McGregor Museum
Department of Archaeology

Heritage Impact Assessment of the proposed Hydropower station on the Orange River at Neus Island on the farm Zwartbooisberg, east of Kakamas, Northern Cape

David Morris
McGregor Museum, Kimberley
November 2010

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

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Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010

PROJECT TITLE

Proposed hydropower station on the Orange River near Kakamas, Northern Cape

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4.2 The specialist appointed in terms of the Regulations_

I, **David Morris** , declare that --

General declaration:

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

[provided in PDF version: hard copy being posted]

Signature of the specialist:

McGregor Museum, Kimberley

Name of company (if applicable):

17 December 2010

Date:

Heritage Impact Assessment of the proposed Hydropower station on the Orange River at Neus Island on the farm Zwartbooisberg, east of Kakamas, Northern Cape

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1. INTRODUCTION

Kakamas Hydro Electric Power (KHEP)1 (previously Mulilo Renewable Energy (Mulilo)) wishes to construct a 12 megawatt (MW) hydropower station on the Orange River on the farm Zwartbooisberg, approximately 12 km east of Kakamas, immediately downstream of the existing Department of Water Affairs (DWA) flow gauging weir (the Neusberg weir site) (see **Figure 1**, **Annexure A**).

The McGregor Museum was approached by Environmental Services, Aurecon Group (Ms Louise Corbett, tel 021-4812512, fax 0866673532, 81 Church Street, Cape Town, Louise.Corbett@af.aurecongroup.com) to conduct a heritage impact assessment which is provided in this report.

1.1. Focus and Content of Specialist Report: Heritage

The archaeology and heritage specialist study is focused on the development footprint of the proposed Hydropower Station and ancillary infrastructure.

This specialist study is a stand-alone report (as per the EIA Regulations) and incorporates the following information:

- Introduction, detailing the focus of the report and Terms of Reference (1.1-1.2) and introducing the author in terms of qualifications, accreditation and experience to undertake the study (1.3)
- Description of the affected environment (2) providing background to the development and its infrastructural components (2.1); background to the heritage features of the area (2.2); and defining environmental issues and potential impacts (2.3)
- Methodology (3) including an assessment of limitations (3.1); statement of expectations or predictions (3.2) and outline of EIA procedures including criteria for assessing archaeological significance (3.3).
- Observations and assessment of impacts (4), including field observations (4.1); characterizing archaeological significance (4.2); and characterizing the overall significance of impacts (4.3).

[1] Note that KHEP has been established by Mulilo for this proposed project, hence the original application for the project was under the name of Mulilo.

- Summary of Significance of Impacts is stated in tabular form (4.3.1).
- Measures for inclusion in a draft Environmental Management Plan for the development are set out in tabular form (5).
- Conclusions (6).

1.2 Terms of reference: Heritage

Aurecon Group requested that the following be provided:

- Undertake a Phase 1 archaeological assessment of the site in accordance with the requirements of Section 38(3) of the NHRA, which would include:
    - Conducting a detailed desk-top level investigation to identify all archaeological, cultural and historic sites in the area;
- Undertake field work to verify results of desktop investigation;
    - Document (GPS coordinates and map) all sites, objects and structures identified on the candidate sites.
    - Submit the relevant application form, as required by the Northern Cape Heritage Authorities.
- Compile a report which would include:
    - Identification of archaeological, cultural and historic sites within the proposed development areas, in particular the derelict, historical irrigation canal;
    - Evaluation of the potential impacts of construction, operation and maintenance of the proposed development on archaeological, cultural and historical resources, in terms of the scale of impact (local, regional, national), magnitude of impact (low, medium or high) and the duration of the impact (construction, up to 10 years after construction (medium term), more than 10 years after construction (long term));
    - Recommendation of mitigation measures to ameliorate any negative impacts on areas of archaeological, cultural or historical importance;
    - The preparation of a heritage resources management plan which includes recommendations on the management of the objects, sites or features, and also guidelines on procedures to be implemented if previously unidentified cultural resources are uncovered during later developments in the area.
    - Consideration of relevant guidelines.

1.3 The author of this report

The author of this report is a qualified archaeologist (MA cum laude, PhD candidate, University of the Western Cape) accredited as a Principal Investigator by the Association of Southern African Professional Archaeologists. The author has worked as a museum archaeologist in the Northern Cape since 1985 and has since the late 1980s carried out surveys in the general area of Upington-

Kakamas (Morris 2002, 2005, 2006; Morris & Beaumont 1991; Morris & Seliane 2006). In addition, the author has a comprehensive knowledge of Northern Cape history and built environment, and received recent UCT-accredited training at a workshop on Architectural and Urban Conservation: researching and assessing local (built) environments (S. Townsend, UCT). He is also Chairman of the Historical Society of Kimberley and the Northern Cape.

The author is independent of the organization commissioning this specialist input, and provides this Specialist Report within the framework of the National Heritage Resources Act (No 25 of 1999).

The National Heritage Resources Act no. 25 of 1999 (NHRA) protects heritage resources which include archaeological and palaeontological objects/sites older than 100 years, graves older than 60 years, structures older than 60 years, as well as intangible values attached to places. The Act requires that anyone intending to disturb, destroy or damage such sites, objects and/or structures may not do so without a permit from the relevant heritage resources authority. This means that a Heritage Impact Assessment should be performed, resulting in a specialist report as required by the relevant heritage resources authority/ies to assess whether authorisation may be granted for the disturbance or alteration, or destruction of heritage resources.

2. DESCRIPTION OF THE AFFECTED ENVIRONMENT

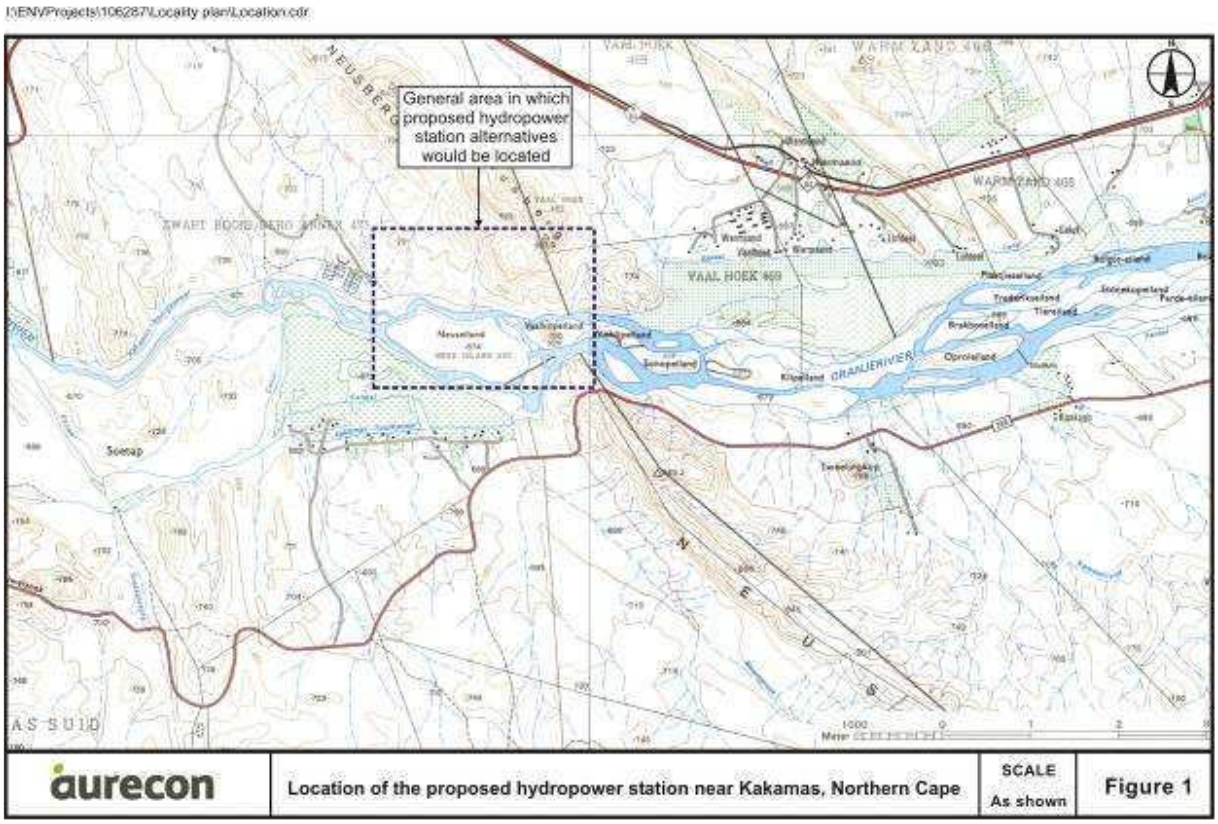
The environment in question is riverside in an arid context, comprising Neus Island and the adjacent north bank of the Orange River immediately down-stream from Neusberg (where there is a weir). The landscape on the island is generally sparsely vegetated, with camel thorn trees and minimal grass cover topping deep unconsolidated river sediment (silt with lenses of more gritty material) and localised outcropping of schistose/gneiss bedrock. Boulders and bedrock are exposed at the northern end of the island. Part of the island is developed for agricultural use with vineyards and citrus plantations. Where archaeological materials might occur on the surface they would be highly visible.

