

**BASIC HERITAGE IMPACT ASSESSMENT**

**FOR THE PROPOSED  
IMPROVEMENT OF STRUCTURES ALONG THE R27 (INCLUDING THE WIDENING  
OF FIVE BRIDGES), SECTION 10 & 11  
BETWEEN KENHARDT AND KEIMOES**

Prepared as part of a basic environmental assessment for:

CCA Environmental Pty Ltd



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*Tim Hart of ACO Associates CC is an independent consultant with no financial or other interest in the proponent SANRAL other than the provision of professional services relating to heritage.*

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## Executive Summary

South African National Road Agency Limited (SANRAL) has appointed BKS (Pty) Ltd to undertake the improvement of various structures located along Section 10 and 11 of the R27 route between Kenhardt and Keimoes. ACO Associates was appointed by CCA Environmental (Pty) Ltd to contribute the heritage component to the Basic Environmental Assessment. This has involved assessing the bridges as well as options for 8 borrow pits for materials.

This report focuses on the heritage issues and impacts associated with the proposed altering of 5 bridges that cross the Orange River valley at Keimoes. Four of these bridges are greater than 60 years of age and therefore require an assessment of their heritage qualities in compliance with Section 38.8 of the National Heritage Resources Act 25 of 1999.

This study has established that bridges 2461, 2462 and 2463 (collectively known as Groblers Bridge) were built between 1931 and 1933 by Murray and Stewart (Pty) Ltd. For their time they represented local civil engineering at its best – the structures have withstood the test of time, but are inadequate in terms of both vehicle and pedestrian capacity. In addition bridges 2461 and 2462 are prone to periodic flooding. The proposal to adjust these bridges has local support however concern has been expressed with respect to retaining their heritage qualities. To this end a conservative approach has been adopted to satisfy the requirement of the proponent SANRAL that the work is accomplished in such a way as to reflect the heritage qualities of the Groblers Bridges, retain as much original fabric as possible and make sure that the form of the arches and detailing are acknowledged in any new work. This study has found that the experience of crossing these archaic and interesting rural bridges will change for the traveller as a “heritage experience” will be largely lost in favour of safety convenience; however retention of the form of the bridges will help retain their place making qualities in a local context.

Bridge 2460 built by the Department of Public Works in 1916-1919 continues to carry a heavy traffic load. It is in poor condition and a potential safety concern. The demolition of bridge 2460, possibly one of the older reinforced concrete bridges in the country is a consequence of its poor condition and light construction in the context of increasing use of the R27 in recent years by heavy vehicles. It was designed for different loadings at a different time. As unfortunate as this is, the physical constraints of the environment do not allow for the conservation of this structure *in-situ*.

In terms of archaeology and palaeontology, no further action is warranted for the borrow pits, however the proponent is not to utilise borrow area 7 unless under strict supervision. In terms of the other options the proponent is encouraged to use the products of tidying the sites although new area may be opened provided that remediation takes place. In the interests of conservation of landscape it is suggested that option 8 is not exercised and that the nearby disused golf course should be investigated as an alternative source. Similarly borrow pit option 3 is constrained by the Kameeldoring thicket which is protected.

## **Glossary**

**Archaeological material** *Remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years, including artefacts, human and hominid remains and artificial features and structures.*

**Cultural landscape** *A landscape that has historical and/or scientific significance.*

**Heritage** *That which is inherited and forms part of the National Estate (Historical places, objects, fossils as defined by the National Heritage Resources Act of 2000)*

**HWC** *Heritage Western Cape*

**Palaeontological** *Any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace.*

**SAHRA** *South African Heritage Resources Agency*

**Structure (historic)** *Any building, works, device or other facility made by people and which is fixed to land, and includes any fixtures, fittings and equipment associated therewith. Protected structures are those which are over 60 years old.*

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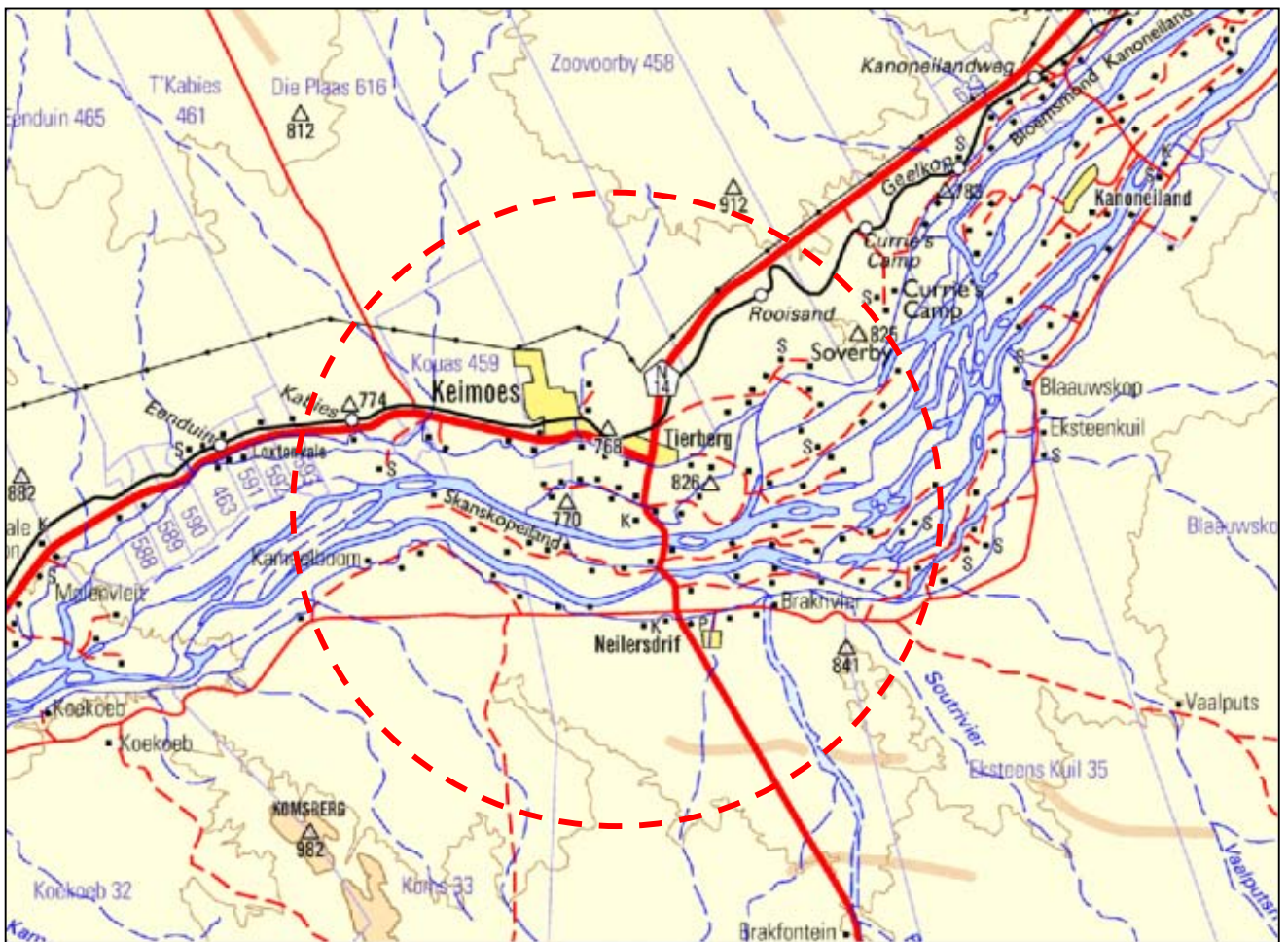
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## 1. Introduction

South African National Road Agency Limited (SANRAL) has appointed BKS (Pty) Ltd to undertake the improvement of various structures located along Section 10 and 11 of the R27 route between Kenhardt and Keimoes (Figure 1 indicates the study area). Of these structures, 5 bridges that cross the Orange River valley are proposed for widening. Four of these bridges are greater than 60 years of age and therefore require an assessment of their heritage qualities in compliance with section 38.8 of the National Heritage Resources Act 25 of 1999. CCA Environmental (Pty) Ltd has been appointed as the independent environmental consultant to undertake the necessary Basic Assessment (BA). This specialist heritage study is being conducted as part of the Basic Assessment to satisfy Section 38.8 of the National Heritage Resources Act 25 of 1999. SAHRA (South African Heritage Resources Agency) and the provincial heritage authority of the Northern Cape are commenting bodies.

