.



Figure 36: Is the localisation of the rock engraving site- above image and bottom left image. Bottom right image are some of the abstract forms recorded at the site.

Each figure occupies its own panel and has a distance of about 100 m between them, and no associated archaeological materials have been observed in the immediate vicinity of the site. The artworks are poorly preserved, largely due to water action, as the outcrop is directly within a wide river system. The site is located approximately 52.3 m from the proposed final ammonia pipeline route; hence, it has a vulnerability rating of 4. Rock art is significant in terms of the National Heritage Act no. 27 of 2004; therefore, avoidance of the site as recommended is the only possible mitigation measure required.



Figure 37: Above image shows the engraved fish on a poorly surface while bottom image also shows a poorly visible ineal figure. (Source: RCHS, 2025c).

12. IMPACT ASSESSMENTS AND MITIGATION MEASURES

IMPACT ASSESSMENT

The nature of anticipated impacts on archaeological/historical sites associated with the Green Ammonia pipeline route project include direct and destructive impact in the course of earthmoving and related works, and indirect impact resulting from accelerated soil erosion at the sites after preparation of the area. This is because nearly all the sites have a vulnerability rating of above 3 and sensitive heritage features identified are confined within 70 m around the footprint of the project. This is the case with **Site 03, Site 05, Site 06, Site 10, Site 11, Site 14, Site 15, Site 16, Site 17** and **Site 18** respectively. Therefore, without mitigation measures suggested in Table 4, the severity of these impacts is considered to be high and the duration of such impacts would be permanent and therefore rated high. The spatial scale of impacts would be limited with the site boundary and should therefore it be rated medium. Once the appropriate mitigation measures are implemented, it would then reduce these ratings to low as they are relevant in terms of National Heritage Act no. 27 of 2004.

MITIGATION MEASURES

- a) All heritage resources recorded in the course of the proposed construction of ammonia pipelines, including routings 2 and 3, were assessed as to their significance (0–5) and vulnerability (0–5) (see **Table 4**), and recommended measures deemed necessary for mitigation of each heritage resource were devised. Some of the heritage features do not require further mitigation, with an excerpt from the following sites: The isolated seed digging site, **Site 03**, which is located 72.20 m from the proposed ammonia pipeline, requires a buffer zone of at least 50 m and is designated as a no-zone, although its significance ranking is low, rated 2-3 in terms of the National Heritage Act (27 of 2004). This is also applicable to **Site 05**, the stone features on the crest of the ridge, which are located 6.41 m from the proposed ammonia pipeline towards Arandis and require a buffer zone of at least 50 m and are designated as a no-zone since their significance ranking is low, rated 3 in terms of the National Heritage Act (27 of 2004).
- b) With regard to the colonial settlement of 120 m at **Site 06**, it may be possible for the project to deviate at least 50 m from the site, as it lies directly within the proposed ammonia pipeline alternate routing 2. Although its significance ranking is low, rated 1-2 in terms of the National Heritage Act (27 of 2004), it is still an important locale related to the late 20th-century history of the Namib. A group of four digging sites, **Site 10** fall directly within the proposed ammonia pipeline alternate routings 2 and 3 and will be impacted. Their significance ranking is rated at 3

in terms of the National Heritage Act (27 of 2004); therefore, to avoid direct destruction, test excavation will be required, or the proponent is required to deviate at least 50 m from them. The superficially isolated MSA unifacial point **Site 11**, which lies directly within the proposed ammonia pipeline alternate routings 2 and 3, requires to be collected from the site – but a heritage consent will be required to facilitate this process.

- c) In respect to **Site 13**, no further mitigation is required as it's located 112 m outside the proposed ammonia pipeline route. However, contractors working in close proximity to this location ought to be sensitised about the presence of the site during all phases of the project development.
- d) Lastly, with regards to **Site 14**, **Site 15**, **Site 16** and **Site 17**, they are highly vulnerable, with ratings above 3 due to their proximity to the proposed final ammonia pipeline routes. In the case of the potential burial cairns, in the unlikely event that they cannot be avoided, GPR surveys and test excavations will be required to confirm their identification as burial sites. If they are burial sites, then exhumation, relocation and reburial will then be commissioned to ensure that they are not damaged by the proposed development. In the case of **Site 18**, the only option available is to completely reroute the pipeline outside the outcrop and create buffer zones of 10 m and 20 m from the pipeline to avoid the rock art site.