2.1 Background to the development – description of proposed infrastructure

Run-of-river hydropower stations, such as that proposed, use the natural flow and drop in elevation of a river to produce electricity. A portion of the river's flow is channeled through the hydropower station and through turbines. The spinning of the turbines generate electricity (a coal-fired power station creates steam to turn turbines, wind turbines are turned by wind and water turns turbines in hydropower stations).

The proposed project would entail the construction of an abstraction point at Neus weir for the abstraction of water at a maximum rate of some 105 cubic

metres per second (m3/s). An aqueduct of approximately 1.3 – 2.2 km long would transfer the water from the weir to the turbine hall (i.e. the power station) downstream on Neus Island, or along the northern bank of the river. From the turbine hall the abstracted water would be returned to the Orange River.



The location of the site identified for the proposed Hydropower Station on the Orange River between Keimoes and Kakamas.

The proposed hydropower station would be constructed on Farm no. 502 Portion 1 (Neus Island) and Portions 4 and 5 of Farm 475. Two distribution lines of 22 kV capacity and up to 1.0 and 2.2 km in length would be necessary to reach the Eskom electricity grid. The first line would cross from the island to connect to existing electricity distribution infrastructure on Farms 1489, 1490, 4 and 27 on the southern bank of the Orange River, south of the island. The second line would cross Farm no. 475 Portion 5 and connect to the existing electricity distribution infrastructure on Farm no. 469 Portion 43, east of the island. Both lines would be required to evacuate power from the proposed hydropower station. The lines would be a 22 kV A-frame line type. These consist of 11 m poles planted 1.8 m deep (i.e. only 9.2 m of the pole is above ground).

Six layout alternatives are being considered for the proposed hydropower station, four on Neus Island and two on the northern bank of the river (see Figure 1

below). Alternatives 1 - 4 would start at the centre point of the Neus weir and cross Neus Island to four alternative turbine hall locations. Alternative 5 would start approximately 60 m upstream of Neus weir on the northern bank of the river. It would bypass the weir wall before cutting across the northern branch of the river across Neus Island to 120 m west of Alternative 2's turbine hall. Alternative 6 (the preferred alternative) would start approximately 270 m upstream of Neus weir on the northern bank of the river and would follow the river before re-connecting with the river approximately 100 m downstream of the island. Each alternative for the proposed hydropower station route would have two electricity distribution lines, as described above.

Alternatives 1-4 of the proposed hydropower station would consist of the following components (which are described in more detail below):

- Temporary upstream caisson (construction only)
- Abstraction point
- Aqueduct (including an open or closed canal, head pond and penstock)
- Turbine hall/power house
- Temporary downstream caisson (construction only)
- Switchroom

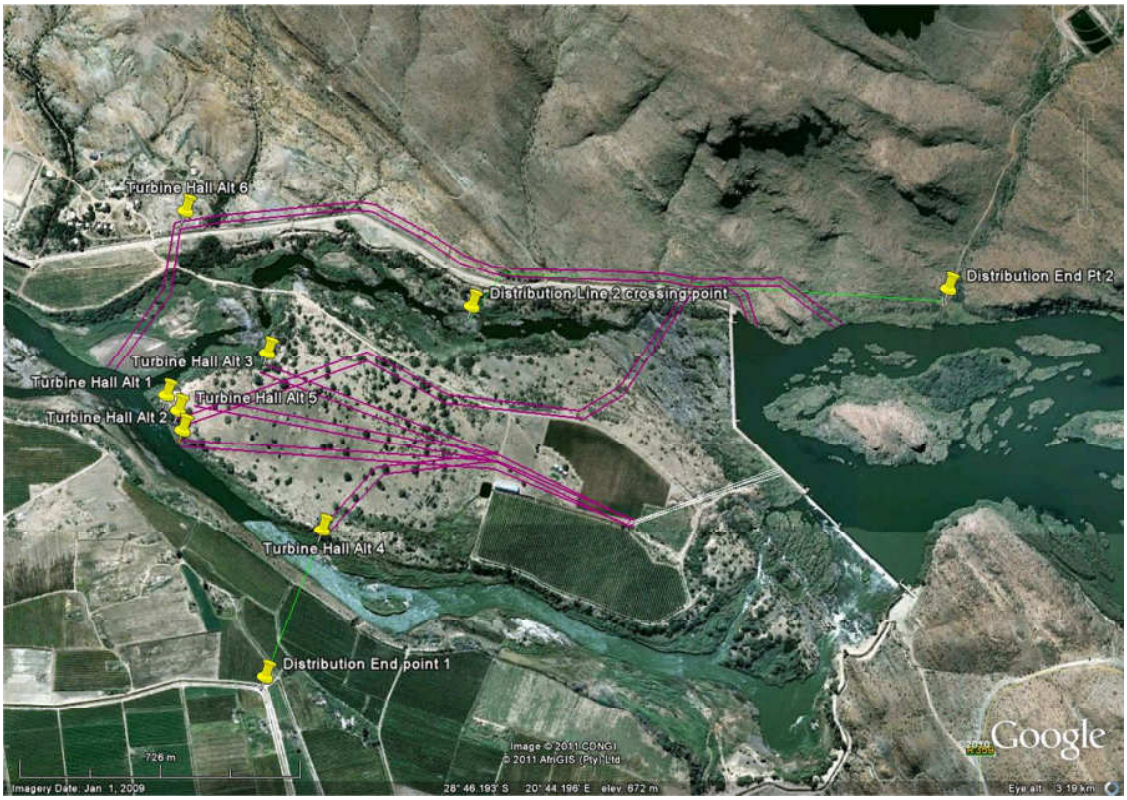


Figure 1a Alternatives 1-6 for the proposed hydropower station at Neus, near Kakamas (distribution lines indicated in green)