A further aspect of this study is the archaeological assessments of 8 borrow pit sites situated close to Keimoes and Neilersdrif. These represent various alternatives for the sourcing of raw material – fill, sand and rock that will be necessary for the proposed activity.



**Figure 1** The location of the study area (after Chief Directorate Surveys and Mapping 1:250 000 2820,2002 ed4)

### 1.1 Terms of Reference

The specific terms of reference for the archaeology and cultural heritage assessment as provided by CCA Environmental Pty Ltd are as follows:

- 3.3.1 Provide a broad, baseline description of the archaeological/cultural history resource potential of the study area, placing the sites in a local and regional context.
- 3.3.2 Provide specific information relating to the archaeology and cultural history resources of the sites, with reference to sites/structures of special concern and their conservation significance, which can be used as baseline information for the assessment of potential impacts of the proposed activity alternatives.
- 3.3.3 Provide guidance on the appropriate design of bridge structures that have to be altered.
- 3.3.4 Provide guidance on the requirement of any permits from the South African Heritage Resources Agency or Heritage Northern Cape that might become necessary.
- 3.3.5 Identify, describe and assess the impacts of the proposed activity alternatives on archaeology and cultural history resources.
- 3.3.6 Determine the significance of the impacts of the proposed activity alternatives on archaeology and cultural history resources.
- 3.3.7 Recommend appropriate, practicable mitigation measures that will reduce all major (significant) impacts or enhance potential benefits, if any.
- 3.3.8 Provide a revised significance rating of the impacts on the archaeology and heritage resources after the implementation of management actions.

## **1.2 Description of the study area**

The study area is located in the vicinity of Keimoes in the Northern Cape Province. This is an arid area of the country, however the Orange River (sometimes referred to as the Gariep) flows through the region diverging into multiple channels and hundreds of small islands. The river floodplain and islands supports extensive agriculture. Table grapes from the region are exported widely – both locally and internationally. The area has a rich heritage dating back from the Early Stone Age millions of years ago to the comparatively recent Korana wars which saw Khoekhoen groups driven away from the islands to be replaced by mostly European farmers.

The focus of this study is the upgrading of 5 bridges over the river at Keimoes. Four of these are greater than 60 years of age. The construction of this suite of bridges (as well as the Upington Bridge) that crosses from island to island facilitated enormous growth in agriculture and contributed in part to economic prosperity of the area after 1933. Today the single lane bridges are an impediment

in the R27, the most direct road to Cape Town and an important national route. The amount and size of vehicles on the road today are a far cry from those of the early 20<sup>th</sup> century, therefore the bridges need to be brought up to modern standards. The three main bridges over the river (known as the Groblers Bridges) are well engineered arch bridges, aesthetically pleasing to look at and evidently nurtured as place makers among the local community. While members of the community support the widening of these structures, both the proponent and the community desire to have the



**Plate 1.** A heavy vehicle drives onto Groblers Bridge

work done in such a way that the heritage qualities of the structures are strongly acknowledged.

### **1.3 The development proposals**

The proposal is the upgrading and widening of the 5 bridges as well as localised upgrading of roads to tie in with the bridge widening. The 4 historic bridges are all single lane bridges built at the beginning of the 20<sup>th</sup> century. The R27 is experiencing fairly heavy traffic volumes, especially heavy vehicles which even out of harvest season cross on an hourly basis. At grape harvest time traffic backups occur as the route is favoured as the most direct option for transporting products to Cape Town. Periodic flooding renders two of the bridges impassable from time to time. Three of historic bridges are only just capable of carrying the weight of heavy vehicles, while the oldest of the historic bridges is in poor repair and significantly below specification.

The bridge widening would entail the following:

- The single lane Salt River Bridge or South Spruit (Bridge B2460) would be demolished and replaced with a wider two-lane bridge. This is the oldest of the 5 bridges apparently built in 1916-1919.
- The 3 arch bridge set known as “Groblers Bridge” over the Orange were completed in 1931-33. Of these Bridges B2461 south of Skanskop Island will need to be widened and heightened. Bridge B2462 between Skanskop and Rooikop Islands will need to be widened and heightened and Bridge B2463 (north of Rooikop Island) which crosses the main channel would be widened.
- Bridge B2464 on Friersdalespruit close to Keimoes (sometimes known as the “Witbrug”), is a two lane bridge dating from 1956. It would also be widened to allow for safe movement of pedestrian traffic.

In each case, provision will be made for cyclists regularly using this route by providing adequate road shoulders in both directions. Pedestrian traffic and safety will be enhanced by the provision of sidewalks in both directions on the bridges. Widening of the arch bridges will require an additional width of approximately 8.7 m in order to increase the existing deck width of approximately 3.7 m to 12.4 m. (CCA Environmental Pty Ltd Background information document 2009)

#### **1.3.1 Alternatives**

Three alternative approaches to the upgrading are proposed (CCA Environmental Pty Ltd 2009)

- Option 1: Retain existing road geometry at most locations and improve within the constraints allowed by the existing structures (upgrade structures very much as they are).
- Option 2: Improve road geometry at critical locations with limited adjustment to vertical and horizontal alignment at selected (undertake enough work to ensure that the bridges operate more efficiently in terms of traffic however bridge heights will not be changed).
- Option 3: Improve road geometry at critical locations with substantial changes to vertical alignment to accommodate larger flood events and limited adjustment to horizontal alignment at selected structures (implies extensive bridge rebuilding, re-routing of road alignments)

#### **1.3.2 Material sources**

The proposed project would also require use of raw material, such as sand, stone and fill for the modifications. The second aspect of this study has been the assessments of 8 potential borrow pit sites and areas to establish which of these is most suitable in environmental and heritage terms for the proposed activity. All the identified sources are situated close to Keimoes, and almost all of them have been subject to unregulated removal of material in the past.

## **1.4 Heritage legislation**

The basis for all heritage impact assessment is the National Heritage Resources Act 25 (NHRA) of 1999, which in turn prescribes the manner in which heritage is assessed and managed.

Loosely defined, *heritage is that which is inherited*. The National Heritage Resources Act 25 of 1999 has defined certain kinds of heritage as being worthy of protection, by either specific or general protection mechanisms. In South Africa the law is directed towards the protection of human made heritage, although places and objects of scientific importance are covered. The National Heritage Resources Act also protects intangible heritage such as traditional activities, oral histories and places where significant events happened. Generally protected heritage which must be considered in any heritage assessment includes:

- Cultural landscapes
- Buildings and structures (greater than 60 years of age)
- Archaeological sites (greater than 100 years of age)
- Palaeontological sites and specimens
- Shipwrecks and aircraft wrecks
- Graves and grave yards.