13. SPECIFIC RECOMMENDATION

- a) The proponent is to submit this HIA report to the competent authority, the National Heritage Council of Namibia, in an effort to secure heritage consent.
- b) The proponent is implored to incorporate the GIS data of the heritage resources in their sensitivity mapping of the project layout so that these flagged sites can be avoided as a management measure to avoid any possible encroachment and disturbance.
- c) With regards to **Site 01**, **Site 04**, **Site 08**, **Site 12** and **Site 13**, the sites should be treated as no go zone, and no further mitigation is required as this documentation report is sufficient.
- d) In case of **Site 02**, **Site 03**, **Site 05**, **Site 07** and **Site 09**, these sites should also be treated as no go zone but various No-Go-Zone buffer zone of 10m, 20m and 50m should be erected at the identified heritage features to avoid direct disturbances to these features.
- e) In respect to **Site 11**, surface collection of the MSA lithic must be undertaken by an archaeologist before the commencement of project construction.
- f) With regards to **Site 10** a test excavation of seed digging sites may be carried out if the proponent is unable to deviate the ammonia pipelines at least 50 m from the site.
- g) In case of **Site 14**, **Site 15**, **Site 16**, **Site 17** and **Site 18**, these must undergo GPR surveys and test excavations are also required at potential burial cairns to confirm their identities as burial sites in the unlikely event that they cannot be avoided. These actions require a heritage permit

and heritage consent if the sites are confirmed to be burial sites, as exhumation, relocation and reburial will then be commissioned to relocate them outside the proposed development.

- h) The proponent is implored to sensitise heritage data to the operator and fieldwork personnel and to exercise due caution when working in close proximity to where the heritage features are found.

14. CONCLUSION AND MANAGEMENT PROCEDURES

This baseline study has identified some potential heritage features with low significance that are neither vulnerable nor significant, as well as significant and vulnerable heritage features directly and around the footprints of the proposed project that are worth preserving in terms of the National Heritage Act (No. 27 of 2004). Therefore, where further mitigations are required, these should be implemented prior to the construction of the proposed ammonia pipelines, including routes 2 and 3 as well as the final proposed route. Those that are not vulnerable do not require further mitigation. However, since this field survey relied only on surface finds, it is possible that buried sub-surface archaeological, paleontological, or historic resources could fall within the footprints of the project during site preparation and construction phases. The following chance-finding procedure, devised by Kinahan (2012) and replicated hereto, is applicable to address these uncertainties in the project phases.

APPENDIX 1: CHANCE FIND PROCEDURES

The ‘chance finds’ procedure covers actions to be taken from the discovery of a heritage site or item to its investigation and assessment by a trained archaeologist or other appropriately qualified person. The ‘chance find’ procedure intends to ensure compliance with the relevant provisions of the National Heritage Act (27 of 2004), especially Section 55 (“a person who discovers any archaeological object must as soon as practicable report the discovery to the Council”). The procedure for reporting set out below, developed by Kinahan (2021) and replicated hereto, is to be observed.

RESPONSIBILITIES

Operator:	To exercise due caution if archaeological remains are found
Foreman:	To secure site and advise management timeously
Superintendent :	To determine safe working boundary and request inspection
Archaeologist:	To inspect, identify, advise management, and recover remains

PROCEDURE

Action by person identifying archaeological or heritage material:

- If operating machinery or equipment stop work
- Identify the site with flag tape
- Determine GPS position if possible
- Report findings to foreman

Action by **Foreman:**

- a) Report findings, site location and actions taken to superintendent.
- b) Cease any works in immediate vicinity Action by superintendent.
- c) Visit site and determine whether work can proceed without damage to findings
- d) Determine and mark exclusion boundary.
- e) Site location and details to be added to GIS for field confirmation by archaeologist