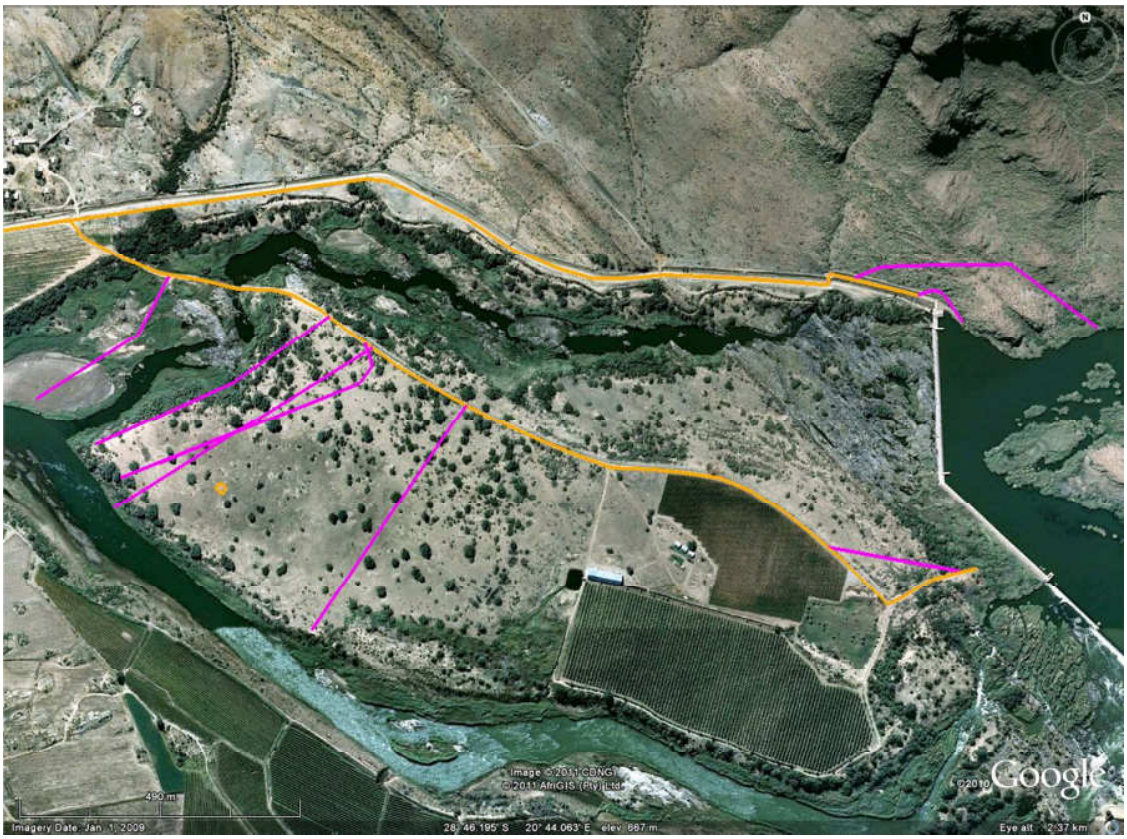


Figure 1b Proposed access roads for Alternatives 1-6 for the proposed hydropower station at Neus, near Kakamas

Temporary upstream caisson

A temporary caisson (coffer dam) is required for construction of the intake at the weir. A caisson is a watertight structure used to keep water out of a construction area. The caisson would be constructed against the weir wall and water inside the caisson would be pumped out (i.e. it is dewatered). Construction work can then be undertaken within the caisson. The cassion could be constructed from two parallel rows of sheet piles driven into the ground, forming a double-walled enclosure. The space between the two parallel walls are usually filled with granular material such as gravel, sand or broken rock. Once construction is complete the caisson is removed, allowing water into the intake. Material used in the construction of the caisson can typically be reused on other projects. The caisson dimensions are estimated to be approximately 70 m long and 7 m high.

Abstraction point

The abstraction point could consist of an intake structure built into the weir itself, or siphons over the weir.

A siphon is a tube, in an inverted “U” shape, which allows water to flow uphill without a pump, over an obstacle and then to discharge at a level lower than the surface of the original reservoir. The siphon requires an initial suction, or water elevation to the maximum height of the tube, to create a negative pressure. Once water begins flowing, the suction continues automatically until the water level drops below the intake level.

Should an intake structure be the preferred abstraction method, it would consist of a rack structure, intake structures and a gate.

The centre line of the intake point, which would be approximately 20 m wide, would be located approximately 75.2 m north of the centre line of a fish ladder. The fish ladder forms part of the weir wall and allows fish to migrate up and down the river past the weir. This is at a point where the farmer of Neus Island abstracts water from the weir for irrigation. It would be necessary to relocate the farmers 350 mm abstraction point either north or south of the proposed abstraction point.

On the northern and southern bank of the river, there are two abstraction points for an agricultural irrigation scheme. The southern canal has a capacity of 6.8 m^3/s and the northern canal 7.5 m^3/s.

This is transferred to local farmers via a concrete irrigation canal, which is approximately 5 m wide and 2 m deep. Remnants of a previous, earthen irrigation canal are located to the south of the current northern canal.

The rack structure (approximately 22 m long and 7.7 m wide) of the abstraction point prevents the intake of debris such as branches or trees. The intake structures (nested in a concrete structure approximately 28.57 m long and 20 m wide) of the abstraction point are located at the bottom of a reservoir. Note that the abstraction point would form part of the weir wall, which itself is approximately 12.5 m wide at its thickest point.

The closure gate regulates the volume of water which entering the abstraction point. The gate has been designed such that its lowest level is approximately 85 cm higher than the fish ladder, approximately 250 cm higher than the irrigation scheme and approximately 45 cm higher than the Neus Island abstraction points. This gate is adjustable so that it can be raised to limit the intake of water, which would be necessary during peak floods as the hydropower station would not be able to take a flow volume greater than 105 m^3/s.

For the proposed project, two siphons with a diameter up to 3 m would be necessary, if an abstraction point was not preferred. The siphons would be enclosed in a support structure, potentially of concrete or a steel cage. The siphons would be embedded in this structure and may be floating (i.e. it would be built such that it does not make contact with the weir) or would be built onto the weir. The siphons and support structure would be approximately 14.84 m wide and 7.70 m long. The siphon structure could have a height of between 3 m to 5.5 m above the weir wall.

The depth of the siphon intake would be no lower than 85 cm above the fish ladder. It would not be possible to regulate the depth of the siphon hence should the water level drop below this level the siphon would not function.

The siphon would discharge into the aqueduct as with the intake structure.

Aqueduct

The aqueduct consists of a canal, head pond and penstocks. The depth of the canal would vary as it cuts through rock and soil. On Neus Island it would typically be 5.6 m deep, 10 m wide at the bottom and 12.8 m wide at the top through rock and 4.6 m deep, 7 m wide at the bottom and 20.8 m wide at the top through soil. The canal would be fenced in to ensure animals and people cannot fall into the canal, with overpasses every 500 m to allow people and animals across. A drainage ditch up slope of the canal would prevent storm water entering the canal and stormwater overpasses would be placed at 250 m intervals. The canal would be lined with reinforced concrete.

The head pond would be located approximately 1.2 - 1.6 km downstream of the intake structure with a length and width of approximately 200 m and a depth of 4 m. The head pond accumulates water and controls the flow into the penstock. An overflow from the head pond would be required. This overflow/spillway would have low velocities (compared to that of the turbine) and would provide a controlled release of flow from the head pond into the downstream river. This would allow for regulation of the volume of water in the head pond.

The penstocks consist of two above-ground steel pipes of approximately 50 m length and 1.5 m radius which deliver water from the head pond to the turbine hall.

Turbine hall/power house

The turbine hall would be located approximately 1.3 – 1.7 km downstream of the intake structure. The turbine hall would house the generation units. Four alternative locations are being considered for the turbine hall. The power house would be approximately 30 m long, 30 m wide and 10 m tall. A crane would be positioned over the power house chamber for the installation and removal of the turbines and generators as well as for any maintenance required during operation.

Water would be released from the turbine hall, via a draft tube, into a canal approximately 40 m long. This canal would terminate in the river where the water would be released at a maximum flow rate of 2 m/s (velocity would vary depending on the volume of water entering the hydropower station).

Temporary downstream caisson

This would be the same as the upstream caisson (see above).

Switchroom[2]

The switchroom would be a small building approximately the size of a triple bay, single story garage. It would be located within 100 m of the turbine hall, outside the 1:100 year floodline, and its final location would be informed by the detailed design of the turbine hall. An area of 20 X 20 m or less would be required for the building. The switchroom would contain breakers to transform the electricity produced by the turbines to 22 kV, prior to being fed into the grid.

As *Alternatives 5 and 6 are* routed through different terrain they are comprised of variations of the components described above, namely:

- Temporary upstream caisson (construction only);
- Abstraction point including an abstraction weir;
- Aqueduct and siphon (including an open or closed canal, head pond and penstock);
- Turbine hall/power house;
- Temporary downstream caisson (construction only); and
- Switchroom.

[2] Note that originally a 200 X 100 m switchyard was anticipated, however this was reduced to a building less than 20 X 20 m. The botanical, aquatic ecology and heritage reports have considered a larger area, hence the potential impact of this structure is likely to be lower than assessed.

The variations to the components described above, namely the abstraction point, aqueduct and siphon, are described below.