Section 38 of the NHRA requires that Heritage Impact Assessments (HIAs) are required for certain kinds of development such as rezoning of land greater than 10 000 sq m in extent or exceeding 3 or more sub-divisions, or for any activity that will alter the character or landscape of a site greater than 5000 sq m. "Standalone HIAs" are not required where an EIA is carried out as long as the EIA contains an adequate HIA component that fulfils Section 38 provisions.

The Provincial Heritage Authority of the Northern Cape is responsible for the management and protection of all provincial heritage sites (grade 2), generally protected heritage and structures (grade 3a-grade 3c) in that province, while SAHRA National Office in Cape Town is responsible for archaeology, palaeontology and meteorites. In terms of this particular project the heritage authorities are commenting bodies but are not responsible for final compliance as this study forms part of an EIA process for which the national Department of Environment Affairs is the compliance authority (in terms of section 38.10 of the National Heritage Resources Act).

## **2. Findings of the heritage impact assessment**

### **2.1 Method of study**

The primary sources of information for this project has involved the perusal of written records and primary information sourced in the Cape Archives in Cape Town. This amounts to some hundreds of pages of diagrams, maps and letters. The early history of the study area has been relatively well published in recent years; however the early 20<sup>th</sup> century local history is mostly contained within a single publication by De Beer (1992). Local information on the history of construction of concrete bridges is extremely scarce. Similarly the subject matter does not feature in any heritage audits or surveys that have taken place in this country. It was therefore necessary to consult international web-based literature to obtain a basic understanding of the history of development of the technology.

The bridges themselves were inspected by Tim Hart who is an archaeologist and general heritage consultant who has some 22 years of working experience. The proposed borrow pit sites were also inspected for evidence of archaeological material.



### 2.1.1 Limitations

The most significant limitation to this study has been the lack of readily available information on the history of concrete bridge construction and the early use of reinforced concrete in South Africa. This has made it very difficult to assign the bridges any specific grading or assess their significance in terms of the significance criteria contained with the NHRA. Fortunately there is good information from Europe and the USA which means that it has been necessary to assume that the history of concrete bridges in South Africa roughly parallels that of more developed nations outside of RSA.

### 2.2 The history of the study area

According to Smith (1995), Gordonia and lower Orange River area was one of the last frontiers of resistance that faced European settlers who began to encroach into the remoter areas of the Northern Cape by the mid-18<sup>th</sup> century. Before the advent of European settlement the Orange River banks and islands were the territory of Khoekhoen herding groups who practised a transhumance subsistence pattern grazing their cattle and small stock on the lush pastures of the river banks and islands. The early European travellers, R J Gordon and H J Wikar who travelled through the Orange River Valley make mention of the local people who formed several groups – the Eniquas, Briquas, Gessiquas and the !Kora – a mixed group of Khoekhoe and Tswana people. All these people spoke a similar language, namely that of the Orange River Khoekhoen. The steady encroachment of European farmers into the northern reaches of the Cape Colony created a “bow wave” of political instability among the various Khoekhoen groups. The Eniqua of the lower and middle Orange River were absorbed by the Korana – a large group of people possibly from the Great Karoo and upper reaches of the Orange who themselves were displaced by the colonial expansion. By the late 1700s a bitter war of attrition had commenced with both the Korana and the San hunter gatherers engaging in lightning- strike raids on *trekboer* farms. The Korana were highly mobile even striking as far south as Calvinia. The colonists developed the commando system to track and hunt down the raiders. Able-bodied farmers and Bastards (half breeds who could handle horses and guns) were conscripted for regular commando duty. Often Bastards who did not wish to serve, trekked northwards to the Orange River where they formed alliances and arrangements with the Korana and introduced the knowledge of handling firearms (Penn 1996).

By the advent of the 19<sup>th</sup> century, the Orange River in the Northern Cape had become a refuge for gangs of cattle raiders, bastards and large groupings of Korana who had secured themselves on the islands of the river. The islands formed a verdant ribbon of land in an otherwise vast and arid landscape. Here the various displaced groups could maintain enough livestock to sustain their communities. The commando attacks failed to displace the dissidents who used their knowledge of the local environment to shift themselves from island to island and launch guerrilla attacks on Trekboers Farmers. The northern border of the Cape Province remained a dangerous liability well into the British period. The situation of general lawlessness became so intolerable that legislation was passed to enable making provision for a special magisterial district with a detachment of border police who were based at Upington. In 1868 the first Korana war broke out which saw a detachment of professional soldiers along with locals and Bastard soldiers loyal to the government break up a number of dissident Korana gangs and see their leaders sent to Robben island. The Chief of the Korana, Klaas Lukas who lived at what is now Upington requested that a Christian Mission be set up to bring some measure of political stability. This heralded the beginnings of the town of Upington. After a brief period of relative stability the Korana reverted to their old ways having been left destitute by a serious drought in 1877. The entire Korana nation and allies led by Klaas Lucas rebelled against the government in a short and vigorous war. The colonial forces made use of artillery eventually breaking up the rebel forces. The leaders of the Korana nation were imprisoned on Robben Island where Klaas Lucas eventually died. By the time other Korana Chiefs had been released in 1883 they were elderly and no longer able to rally their communities who were mostly employed on the European farms or had trekked into Namibia to escape colonial rule. The islands were fully occupied and under cultivation by white farmers, the Korana communities were irrevocably fragmented (Smith AB 1996) and culturally extinct.

When Cornel (1921) travelled the Orange River area in the 1920's he remarked on the well organised farms and orchards that farmers had established on the Orange River islands and the fact that the Islands were linked to each other by a system of suspension bridges. Grapes were being produced in enormous quantities along with various other fruit and vegetables. Within just two decades of the defeat of the Korana nation the islands of the river had been fully transformed into a network of highly productive farms. While the river was the life blood for these activities, it was also a huge economic impediment. There were no bridges capable of carrying large loads which inhibited the economic capacity of the area. Farmers relied on being able to ford the river at times of low water, or pontoons. For several months of the year the entire island communities were marooned by floodwaters. The need for adequate bridges was pressing, for without these, the economic development of the community could not continue. According to De Beer (1992) as the agricultural community that occupied the islands of the Orange River burgeoned, so the community discontent with the means of crossing the river increased. Initially farmers were forced to swim between Keimoeseiland and Rooikopeiland, however after nearly drowning, a local farmer decided to build a pontoon. The Rooikopeiland Pont was opened in 1910 and another was established between Rooikopeiland and Brakboseiland. While the pontoons worked under ideal circumstances, they were useless when the water was too low or the river was in flood. The situation was exacerbated in 1925 when the pontoon over the deepest section of the river capsized drowning a nun and almost drowning the Bishop of Pella. The Keimoes farming community then petitioned the local council to raise funds for the construction of bridges across the entire width of the river. The government however wished to prioritise the construction of a bridge at Upington, fuelling local discontent, however in 1931 the Divisional Council of Gordonia and Kenhardt agreed to obtain permission from the Provincial Government to seek a bank loan (47 000 Pounds) to raise funds for the construction of bridges at Keimoes and Upington (Cape Archives: Letter to the Provincial Governor 1931). The Upington and Keimoes Bridges Ordinance (Provincial Gazette 1931) was passed and a tender call was advertised in February 1932. Some 14 companies responded, of which the new Cape Town based company, Murray and Stewart (Pty) Ltd offered the most competitive bid.