Action by **Superintendent:**

1. Visit the site and determine whether work can proceed without damage to findings.
2. Determine and mark exclusion boundaries.
3. Site location and details to be added to Archaeological Heritage Geographical Information System (GIS) for field confirmation by archaeologist

Action by **Archaeologist:**

- a) Inspect site and confirm addition to GIS.
- b) Advise NHC and request written permission to remove findings from work area.
- c) Recovery, packaging, and labeling of findings for transfer to National Museum

In the event of discovering human remains

- d) Actions as above
- e) Field inspection by archaeologist to confirm that remains are human
- f) Advise and liaise with NHC and Police
- g) Recovery of remains and removal to National Museum or National Forensic Laboratory, as directed.

15. REFERENCES

- 1) Cleanergy Solutions (Namibia) (Pty) Ltd, (2024). Public presentation of the project description.
- 2) Environmental Compliance Consultancy, (2023). BID for the proposed construction of an Ammonia pipeline from Farm 58 to Walvis Bay port, Erongo region, Namibia. December 2023.
- 3) Environmental Compliance Consultancy, (2024). I&AP public consultation document: I&AP comments and responses for the green ammonia terminal, ammonia pipeline and hydrogen pipeline project, Erongo region, Namibia. ECC Report No : ECC-145-453-REP-11-C.
- 4) Environmental Compliance Consultancy, (2024). Draft scoping report for the construction of a green hydrogen pipeline from Arandis to farm 58, Erongo region, Namibia. ECC-145-480-REP-31-C.
- 5) Clean Energy Solutions, (2024). Public Presentation for ammonia terminal, ammonia pipeline and hydrogen pipeline ESIA process scoping phase 12, 13 &14 March 2024.
- 6) Clean Energy Solutions, (2024). Project description: PowerPoint Presentation.
- 7) Kinahan, J. (2020). *Namib: The Archaeology of an African Desert*. Windhoek, University of Namibia Press.
- 8) Kinahan, J. (2005). The late Holocene human ecology of the Namib Desert. In Smith, M. & Hesse, P. eds. *23 degrees South: archaeology and environmental history of the southern deserts*. National Museum of Australia Press, Canberra, 120-131.
- 9) Kinahan, J (2010). Appendix 3: the ecological and social dimensions of wild seed exploitation in the deserts of the southern hemisphere. Contribution to joint paper with M. Smith & S. Calogero in Phase 2 of the Social & Environmental Impact Assessment for Rössing's Expansion Project: Archaeological survey and assessment revised. Quaternary Research Services.
- 10) Kinahan, J. (2014). Archaeological baseline survey of the proposed Port of Walvis Bay SADC Gateway Development, QRS Job 206. In Botha, P., Faul, A., Hooks. P., Brews. L., November 2016. Strategic Environmental Assessment for the New Port of Walvis Bay SADC Gateway by Geo Pollution Technologies (Pty) Ltd.
- 11) Kinahan, J. (2012). Archaeological Guidelines for Exploration & Mining in the Namib Desert, the Namibia Archaeological Trust. <https://www.namibianuranium.org/nua-charter/>
<https://chamberofmines.org.na/>
- 12) Kinahan and Stejskal (2011). *Namib Desert: Finding Europe's Greatest Wars in Africa*. Current Archaeological Congress.
- 13) Kinahan, J. (2022). archaeological assessment of MDRL 3345 for the construction phase of the bannerman Etango project, Erongo region, Namibia. 2 November 2022.
- 14) National Heritage Act No. 27. of 2004. Government Gazette of the republic of Namibia dated, 29 December 2004.

- 15) Sullivan, S. (1999). Folk and formal, local and national – Damara knowledge and community conservation in southern Kunene, Namibia. *Cimbebasia* 15: 1-28.
- 16) Steyn, P. & du Pisani, A. (1984). Grass seeds, game and goats: an overview of Dama subsistence. *Journal of the South West Africa Scientific Society* 39: 37-52.