Abstraction point

In the case of Alternatives 5 and 6, the intake point would be located approximately 50 and 270 m, respectively upstream of the weir on the northern bank of the river. The intake structure would be a small weir which would regulate the volume of water entering the scheme. This weir would be constructed with a crest level 10 cm higher than the fish ladder and 175 cm higher than the irrigation scheme. This would ensure that the proposed hydropower station would never be able to affect either the water supply to the irrigators or reduce the flow from the weir to lower than approximately 16.2 m^3/s.

The intake structure, similar to that described for Alternatives 1-4, would be located approximately 150 and 350 m for Alternative 5 and 6, respectively downstream of the intake weir.

Aqueduct

The first section of the open aqueduct would be a cut through the south western foot of the Neusberg mountain. The 20 – 30 m deep and 15 m wide cut would circumvent the weir and would be 20 m or further from the weir. The sides of the cut would have benches generally 2 m wide, at 10 m height intervals. One of the benches would be 5 m wide to serve as a service road to the intake weir so that maintenance of both the intake weir and the cut leading to the intake structure could be conducted. The exact details of the slopes, bench widths and bench intervals would be established once a detailed geotechnical investigation had been conducted. The cut would terminate at a point above the northern irrigation canal, approximately 80 m downstream of the weir.

From here, an inverted siphon would run below the existing irrigation canal across the northern branch of the river to terminate in an open canal again on Neus Island in the case of Alternative 5. The siphon would start north of the irrigation canal and would have a drop shaft that would be deep enough so that the siphon would pass beneath the irrigation canal. For the river crossing, the siphon would be cut into the river bed so that the top of the siphon would not project out of the river bed.

For Alternative 6, a siphon would not be necessary as the canal would follow the river along the northern bank. For this section of the canal the route would be covered with excavated material. The turbine hall for alternative 6 would be located on the river bank, north of the irrigation canal, and an underground pipe would release water back to the river, below the irrigation canal.

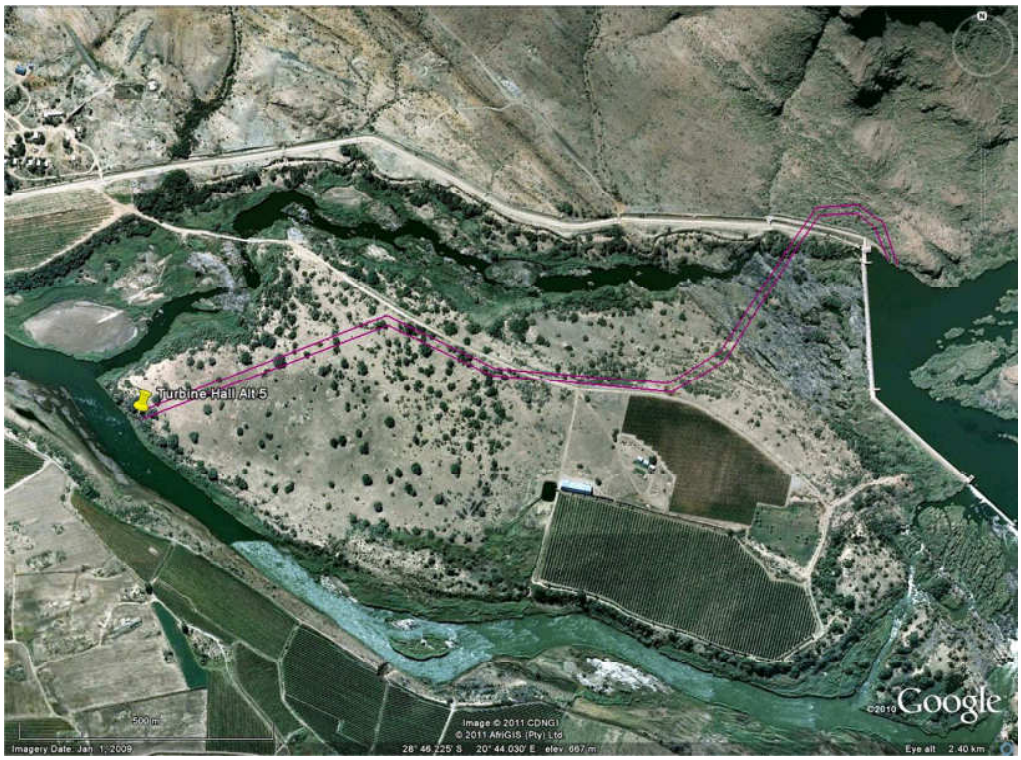
The irrigation canal closes once a year for maintenance. During this period the section of routes for Alternatives 5 and 6 under the canal would be constructed and a pre-fabricated canal section would be put in place over the siphon. The pre-fabricated section would be placed in the existing canal footprint.

Turbine Hall Alternative 1

Turbine Hall Alternative 2

Turbine Hall Alternative 3

Turbine Hall Alternative 4



Turbine Hall Alternative 5

Turbine Hall Alternative 6

2.2. Heritage features of the region

No previous archaeological survey work had been carried out in the vicinity of Neus Island itself. Some general comments may be offered.

2.2.1 Colonial frontier

The eighteenth- and nineteenth-century records for this region (Penn 2005) pertain mainly to the areas south of and along the Orange River. The travellers Wikar and Gordon followed the river as far as and beyond this region in the 1770s, describing communities living along the river (see Morris & Beaumont 1991 for a summary).

Gordon noted that the place was called *Garieb eib* (the Gariep 'nose'). He noted the drop in gradient as the river flowed around the island. A group of Bushmen whose encampments were on the north bank of the river, some distance off according to his map, were known as *Khein eis* (= lean and thin people) (transcription of Gordon's Journal by Fredi Pheiffer nd:41, cf, Mossop 1935).

Dunn and others describe the situation a century later (Robinson 1978). Frontiersmen such as the colourful character Stephanos can be linked with particular places in the landscape – near Keimoes (Morris 2002).

The region was caught up in the Koranna War of 1879-1880, while further military activity in the area included the risings of rebels during the Anglo-Boer War and again in January-February 1915 when there was also an incursion of German troops some of whom were killed in the area (Hopkins 1978:128-129).

One of the most significant historical watersheds for the particular vicinity under consideration was the establishment of the agricultural settlement at Kakamas in 1898. The irrigation scheme set up by this community included canal construction, beginning at the upper end of Neus Island (Hopkins 1978). The Kakamas settlement is also known for its pioneering development of a hydro-electric power generator, brought into operation in 1924 (Hopkins 1978). The building which housed the generator has been ear-marked as a museum.

2.2.2 Later Stone Age

Late Holocene Later Stone Age (LSA) sites are frequently noted in surveys south of and west of the region of proposed development including along the Orange River (e.g. Morris & Beaumont 1991; Beaumont et al. 1995). These are generally short-duration occupations by small groups of hunter-gatherers. In contrast, there are substantial herder encampments along the Orange River floodplain itself (Morris & Beaumont 1991) and in the hills north of Kakamas (Parsons 2003). In a range of hills north east of Keimoes, on Zovoorby, a rock shelter and specularite working (a sparkling mineral with known cosmetic and ritual use in the precolonial past) has been excavated (Smith 1995). LSA sites are usually focused on a particular feature in the landscape such as a hill or rocky outcrop and in relation to resources like water and associated habitats richer in animals and plant foods.

2.2.3 Pleistocene: Middle and Earlier Stone Age

Beaumont et al. (1995:240-1) note a widespread low density stone artefact scatter of Pleistocene age across areas of Bushmanland to the south where raw materials, mainly quartzite cobbles, were derived from the Dwyka glacial till. Similar occurrences have been noted north of Upington in situations where raw materials are abundant. Systematic collections of this material at Olyvenkolk south west of Kenhardt and Maans Pannen east of Gamoep could be separated out by abrasion state into a fresh component of Middle Stone Age (MSA) with prepared cores, blades and points, and a large aggregate of moderately to heavily weathered Earlier Stone Age (ESA) (Beaumont et al. 1995).

The ESA included Victoria West cores on dolerite and quartzite (a fine example has been found at Hondeblaf north of Upington), long blades, and a very low incidence of handaxes and cleavers. The Middle (and perhaps in some instances Lower) Pleistocene occupation of the region that these artefacts reflect must have occurred at times when the environment was more hospitable than today.

This is suggested by the known greater reliance of people in Acheulean times on quite restricted ecological ranges, with proximity to water being a recurrent factor in the distribution of sites.