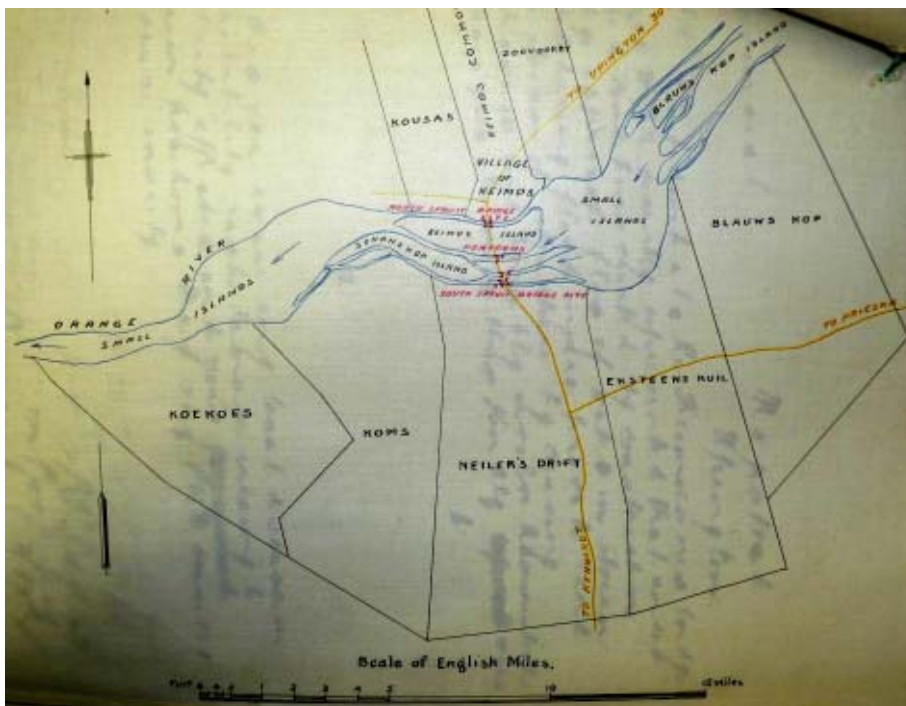


Plate 2. Early 20<sup>th</sup> century sketch map showing the two pontoons and the early bridges (CA Department of Public Works).

According to De beer (1991) all 3 Groblers Bridges were built making use of local labour. These were the years of the great depression so the work was seen as an employment opportunity for destitute members of the community. The construction methods were labour intensive using local material as far as was possible. The building specifications provided by Murray and Stewart were highly detailed even specifying the manner in which the reinforcing bars were to be cleaned and prepared prior to being set into the reinforced concrete (Original specifications 1931). At the time that the bridges were built, Portland Cement had only been in

common use in South Africa for 10 years which means that the bridges were significant early structures in local terms, and possibly among the first built by Murray and Stewart. A large flood that took place in 1925 informed in part the specifications for the bridges. It would appear that the design

engineer, Mr McLaren (initials illegible) was fully aware that the bridges would overtop from time to time and built them accordingly even to the detail of having light removable railings so that current flow would not be impeded. It was felt that should they be built any higher, this would be at the expense of valuable agricultural land on Rooikopeiland. The tests of time have revealed that the two smaller Groblers bridges overtop leaving the islands marooned from time to time. Groblers Bridge (the main 10 arch span) is of adequate height above the water. The Upington Bridge was built by Murray and Stewart at the same time according to a similar design, the difference being that Upington Bridge has a substantially larger span.

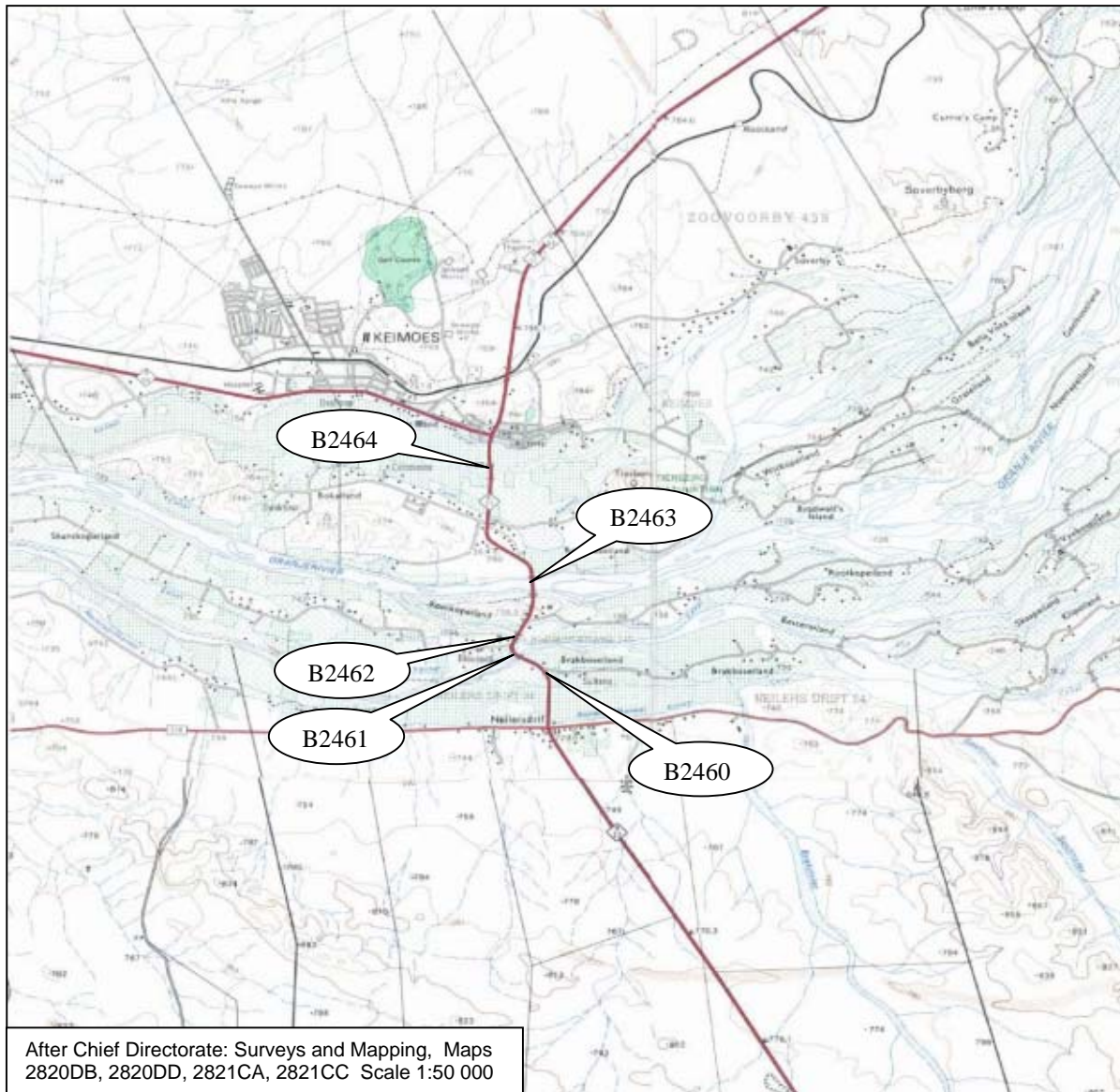


Figure 1. Location of the 5 bridges which will be modified

### 3. Assessment of the Keimoes Bridges

#### 3.1 A brief history of concrete bridges

In the absence of any local heritage studies with respect to bridges that would assist in determining relative significance, international web-based literature was consulted in order to gain some understanding of the heritage significance of the Keimoes Bridges. According to the Concrete Bridge Development Group (2009) plain concrete was used in components of bridge construction in the 1870's in the UK, however the first recorded use of reinforced concrete for a bridge in that country was in a 28 foot long railway bridge in 1902. In the USA the first reinforced concrete bridge was built in 1884 and has remained functional until present ([www.wikipatents.com/4464803.html](http://www.wikipatents.com/4464803.html)). In South Africa concrete blockhouses were constructed during the South African War, while the author of this report has observed reinforced concrete structures dating to the late 19<sup>th</sup> century – the Robben Island south Jetty, the Thesen Island jetty as well as the locomotive shed at AECl, Somerset West. Although Portland Cement was not readily available in RSA until the Piketberg Plant was constructed in 1920, the knowledge of working with concrete did not lag behind the rest of the world. By 1930 more than 2,000 reinforced concrete bridges had been built in the UK, many of them mimicking the earlier styles of stone arched bridges. This was the dawn of the world's great concrete structures. Murray and Stewart (Pty) Ltd who built the Groblers Bridges evidently made sure that the technology they used was the latest and best available at the time.

#### 3.2 Bridge 2464

This is a relatively modern concrete bridge known as the "Witbrug" built in 1956. According to De Beer (1992) where the "Witbrug" is located today, there was at the turn of the century a reasonably easy drift, which was later spanned by a hang bridge. Since the hang bridge was always out of order, and the drift was often impassable during floods, petitions were made for a more permanent structure. The single lane cast concrete bridge was opened to traffic in 1916. As far as can be ascertained, the single lane bridge over the river closest to Neilersdrif was also built at the same time. The two bridges were more or less the same in terms of appearance and width. The one close to Nellersdrif is still in use although no longer suitable for heavy traffic. The old 1916 concrete bridge over the Keimoes Spruit was replaced in 1956/1957 by the "Witbrug" bridge. The site inspection revealed that there is no immediately visible physical evidence of the 1916 structure. The existing bridge is entirely recent and is therefore not subject to the general protections of the NHRA.



Plate 3. Bridge 2464 (looking south)

##### 3.2.1 Proposed alterations:

The proposal is to widen the bridge to provide a shoulder and improve pedestrian access. This is to be achieved by adding 3 m wide cantilevered extensions to either side of the existing structure to create a shoulder and pavement.

### 3.3 Bridge 2463 (Groblers Bridge)

This bridge crosses the main stream of the Orange River. It was the largest of three built by Murray and Stewart in 1933 comprising 10 arches. The sense of entry onto the structure – a moderate descent onto a long narrow and apparently rickety rural crossing deprives the casual traveller of the knowledge of the well engineered and skilfully proportioned reinforced concrete arches that lie underneath. This bridge has stood the test of time having withstood some 80 years of significant annual floods. Although the bridge is structurally sound, it was never designed to handle the tonnage or size of modern heavy vehicles and is inadequate in terms of modern safety standards for pedestrian use. The single lane (10 feet wide) is scarcely able to accommodate the width of a large truck (see Plate 1), and the single pedestrian walkway with its simple wire balustrade is unsafe and insecure, although crossing on foot is an enjoyable experience as the bridge offers excellent views up and down stream. It is of interest to note that originally two pedestrian walkways were specified, but each bridge has only one.



Plates 4 (left) and 5 (right). Views of bridge 2463 showing the pedestrian walkway and arches

#### 3.3.1 Proposed alterations

The proposal is to widen the bridge to modern specifications, namely two lanes with shoulders and adequate pavements and balustrades for safe pedestrian use. The proponent is mindful of the heritage qualities of the structure and does not wish to consider demolition. The proposal is to widen the bridge by removing the upstream edge and extending it laterally. The forms of the piers and arches will be continued so that in profile the bridge will look very similar to that of today. However the modern conservation principal of being able to distinguish old from new fabric will be applied. Visually permeable balustrades will be used so that the traveller's view of the spectacular expanse of river will be unimpeded. The successful widening of the graceful Carlisle Bridge in the Eastern Cape (another heritage structure) has been adopted by BKS (Pty) Ltd as a methodological model through which a suitable result can be achieved.

### 3.4 Bridge 2462 (Groblers Bridge)

Collectively with bridge 2463 and 2461 this forms part of the Groblers Bridge complex. The bridge is a single lane 3 arch bridge similar in finish and detail to the other Murray and Stewart bridges. Although much smaller, it too is a pleasing structure, however, getting a good view involves leaving the road reserve to find a vantage point. The bridge connects Skanskopeiland to Rooikopeiland. In current terms it also shares similar inadequacies. Pedestrian access is inadequate, the single lane is too narrow. However its biggest failing is that the bridge overtops at times of peak flood cutting Keimoes off from the south bank and marooning the Skanskop Island community.



Plate 6. Bridge 2462

#### 3.4.1 Proposed alterations

Given that this bridge is subject to overtopping, it is proposed that it is heightened by 1.8 m to lift the arches above the commonly experienced flood levels (1:20 years). As with the other bridges it is proposed that the bridge is widened on the upstream side to accommodate two traffic lanes as well as shoulder and pedestrian walkways. While the work will require extensive demolition and alteration, it is the intention of the design team to retain the essential form and appearance of the bridge in line with the wishes of the proponent and the community.

### 3.5 Bridge 2461

This is a single lane bridge built by Murray and Stewart Pty Ltd. Linking Skanskopeiland with Brakboseiland it consists of 6 arches with originally stone abutments (now mostly clad in concrete). The bridge enjoys similar aesthetic values to the others of similar design and is particularly spectacular when viewed from cleared areas of the river bank upstream. Unfortunately the casual motorist is not in a position to appreciate the structure unless he/she makes a particular point of leaving the vehicle. Like bridge 2462, bridge 2461 is subject to overtopping and needs to be both widened and raised.



Plate 7. Bridge 2461

#### 3.5.1 Proposed alterations

It is proposed that this bridge is heightened by 1.8 m to lift the arches above the commonly experienced flood levels (1:20 years). As with the other bridges it is proposed that the bridge is

widened on the upstream side to accommodate two traffic lanes as well as shoulder and pedestrian walkways. While the work will require extensive demolition and alteration, it is the intention of the design team to retain the essential form and appearance of the bridge in line with the wishes of the proponent and the community. The bridge railings will be designed to be visually permeable to enhance the travellers' experience of the river crossing.

### **3.6 Bridge 2460**

Bridge 2460 links Brakboseiland with the south bank of the river. According to De Beer (1992) this decrepit looking single lane bridge was built in 1916. Our own research has revealed that drawings exist produced by the Department of Public Works in 1919, confirming an unusually early date for this reinforced concrete structure. The bridge appears to be constructed from pre-cast concrete components which were probably in part assembled on site. The piers which have a very gracile appearance are cast into the riverbed. The bridge bears a very close resemblance to that depicted on drawings indicating that the structure is largely original, the only significant change being the walkway which has been cantilevered onto the structure. A visual inspection of the underside of the bridge revealed that spalling was taking place in places and the reinforcing steel was exposed. There were also noticeable cracks in major components. Of concern is the fact that a bridge that was designed 90 years ago for loads equivalent to a light motor vehicle or heavily laden wagon is now carrying heavy articulated trucks on an hourly basis.



Plate 8. Bridge 2460 built c1916-1919

In the absence of local comparative information, it is tentatively suggested that the Neilersdrift Soutrivier (or south bridge) represents an early rare example of local concrete bridge construction and is therefore of significance in heritage terms. In terms of its physical setting it serves as a “gateway” to the Nellersdrift village and imparts a strong sense of arrival.