2.3 Description and evaluation of environmental issues and potential impacts

Heritage resources including archaeological sites are in each instance unique and non-renewable resources. Area and linear developments such as those envisaged can have a permanent destructive impact on these resources. The objective of an EIA would be to assess the sensitivity of such resources where present, to evaluate the significance of potential impacts on these resources and, if and where appropriate, to recommend no-go areas and measures to mitigate or manage said impacts.

Area and linear impacts are possible in the case of the Neus Island Hydropower Station and ancillary developments including power lines.

2.3.1 Direct, indirect and cumulative impacts (in terms of nature, magnitude and extent)

The destructive impacts that are possible in terms of heritage resources would tend to be direct, once-off events occurring during the initial construction period. In the long term, the proximity of operations in a given area could result in secondary indirect impacts resulting from the movement of people or vehicles in the immediate or surrounding vicinity. The Environmental Management Plan should seek to minimize the latter impacts as far as possible.

With respect to the magnitude and extent of potential impacts, it has been noted that the erection of power lines would have a relatively small impact on Stone Age sites, in light of Sampson's (1985) observations during surveys beneath power lines in the Karoo (actual modification of the landscape tends to be limited to the footprint of each pylon), whereas a road or a water supply pipeline would tend to be far more destructive (modification of the landscape surface would be within a continuous strip), albeit relatively limited in spatial extent, i.e. width (Sampson compares such destruction to the pulling out of a thread from an ancient tapestry). Powerline development could however have a more substantial impact than suggested by Sampson for Stone Age sites if other kinds of heritage are present. In this case there are remains of the 1908 irrigation canal on the north bank of the river alongside Neus Island which could be impacted detrimentally.

3. METHODOLOGY

A site visit was necessary to inspect various parts of the terrain on foot, focusing on areas of expected impact. Heritage traces would be evaluated in terms of their archaeological significance (see tables below). A set of predictions were made which the study would test with observations made in the field.

3.1 Assumptions and limitations

It was assumed that, by and large in this landscape, with its sparse vegetation and often shallow soil profiles, some sense of the archaeological traces to be found in the area would be readily apparent from surface observations (including assessment of places of erosion or past excavations that expose erstwhile below-surface features).

Deep soils of Neus Island make it difficult, however, to make clear predictions as to archaeological traces below the surface – although it was expected that erosion features would yield profiles and sections that could be examined and in view of this it was not considered necessary to conduct excavations as part of the EIA to establish the potential of sub-surface archaeology.

A proviso is routinely given, that should sites or features of significance be encountered during construction (this could include an unmarked burial, an ostrich eggshell water flask cache, or a high density of stone tools, for instance), specified steps are necessary (cease work, report to heritage authority).

With regard to fossils, it is noted that for the most part bedrock would not be affected (L. Corbett pers. comm.). The local geology consists of unconsolidated Quaternary sediment overlying basement gneisses of the 1.1 billion year old Namaqualand Mobile Belt. Pending specialist input, it would seem unlikely that fossils would be preserved here and if so there would be no impact on fossils by the proposed development even where bedrock is intercepted.

3.2 Predictions

It may be predicted that:

The riverside/island environment may provide places where Stone Age settlement occurred, particularly in Later Stone Age times, but that deep river channels on either side may have rendered this particular island less attractive. A survey along the river at Riemvasmaak suggested that river banks alongside deep channels may not have been as attractive as places with a shallower rocky river bed (opportunities for fording as well as activities such as fishing).

Various features relating to the construction and maintenance of the Neus Island-Kakamas canals were likely to exist and might be impacted by the development.

3.3 Potentially significant impacts to be assessed in the EIA process

Any area or linear, primary and secondary, disturbance of surfaces in the development locales could have a destructive impact on heritage resources, where present. In the event that such resources are found, they are likely to be of a nature that potential impacts could be mitigated by documentation and/or salvage following approval and permitting by the South African Heritage Resources Agency and, in the case of any built environment features, by Ngwao Bošwa ya Kapa Bokone (the Northern Cape Heritage Authority). Although unlikely, there may be some that could require preservation in situ and hence modification of intended placement of development features.

Disturbance of surfaces includes any construction: of a road, a pipeline, erection of a pylon, or preparation of a site for a sub-station, or plant, or building, or any other clearance of, or excavation into, a land surface. In the event of archaeological materials being present such activity would alter or destroy their context (even if the artefacts themselves are not destroyed, which is also obviously possible). Without context, archaeological traces are of much reduced significance. It is the contexts as much as the individual items that are protected by the heritage legislation.

3.4 Determining archaeological significance

In addition to guidelines provided by the National Heritage Resources Act (Act No. 25 of 1999), a set of criteria based on Deacon (nd) and Whitelaw (1997) for assessing archaeological significance has been developed for Northern Cape settings (Morris 2000a). These criteria include estimation of landform potential (in terms of its capacity to contain archaeological traces) and assessing the value to any archaeological traces (in terms of their attributes or their capacity to be construed as evidence, given that evidence is not given but constructed by the investigator).

Estimating site potential

Table 1 (below) is a classification of landforms and visible archaeological traces used for estimating the potential of archaeological sites (after J. Deacon nd, National Monuments Council). Type 3 sites tend to be those with higher archaeological potential, but there are notable exceptions to this rule, for example the renowned rock engravings site Driekopseiland near Kimberley which is on landform L1 Type 1 – normally a setting of lowest expected potential. It should also be noted that, generally, the older a site the poorer the preservation, so that sometimes any trace, even of only Type 1 quality, can be of exceptional significance. In light of this, estimation of potential will always be a matter for archaeological observation and interpretation.

Assessing site value by attribute

Table 2 is adapted from Whitelaw (1997), who developed an approach for selecting sites meriting heritage recognition status in KwaZulu-Natal. It is a means of judging a site's archaeological value by ranking the relative strengths of a range of attributes (given in the second column of the table). While aspects of this matrix remain qualitative, attribute assessment is a good indicator of the general archaeological significance of a site, with Type 3 attributes being those of highest significance.

Table 1. Classification of landforms and visible archaeological traces for estimating the potential for archaeological sites (after J. Deacon, National Monuments Council).

Class	Landform	Type 1	Type 2	Type 3
L1	Rocky surface	Bedrock exposed	Some soil patches	Sandy/grassy patches
L2	Ploughed land	Far from water	In floodplain	On old river terrace
L3	Sandy ground, inland	Far from water	In floodplain or near feature such as hill	On old river terrace
L4	Sandy ground, Coastal	>1 km from sea	Inland of dune cordon	Near rocky shore
L5	Water-logged deposit	Heavily vegetated	Running water	Sedimentary basin
L6	Developed urban	Heavily built-up with no known record of early settlement	Known early settlement, but buildings have basements	Buildings without extensive basements over known historical sites
L7	Lime/dolomite	>5 myrs	<5000 yrs	Between 5000 yrs and 5 myrs
L8	Rock shelter	Rocky floor	Sloping floor or small area	Flat floor, high ceiling
Class	**Archaeo-logical traces**	**Type 1**	**Type 2**	**Type 3**
A1	Area previously excavated	Little deposit remaining	More than half deposit remaining	High profile site
A2	Shell or bones visible	Dispersed scatter	Deposit <0.5 m thick	Deposit >0.5 m thick; shell and bone dense
A3	Stone artefacts or stone walling or other feature visible	Dispersed scatter	Deposit <0.5 m thick	Deposit >0.5 m thick

Table 2. Site attributes and value assessment (adapted from Whitelaw 1997)

Class	Attribute	Type 1	Type 2	Type 3
1	Length of sequence/context	No sequence Poor context Dispersed distribution	Limited sequence	Long sequence Favourable context High density of arte/ecofacts
2	Presence of exceptional items (incl regional rarity)	Absent	Present	Major element
3	Organic preservation	Absent	Present	Major element

Class	Attribute	Type 1	Type 2	Type 3
4	Potential for future archaeological investigation	Low	Medium	High
5	Potential for public display	Low	Medium	High
6	Aesthetic appeal	Low	Medium	High
7	Potential for implementation of a long-term management plan	Low	Medium	High

4. OBSERVATIONS AND ASSESSMENT OF IMPACTS

The manner in which archaeological and other heritage traces or values might be affected by the proposed development may be summed up in the following terms: it would be any act or activity that would result immediately or in the future in the destruction, damage, excavation, alteration, removal or collection from its original position, any archaeological material or object (as indicated in the National Heritage Resources Act (No 25 of 1999)). The most obvious impact in this case would be land surface disturbance associated with infrastructure construction.