#### **3.6.1 Proposed demolition**

The condition of the bridge is poor and its weight bearing capacity (even if the structure were in good condition) is dangerously inadequate. The proposal is to demolish the bridge in its entirety and replace it with a contemporary SANRAL design. Discussions with the project design engineers indicate that it is not possible to repair or rebuild the bridge in its current form that will adequately cater for modern transport needs. The diversion of the R27 to one side over a new bridge while retaining the original one is not considered a desirable alternative. The old bridge will create an additional hydrological impediment, and will continue to deteriorate if not managed. In addition a road diversion implies further loss of valuable agricultural land which is a very finite resource in this area. The balance of heritage significance as opposed to economic and safety needs unfortunately weighs in favour of demolition, however some actions are possible in terms of mitigation.

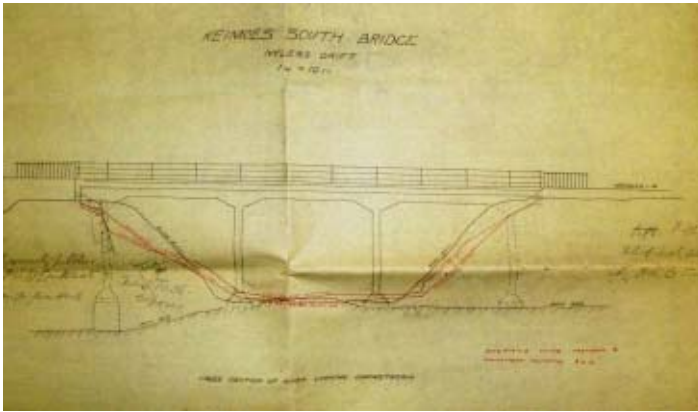


Plate 9 (left). A Public Works Department drawing depicting bridge 2460 dated 1919.

Plate 10 (bottom left). Bridge 2460 as it is today.

Plate 11 (bottom right.) Detail of cracking and spalling on underside of bridge 2460.





## **4. Evaluation of Impacts**

Given the increasing pressures on the transport infrastructure of Keimoes, the proposed actions with respect to the Keimoes Bridges is a reasonable compromise between heritage concerns and modern requirements. The Keimoes community is clearly in favour of upgrading of the bridge system (author was present at a public meeting) however it was indicated by some people that they would like the bridges “to look the same”, while at least one member of the public was of the opinion that the single lane bridges were of tourism interest. Given that the constraints imposed by the behaviour of the river and the value of the surrounding land necessitate a practicable engineering response, modification of the bridges is un-avoidable. The design engineers have proposed a solution that sees the bridges, where necessary widened and heightened, yet tries to retain the form of the arches and piers.

### **4.1 Groblers Bridges 2461-2463**

#### **4.1.1 Intangible impacts**

Bearing in mind that the bridges of Keimoes are inextricably linked with the identity of the place, some degree of intangible impact is inevitable. The bridges in their present form have a rural and old world charm. Single lane bridges of this size are becoming increasingly unusual. It is understandable that visitors to the area find them to be of particular interest. With the proposed changes, the experience of driving over the bridges will change – perhaps more mundane but considerably safer and faster. The retention of design characteristics of the Groblers bridges and visually permeable bridge railings will go a long way to retaining the character of the area, however the experience of driving or walking over the bridges will be irrevocably changed. This aspect constitutes a negative heritage impact.

*Mitigation measures:* None suggested

#### **4.1.2 Physical impacts**

Groblers bridges: The development proposal acknowledges the high aesthetic value of the Groblers Bridges and goes to considerable lengths to retain this quality. On the main bridge a great deal of the physical fabric will be retained, though modification of the others will be more extensive. Bearing in mind that the actual fabric that the bridges are made from is not unique, and that by the 1930's reinforced concrete bridges were becoming relatively common the impact of the proposed activity is considered to be neutral.

*Mitigation measures:* The proposal to retain the form of the bridges is considered to be an acceptable compromise in heritage terms and is supported. As a general rule a comprehensive photographic survey should be taken before work commences and during construction so that an archive of information can be generated. A compact disc containing such information should be lodged with the Provincial Heritage Authority and SAHRA. The engineer in charge of the site would probably be the best person to accomplish this task.

### **4.2 Bridge 2460**

This structure is considered to be significant in local heritage terms in that it is an early example of its kind. Its destruction therefore constitutes a heritage loss and a negative impact of as yet un-established significance.

*Mitigation measures:* The total destruction of the bridge can only be mitigated in part through commissioning measured drawings and a photographic survey of the structure prior to demolition. A comprehensive photographic survey should be taken before work commences and during construction so that an archive of information can be generated. A compact disc containing such

information should be lodged with the Provincial Heritage Authority and SAHRA. The engineer in charge of the site would probably be the best person to accomplish this task.

The gateway view towards Neilersdrift should be borne in mind in designing the replacement structure. Building the new bridge on the same road alignment will go some way to maintaining this quality; however it is important that visual bulk is kept to a minimum.

#### 4.3 Impact summary tables

Summary Table 1  
Bridge 2464

Environmental aspect and impact description	Extent	Duration	Intensity	Probability	Confidence	Significance (before mitigation)	Proposed mitigation	Significance (after mitigation)
Modification of unprotected structure less than 60 years of age.	n/a	n/a	n/a	n/a	n/a	No significance – structure is not protected.	Not required	n/a

Summary Table 2  
Bridge 2 463(Groblers bridge)

Environmental aspect and impact description	Extent	Duration	Intensity	Probability	Confidence	Significance (before mitigation)	Proposed mitigation	Significance (after mitigation)
Modification of a protected structure of high aesthetic value and strong place making qualities	Local	Permanent	Medium	Highly probable	High	Medium	Ensure that design characteristics of old bridges are adhered to, change fabric only where necessary, and implement visually permeable balustrades. Photo record.	low

Summary table 3  
Bridge 2462 (Groblers bridge)

Environmental aspect and impact description	Extent	Duration	Intensity	Probability	Confidence	Significance (before mitigation)	Proposed mitigation	Significance (after mitigation)
Modification of a protected structure of high aesthetic value and strong place making qualities	Local	Permanent	Medium	Highly probable	High	Medium	Ensure that design characteristics of old bridges are adhered to, change fabric only where necessary, and implement visually permeable balustrades. Photo record	low

Summary table 4  
Bridge 2461 (Groblers bridge)

Environmental aspect and impact description	Extent	Duration	Intensity	Probability	Confidence	Significance (before mitigation)	Proposed mitigation	Significance (after mitigation)
Modification of a protected structure of high aesthetic value and strong place making qualities	Local	Permanent	Medium	Highly probable	High	Medium	Ensure that design characteristics of old bridges are adhered to, change fabric only where necessary, and implement visually permeable balustrades. Photo record.	low

Summary table 5  
 Bridge 2460

Environmental aspect and impact description	Extent	Duration	Intensity	Probability	Confidence	Significance (before mitigation)	Proposed mitigation	Significance (after mitigation)
Modification of a protected structure of high aesthetic value, possibly unique and with strong place making qualities	Local	Permanent	High	High	High	High	Sytematic recording of fabric before demolition. Acknowledge the view towards Neilersdrift in the design of the replacement bridge.	Medium (negative)

### 5. Borrow pits and borrow areas

The proposed activities will require a variety of raw material – boulder to be used for current breaking (rip-rap), various grades of fill material and sand. The terms of reference required that 8 areas be checked for possible heritage impacts. The results of the findings are indicated on table 6 while the locations of the borrow pits and raw material sources are indicated on Figure 3.

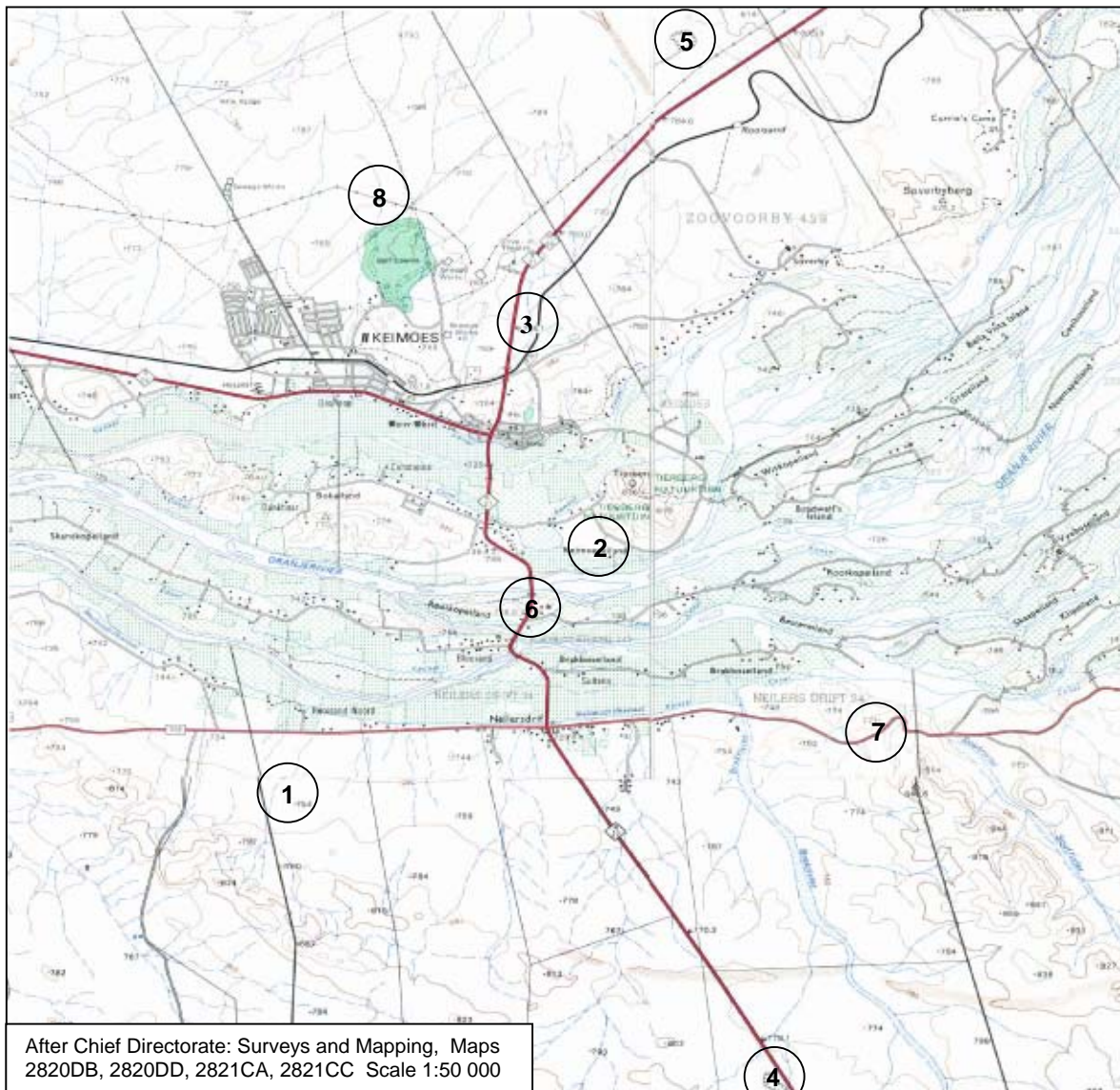


Figure 3. locations of borrow pits

## **5.1 Findings**

### **5.1.1 Assessment of impacts**

Overall the impacts that will be experienced are very moderate, and where work involves landscape tidying and remediation of a number of badly managed pits, the proposed activity will be advantageous.

In terms of archaeology and palaeontology the impacts are expected to be very low, especially if the various unsightly piles of disturbed material that characterise some of the borrow pits are utilised and pits rehabilitated.

It is noted that localities 1 and 4 are visually prominent and possibly should be avoided, however benefits could be derived depending on how the work is done – especially if loose material is used and the borrow pit is tidied up.

Concern is expressed over areas which contain Kameeldoring trees (localities 3 and 8) as it is felt that besides their botanical status, these trees contribute to the character and landscape qualities of the area.

Also of concern is the proposal to remove large boulders for rip-rap from the road reserve (borrow area 7). For this activity to leave minimal scarring on the landscape, the boulders would have to be selected and carefully removed from a wide area (in some instances by hand) so that the appearance of the road reserve (this is a picturesque area) is not noticeably changed. Removal of rocks cleared from vineyards at locality 5 is considered a far better alternative.

### **5.1.2 Mitigation**

No mitigation is suggested in terms of archaeology and palaeontology. Areas that contain Kameeldoring trees are best avoided in the interests of landscape conservation. A summary that describes the various proposed borrow pits and the impacts that could take place is presented in table 6.

Table 6. Summary of borrow characteristics and impacts.

Name/ID	Possible use	Location	Material type	Description/comments	Identified heritage issues
1. Neilersdrift	Selected/fill	Adjacent to R359; 2,2 km west from R359/R27 intersection	Thin layer of calcretized gravel (transported) overlying highly weathered rock (charnockite)	Large, existing pit about 1,5 m deep. Good extension potential to south; some extension potential to east and west. Can be rehabilitated/improved by landscaping of existing excavations as part of borrowing for this project.	Site is visually prominent, however no other heritage issues identified, no impacts expected
2. Tierberg	Selected/fill	East of Tierberg nature reserve	Thin layer of alluvial sandy gravel overlying highly weathered rock (gneiss and calc-silicate)	Existing pit about 1,5 m deep. Limited extension potential - bordered by roads, vineyards and micro light gravel runway. Can be rehabilitated/improved by landscaping of existing excavations as part of borrowing for this project.	Occasional Early Stone Age artifacts noted in a secondary context in river gravels. Impacts Low (negative), no mitigation required. Proposed quarry extension area is acceptable.
3. Cemetery	Selected/fill	Adjacent to road to Upington; outside Keimoes	Red brown, medium to fine grained, aeolian sand	Large, existing pit about 1,5 m to 2,0 m deep. Extension potential to north - near cemetery and railway line. Kameeldoring trees present. Can be rehabilitated/significantly improved by landscaping of existing excavations as part of borrowing for this project. Indications are that material is not suitable for concrete aggregate - possibly too silty.	No archaeological material present, however damage to existing Kameeldoring grove is noted. Kameeldorings make up a natural heritage landscape. Impacts will be high (negative). The site should be avoided.
4. Laenartsville	Selected/fill	Adjacent to R27; 7 km south of Keimoes	Calcrete and highly weathered rock (granite gneiss)	Small, shallow existing pit. Not preferred due to locality adjacent to main route (visibility).	Archaeological material in the form of quartz artefacts (Middle Stone Age) which form a diffuse scatter all round the area. Lateral expansion should be avoided, however material that is gained as a part of a rehab. Process may be used.
5. Blucuso Trust	Rip-rap	Adjacent to road to Upington; 4,5 km outside Keimoes	Stockpiled 600 mm dia boulders (granite gneiss/ calc silicate)	Boulders removed from subsoils for establishment of new vineyards (community project) and stockpiled along the boundaries of the worked land. Use of this material will reduce visual impact of stockpiles.	No heritage impacts expected.