4.1 Fieldwork observations

The proposed development footprint area and ancillary infrastructure locales were visited on 17-18 November 2010 and 28 March 2011. In summary the findings can be reported in relation to predictions made in the scoping report (see 3.2 above):

4.1.1 Occurrence of Stone Age traces:

4.1.1.1 Findings on Neus Island

Not a single stone tool or other Stone Age trace was noted during our survey across Neus Island (as opposed to findings on the north bank).

- At the north eastern end of the island there is major disturbance related to farming and outcrops of bedrock and boulders also occur. Much of the island is covered by an impressive depth of silt up to several metres, with rock outcrops in places.
- Cuttings through the silt, both dongas and roadways (e.g. down to the bridge which crosses to the north bank), were examined closely for evidence of stratigraphy and artefact lenses. Gritty lenses and lag deposits were noted at various depths, but none contained any artefacts.

Strata visible in the dongas, but no artefacts

- Deflation hollows and erosion surfaces and steps on the south east side of the island were also carefully checked and yielded no signs of Later Stone Age or earlier material.

Gritty lag deposit horizons are exposed in a few places (below) – no artefacts present.

It is concluded that the island had not been an attractive locale for hunter-gatherer-fishers of the past. Parts of its circumference would not have been easy to access across deep high-energy river channels. Wikar refers to dangerous whirlpools in the vicinity (Mossop 1935:131).

Given the absence of observations of precolonial traces, no GPS co-ordinates are relevant to this section of the report.

It may yet be possible that some material could be encountered during construction and recommendations concerning accidental discovery should be adhered to (see section 5, below).

4.1.1.2 Findings on the north bank of the river

In striking contrast to the situation on the island, varying densities of stone artefacts were noted along the north bank of the river, upslope from the canal as well as on the higher ground north east of the weir along the northern alternative distribution line route.

A number of distinctive 'hotspots' with higher densities of stone tools (5 or more per m^2) were separated by areas where densities drop off to much less than 1/10x10 m area. The artefacts are made on jaspilite (banded ironstone) which occurs in the gravels along the river. Typologically they appear to be Middle Stone Age, with some triangular flakes and flakes with facetted butts.

Particular concentrations that were noted were at 28.76717^o S 20.73735^o E, 28.76691^o S 20.73866^o E (where possibly earlier twentieth century glass was also noted), and 28.76720^o S 20.73694^o E (where a smaller debitage or 'waste flake' component amongst the artefacts was observed, suggesting possibly better preservation of a wider range of tool types in some localised settings).

The most impressive surface spread of artefacts was found between gneiss ridges at 28.76684^{o} S 20.73851^{o} E (pictured above) where stone tool densities in some areas exceed 10-20 per m^{2}.

Some of the flakes have facetted butts suggesting a Middle Stone Age ascription.

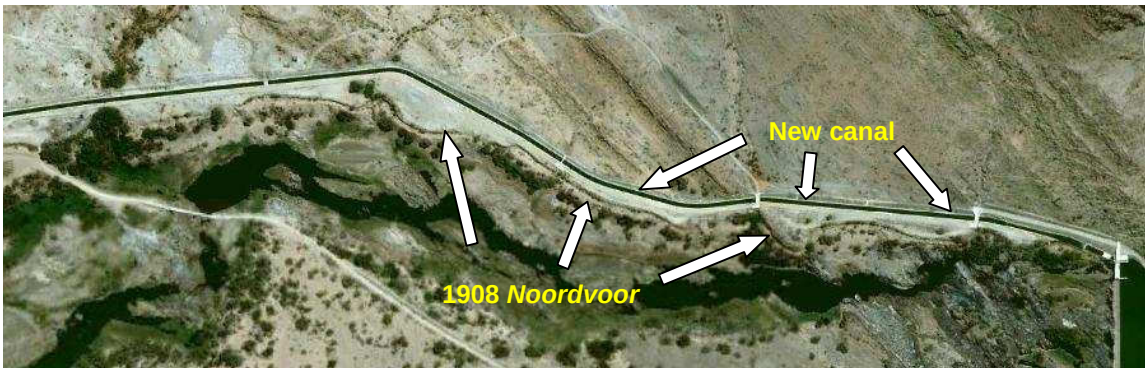
The isolated stone artefact found in the vicinity of 28.76804^{o} S 20.74179^{o} E (L. Corbett, pers. comm.) suggests a continuation there of the same phenomenon of localized hotspots and off-site scatters which are referred to above.

Parts of the north bank downstream from approximately where the causeway crosses the northern stream have been substantially transformed by agricultural activity and any erstwhile in situ heritage resources here are likely to have been disturbed long since.

4.1.2 Colonial era traces inter alia relating to canal construction and maintenance:

Major features relating to the colonial era, most likely early twentieth century in age, were encountered, both on the island and on the north bank of the river and it is recommended that cognizance be taken of these features in terms of infrastructure layout and mitigation procedures.

- Along the north bank of the river, immediately downslope from the modern canal are the remains on the Noordvoor – the North Canal – which was constructed from 1908 to carry water from the Neus area to extensions of the Kakamas settlement.



The route of the old *Noordvoor* (below) clearly visible (above)

A portion of this canal is a declared Heritage Site, namely that portion that flows through two tunnels built in the early twentieth century downstream from Neus in the vicinity of 28.75907^{o} S 20.66902^{o} E and 28.76301^{o} S 20.67571^{o} E.
Parts of the canal were upgraded in the 1940s when cement was used to strengthen it (visible in the image below). Eventually flooding caused damage which resulted in the construction of the modern canal immediately upslope. The old *Noordvoor* is clearly visible in the Google Earth images of the site.

Cement and packed stone strengthening of the old canal. At one point the initials and date “AJK 19-2-1941” are inscribed in the cement.

Upslope of the new canal at 28.76602^{o} S 20.72972^{o} E there is a foundation of cement, either relating to the canal itself or some farming activity, estimated to be of mid-twentieth-century age. This would appear to be of minimal if any heritage significance.

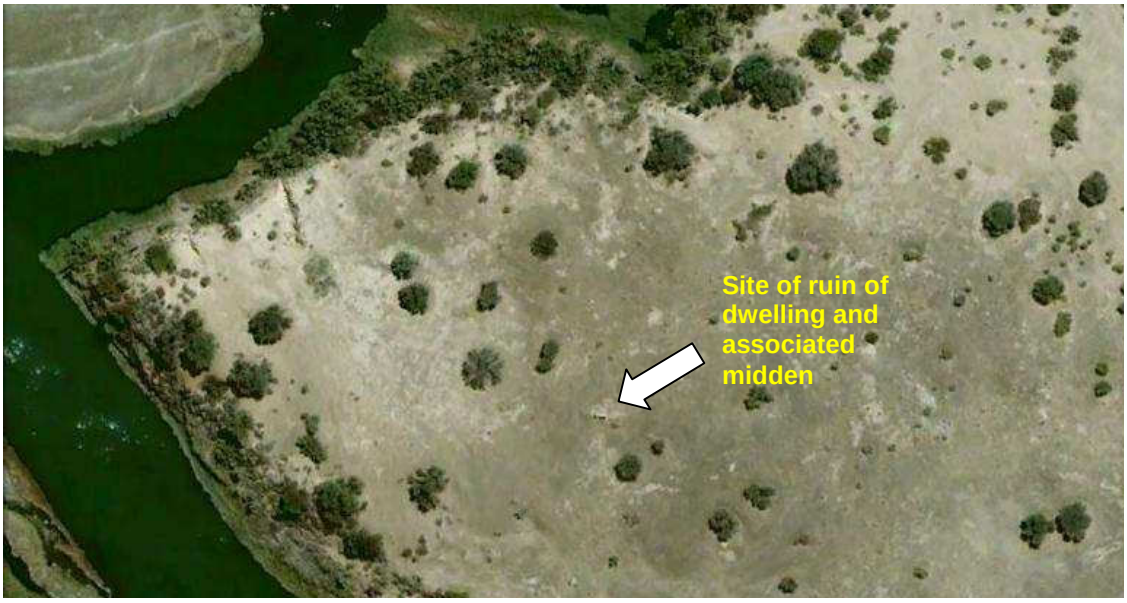
- On the island itself there is a ruin of a three-room dwelling and associated ash middens which is estimated to date from the earlier twentieth century.

It was not clear how this structure related, if at all, to canal construction or maintenance: it may have been part of an agricultural set-up. The middens immediately north east of the structure exhibit good preservation of bone, glass, porcelain, metal and other materials. It seems likely that this structure and midden area would be impacted by the development and it is recommended that mitigation procedures be put in place to record and recover material. Archival work would very likely establish more closely the age and purpose of this structure. Mud brick walls were constructed on a stone foundation.

A variety of objects and organic remains (bone) were found in the nearby midden.

Artefacts – metal – and bone.

- The structure is situated at 28.77085° S 20.72815° E
- The ash midden is situated between 28.77086° S 20.72837° E and 28.77062° S 20.72853° E.
- Other minor midden occurrences were noted in the near vicinity at 28.77057° S 20.72835° E; 28.77116° S 20.72857° E; 28.77106° S 20.72872° E; 28.77080° S 20.72903° E and 28.77073° S 20.72919° E.



4.2 Characterising the archaeological significance (Refer to 3.4 above)

In terms of the significance matrices in Tables 1 and 2 under 3.4 above, most of the archaeological observations fall under Landform L3 Type 3. In terms of archaeological traces they all fall under Class A3 Type 1-2. These ascriptions (Table 1) reflect medium to high potential for these criteria.

For site attribute and value assessment (Table 2), both the canal and the ruin and associated middens score relatively highly as indicated below:

Stone Age remains – based on Table 2 above

Class	Attribute	Type 1	Type 2	Type 3
1	Length of sequence/context	**No sequence** **Poor context** **Dispersed distribution**	Limited sequence **Some sites on north bank with higher densities**	Long sequence Favourable context High density of arte/ecofacts
2	Presence of exceptional items (incl regional rarity)	**Absent**	Present	Major element
3	Organic preservation	**Absent**	Present	Major element
4	Potential for future archaeological investigation	**Low**	Medium	High
5	Potential for public display	**Low**	Medium	High
6	Aesthetic appeal	**Low**	Medium	High
7	Potential for implementation of a long-term management plan	**Low**	Medium	High

Colonial era: Canal remnants – based on Table 2 above

Class	Attribute	Type 1	Type 2	Type 3
1	Length of sequence/context	No sequence Poor context Dispersed distribution	**Limited sequence**	Long sequence Favourable context High density of arte/ecofacts
2	Presence of exceptional items (incl regional rarity)	Absent	Present	**Major element**
3	Organic preservation	**Absent**	Present	Major element
4	Potential for future archaeological investigation	**Low**	Medium	High
5	Potential for public display	Low	**Medium**	High
6	Aesthetic appeal	**Low**	Medium	High
7	Potential for implementation of a long-term management plan	**Low**	Medium	High

Colonial era: Ruin of structure and associated middens – based on Table 2 above

Class	Attribute	Type 1	Type 2	Type 3
1	Length of sequence/context	No sequence Poor context Dispersed distribution	**Limited sequence**	Long sequence Favourable context High density of arte/ecofacts
2	Presence of exceptional items (incl regional rarity)	Absent	**Present**	Major element
3	Organic preservation	Absent	Present	**Major element**
4	Potential for future archaeological investigation	Low	Medium	**High**
5	Potential for public display	Low	**Medium (e.g. in museum exhibit)**	High
6	Aesthetic appeal	Low	**Medium**	High
7	Potential for implementation of a long-term management plan	**Low (i.e. on-site potential is limited – mitigation recommended)**	Medium	High

On archaeological/heritage grounds, therefore, the occurrences can be said to be: for precolonial traces (Stone Age), of low significance, while for colonial era traces including the canal and the ruin with associated middens, medium to high significance requiring careful infrastructure layout and mitigation.

4.3 Characterising the significance of impacts

The criteria on which significance of impacts is based include **nature**, **extent**, **duration**, **magnitude** and **probability of occurrence**, with quantification of significance being grounded and calculated as follows:

- The **nature**, namely a description of what causes the effect, what will be affected, and how it will be affected.

- The **extent**, indicating the geographic distribution of the impact:
  - local extending only as far as the development site area – assigned a score of 1;
  - limited to the site and its immediate surroundings (up to 10 km) – assigned a score of 2;
  - impact is regional – assigned a score of 3;
  - impact is national – assigned a score of 4; or
  - impact across international borders – assigned a score of 5.

- The **duration**, measuring the lifetime of the impact:
    - very short duration (0–1 years) – assigned a score of 1;
    - short duration (2-5 years) - assigned a score of 2;
    - medium-term (5–15 years) – assigned a score of 3;
    - long term (> 15 years) - assigned a score of 4;
    - or permanent - assigned a score of 5.

- The **magnitude**, quantified on a scale from 0-10:
    - 0 is small and will have no affect on the environment;
    - 2 is minor and will not result in an impact on environmental processes;
    - 4 is low and will cause a slight impact on environmental processes;
    - 6 is moderate and will result in environmental processes continuing but in a modified way;
    - 8 is high (environmental processes are altered to the extent that they temporarily cease); and
    - 10 is very high and results in complete destruction of patterns and permanent cessation of environmental processes.

- The **probability of occurrence**, indicating the likelihood of the impact actually occurring (scale of 1-5)
    - 1 is highly improbable (probably will not happen);
    - 2 is improbable (some possibility, but low likelihood);
    - 3 is probable (distinct possibility);
    - 4 is highly probable (most likely); and
    - 5 is definite (impact will occur regardless of any prevention measures).

- The **significance**, determined by a synthesis of the characteristics described above and expressed as low, medium or high. Significance is determined by the following formula:
  S= (E+D+M) P; where S = Significance weighting; E = Extent; D = Duration; M = Magnitude; P = Probability.

- The **status**, either positive, negative or neutral, reflecting:
    - the degree to which the impact can be reversed.
    - the degree to which the impact may cause irreplaceable loss of resources.
    - the degree to which the impact can be mitigated.

- **The significance weightings for each potential impact are as follows:**

    - < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),

- 30-60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),

- > 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

4.3.1 SUMMARY OF THE SIGNIFICANCE OF IMPACTS

The Table below indicates the Significance of Impacts, with and without mitigation – based on the worst case scenario.

This Table is for the site as a whole, i.e. development footprint of the proposed Hydropower Station together with ancillary infrastructure. A break-down of component impacts is indicated in the Table.

Nature:
Acts or activities resulting in disturbance of surfaces and/or sub-surfaces containing artefacts (causes) resulting in the destruction, damage, excavation, alteration, removal or collection from its original position (consequences), of any archaeological or other heritage material or object (what affected).

Anticipated impact of the distribution lines:
Generally, it is noted, powerline development has had a limited impact on Stone Age sites – except where towers are positioned on particular features such as burials. Where more 'fabric-heavy' heritage occurs – such as structures, stone walling, etc, with the local instances including building ruins and the remnants of the *Noordvoor* canal – the negative impact could be significant.

Anticipated impact of the hydropower station alternatives:
It is expected that at least two of the four alternative locations for turbine halls (namely Alts 1 and 2) and hence anticipated aqueduct routes would have a direct destructive impact on the ruin of a dwelling with associated middens on Neus Island. It is possible that secondary impacts associated with Alts 3 - 5 would also negatively affect the said heritage features and hence all five alternatives are given equal treatment in the following matrix and recommendation of mitigation measures. Alternatives 5 and 6 may have an impact on Stone Age sites on the north bank. Alternative 5 may have an impact where it is planned to intersect remnants of the Noordvoor, but traces of the old canal are already damaged at that point. Measures indicated below would serve to mitigate these impacts.

	Without mitigation	**With mitigation**
Extent	3	1

Duration	5	5
Magnitude	8	4
Probability	4	2
Significance	**64**	**20**
Status (positive or negative)	NEGATIVE	NEUTRAL
Reversibility	No	No, but possible to mitigate.
Irreplaceable loss of resources?	Yes, where present.	Loss of context but possible to mitigate.
Can impacts be mitigated?	Yes	Recommended.

Mitigation: Mitigation Measures:

1. In the event of major construction on the north bank of the river (as in Alternatives 5 and 6), upslope of the new canal, a systematic collection of a surface scatter of cf. Middle Stone Age artefacts should be made or excavation if any of the identified 'hotspots' is likely to be compromised.

2. Where distribution lines cross or run alongside the remnants of the 1908 *Noordvoor*, tower positions and procedures for distribution line erection must not impact on the old canal structures.

   Mitigation measures should include more detailed documentation of the canal remnants along this uppermost section of the *Noordvoor* and at any point where proposed infrastructure would have an impact on it.

   Where distribution line alignment options exist that which has least impact on the canal would be preferred from a heritage perspective.

3. With respect to the ruin of a dwelling with associated middens on Neus Island, it is anticipated that aqueduct routes for at least two of the alternative locations for turbine halls (namely Alts 1 and 2) would have a direct impact. It seems likely that secondary impacts associated with Alts 3 - 5 would also have an impact, unless this can be guaranteed to the contrary.

   Mitigation is recommended to include more detailed documentation of the ruin itself (preliminary characterisation is included in this report and in field records held by the McGregor Museum) as well as excavation of a representative sample of the midden material which shows good preservation and could shed much light on the nature of use of the dwelling and its context in the earlier twentieth century.

4. It is recommended that the findings of Phase 2 mitigation be worked into a museum-type display with objects and posters that could be

exhibited in Kakamas (the original 1924 hydro-electric generator building is ear-marked as a museum) and Upington.
Cumulative impacts: Cumulative Impacts: where any archaeological contexts occur, direct impacts are once-off permanent destructive events. However it can be anticipated that secondary cumulative impacts may occur with the increase in development and operational activity associated with the life of the proposed hydropower station.
Residual Impacts: -

5. MEASURES FOR INCLUSION IN THE DRAFT ENVIRONMENTAL MANAGEMENT PLAN

The objective

Archaeological or other heritage materials occurring in the path of any surface or sub-surface disturbances associated with any aspect of the development are highly likely to be subject to destruction, damage, excavation, alteration, or removal. The objective is to limit such impacts to the primary activities associated with the development and hence to limit secondary impacts during the medium and longer term operational life of the facility.

Project component/s	Any road or other infrastructure construction over and above what is outlined in the proposal and any extension of other components addressed in this EIA.
Potential Impact	The potential impact if this objective is not met is that wider areas or extended linear developments may result in further destruction, damage, excavation, alteration, removal or collection of heritage objects from their current context on the site, where they exist (the canal and other earlier twentieth century remains in particular).
Activity/risk source	Activities which could impact on achieving this objective include deviation from the planned lay-out of infrastructure without taking heritage impacts into consideration.
Mitigation: Target/Objective	A facility environmental management plan that takes cognizance of heritage resources in the event of any future extensions of infrastructure. Mitigation as proposed in this report (see 4.3.1) should be implemented.

Mitigation: Action/control	Responsibility	Timeframe
The Phase 2 (Mitigation) recommended above should have been completed prior to construction commencing.	Environmental management provider to set this up.	Completion prior to construction
Provision for on-going heritage monitoring in a facility environmental management plan which also provides guidelines on what to do in the event of any major heritage feature being encountered during any phase of development or operation.	Environmental management provider with on-going monitoring role set up by the developer for the construction period primarily and for any instance of periodic or on-going land surface modification thereafter.	Environmental management plan to be in place before commencement of development.
Should precolonial burials (not necessarily marked and potentially at some depth below the modern silt surface on Neus Island), ostrich eggshell container cache, or localised Stone Age sites with stone tools, pottery and possibly organic remains such as fish bones be found the relevant Heritage Authority should be contacted.	Environmental Control Officer should become acquainted at a basic level with the kinds of heritage resources potentially occurring in the area and should report to the Heritage Authority as needed (see next column).	In the event of finding any of the features mentioned in column 1, reporting by the developer to relevant heritage authority should be immediate. Contact: SAHRA Ms N. Ndobochani/Ms C. Scheermeyer or Ms M. Galimberti, 021-4624502 or Bošwa ya Kapa Bokone Mr Shane Christians 053-8074700.

Performance Indicator	Inclusion of further heritage impact consideration in any future extension of infrastructural elements. Immediate reporting to relevant heritage authorities of any heritage feature discovered during any phase of development or operation of the facility.

Monitoring	Officials from relevant heritage authorities (National and Provincial) to be permitted to inspect the operation at any time in relation to the heritage component of the management plan.

6. CONCLUSIONS

No precolonial/Stone Age material was noted in the development footprint areas on Neus Island. Varying densities of stone artefacts were noted along the north bank of the river, upslope from the canal as well as on the higher ground north east of the weir along the northern alternative distribution line route.

Significant Colonial structures including remnants of the 1908 *Noordvoor* canal on the north bank of the Orange River and a ruin of a dwelling with associated middens near the west end of Neus Island were found. Criteria used here for impact significance assessment rate the impacts as worthy of mitigation, recommended in the above tables. The potential impacts on heritage material were considered to be acceptable, provided the recommended mitigation measures are implemented.

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REFERENCES

Beaumont, P. B., Smith, A.B., & Vogel, J.C. 1995. Before the Einiqua: the archaeology of the frontier zone. In A. B. Smith (ed.). *Einiqualand: studies of the Orange River frontier*. Cape Town: UCT Press.

Deacon, J. nd. Archaeological Impact Assessment - specialist input to planning and design. Unpublished notes compiled for the National Monuments Council.

Hopkins, H.C. 1978. *Kakamas: uit die wildernis 'n lushof*. Goodwood: Nasionale Boekdrukkery.

Masson, J.R. 1995. A fragment of colonial history: the killing of Jacob Marengo. *Journal of Southern African Studies* 21:247-256.

Morris, D. 2000. Gamsberg Zinc Project environmental impact assessment specialist report: archaeology.

Morris, D. 2002. Archaeological inspection of site for vineyard development at Keboes on the Orange River opposite Kanoneiland, Northern Cape. Unpublished report.

Morris, D. 2005. Reports on a Phase 1 Archaeological Assessments of proposed salt mining areas on the Eenbeker Pan, Opstaan Pan and Goeboe Goeboe Pan north of Upington, Northern Cape.

Morris, D. 2006. Report on a Phase 1 Archaeological Assessment of proposed salt Works areas on the Eenzaamheid Pan north of Upington, Northern Cape.

Morris, D. & Beaumont, P.B. 1991. !Nawabdanas: archaeological sites at Renosterkop, Kakamas District, Northern Cape. *South African Archaeological Bulletin* 46:115-124.

Morris, D. & Seliane, M. 2006. Report on a Phase 1 Archaeological Assessment of the site of a proposed Shopping Mall, Erf 19981, Van Riebeeck Street, Upington, Northern Cape.

Mossop, E.E. 1935. *The journal of Hendrik Jacob Wikar (1779)*. Cape Town: Van Riebeeck Society.

Parsons, I. 2003. Lithic Expressions of Later Stone Age Lifeways in the Northern Cape. *South African Archaeological Bulletin* 58:33-37.

Penn, N. 2005. *The Forgotten Frontier: Colonist and Khoisan on the Cape's Northern Frontier in the 18th Century*. Athens, Ohio and Cape Town: Ohio University Press and Double Storey Books.

Robinson, A.M.L. (ed) 1978. *Selected articles from the Cape Monthly Magazine NS, 1870-1876*. Cape Town: Van Riebeeck Series Second Series No 9.

Sampson, C. G. 1974. *The Stone Age archaeology of South Africa*. New York: Academic Press.

Smith, A.B. 1995. Archaeological observations along the Orange River and its hinterland. In A. B. Smith (ed.). *Einiqualand: studies of the Orange River frontier*. Cape Town: UCT Press.

Whitelaw, G. 1997. Archaeological monuments in KwaZulu-Natal: a procedure for the identification of value. *Natal Museum Journal of Humanities*. 9:99-109.