6. R27 Road reserve	Rip-rap	Adjacent to R27; between bridges 2&3; near turnoff to Rooikop eiland; in area of cutting	Stockpiled 600 mm dia boulders (granite gneiss/ calc silicate)	Small amount of boulders in road reserve and along inside of fenceline (private land). Mostly spoiled material. Will only partly fulfill volume requirements.	No Heritage impacts expected
7. R359 Road reserve	Rip-rap	Adjacent to R359; 4 km east from R359/R27 intersection	500 mm dia colluvial boulders (granite gneiss)	Large amounts of boulders in wide available road reserve and adjoining private land.	If work is carried out injudiciously, rock removal will change the appearance of the road reserve, damage vegetation and cause scarring which will cause a medium term landscape impact (negative) of medium significance.
8. Golf course	Concrete sand?	Rivercourse east (behind) clubhouse and at entrance to golf course; 2,5 km north of Keimoes CBD	Red brown, medium to fine grained, aeolian/alluvial sand	Sand in rivercourses at the entrance to the golf club and behind the club house. Kameeldoring trees present. Detailed laboratory testing required to prove source.	Kameeldoring rich area should be avoided, however area behind old golf clubhouse is suitable in heritage terms.

## **5.2 Human graves**

Human remains can occur at any place on the landscape such as at borrow pits. They are regularly exposed during construction activities, either through the disturbance of lost grave yards, prehistoric burials or illegal burials. Such remains are protected by a plethora of legislation including the Human Tissues Act (Act No 65 of 1983), the Exhumation Ordinance of 1980 and the National Heritage Resources Act (Act No 25 of 1999) which applies to graves and their contents which are greater than 60 years of age.

No graves were located within the study area, however there is always a low possibility that unmarked illegal or historic graves could occur.

*Mitigation:* In the event of human bones being found on site, the South African Police Services and SAHRA must be informed immediately. If it is apparent that the remains are an illegal burial and foul play is suspected, the police will need to open a murder docket and the remains placed within the chain of custody. If the remains appear to be very old or are from a legal burial greater than 60 years of age, they must be removed by an archaeologist under an emergency permit. This process will incur some expense as removal of human remains from an archaeological context is at the cost of the developer. Time delays may result while application is made to the authorities and an archaeologist is appointed to do the work.

## **5.3 Evaluation of options**

- *Option 1: Retain existing road geometry at most locations and improve within the constraints allowed by the existing structures (upgrade structures very much as they are).*

Implementation of this option is unlikely to adequately resolve the issues of safety, traffic congestion and period flooding. While it would be strictly advantageous in heritage terms in the medium term, it is not anticipated that the upgrade will be functionally effective.

- *Option 2: Improve road geometry at critical locations with limited adjustment to vertical and horizontal alignment at selected structures (undertake enough work to ensure that the bridges operate more efficiently in terms of traffic).*

While implementation of this option may improve the situation, its weakness is that it does not involve the raising of the bridges. Periodic flooding (isolating communities for up to 3 weeks at a time) will not be solved, and it will only be a matter of time until the historic arch bridges themselves will begin to fail. While implementation of this option will conserve the bridges for the short - medium term, it is doubtful as to whether it will be sustainable; In addition it fails to meet the current needs of the community.

- *Option 3: Improve road geometry at critical locations with substantial changes to vertical alignment to accommodate larger flood events and limited adjustment to horizontal alignment at selected structures (implies extensive bridge rebuilding, re-routing of road alignments).*

Option 3 (the preferred option) implies extensive changes to bridges such as widening and heightening, cut and fill operations and road realignment adjustments to facilitate easy traffic flow onto the bridges. While this option will involve extensive change, it fulfils the needs of the upgrade to the R27 and best services the local and regional economic future growth. The proponent has committed themselves to retaining the form of the bridges which is the most reasonable compromise between real material need and heritage conservation. Hence option 3 is supported.

## 6. Conclusion and Recommendations

The need to upgrade the bridges is acknowledged in this heritage report. The conservative approach of the engineers (BKS (Pty) Ltd) reflects the requirement of the proponent SANRAL that the work is accomplished in such a way as to reflect the heritage qualities of the Groblers Bridges, retain as much original fabric as possible and make sure that the form of the arches and detailing are acknowledged in any new work. For the information of the design team, included as Appendix A is a summary of the principles of the Burra Charter, an internationally adopted standard and a UNESCO guideline for the conservation of historic places and features.

The proposed demolition of bridge 2460, possibly one of the older reinforced concrete bridges in the country is a consequence of its poor condition and light construction in the context of increasing use of the R27 in recent years by heavy vehicles. It was designed for different loadings at a different time. As unfortunate as this is, the physical constraints of the environment do not allow for the conservation of this structure *in-situ*.

In terms of archaeology and palaeontology, no further action is warranted for the borrow pits, however the proponent is encouraged not to utilise borrow area 7 unless under strict supervision. In terms of the other options the proponent is encouraged to use the products of tidying the sites although new area may be opened provided that remediation takes place. In the interests of conservation of landscape it is suggested that option 8 is not exercised and that the nearby disused golf course should be investigated as an alternative source. Similarly borrow pit option 3 is constrained by the Kameeldoring thicket which is protected.

### 6.1 Recommendations

- The proponent must furnish the local heritage authority with a set of drawings indicating how the Groblers Bridges will be modified, together with an application to alter structures greater than 60 years of age. A copy of the Heritage Assessment report and the basic assessment report should be submitted to the Heritage Authority of the Northern Cape as supporting information.
- As a general principle all structures that are to be altered should not be changed until there is an adequate photographic record of as much detail as possible. In addition the process should be continued through the construction process in order to create an archive for the future. In these terms the excellent archive left by Murray and Stewart Pty Ltd is a case in point. Their diligence 80 years ago will assist in informing the current proposal.

#### 6.1.1 Sources

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## APPENDIX A

### Guiding Principles of the Burra Charter

*The Australia ICOMOS Charter for the Conservation of Places of Cultural Significance* (the Burra Charter) provides the guiding philosophy for the care of important places. The Burra Charter defines the basic principles and procedures to be observed in the conservation of important places. The principles and procedures can be applied to places including buildings, sites, areas, structures, ruins, archaeological sites and landscapes modified by human activity.

The following principles are in part derived from the Burra Charter (revision November 1999). These principles underpin the guidelines for the assessment of a heritage place. The specific guidelines for the assessment of heritage places provide more solid direction on how to apply the general guiding principles.

#### **Care for significant fabric**

Changes to heritage places should not distort the physical evidence, or other evidence, it provides. Change should not diminish, destroy or conceal significant fabric (the elements, components and physical material that make up the place). Care for significant fabric requires a cautious approach of changing as much as necessary but as little as possible.

#### **Reversible alterations**

If alterations to fabric are permitted they should be reversible. Reversible alterations should be considered temporary and should not prevent future conservation action.

#### **Distinguishing new from old**

Changes to buildings, areas and heritage places that falsify the evidence of their history should be avoided. Buildings and structures should not nostalgically create a false impression or interpretation of age or a style. Decorative detail or additions to heritage places should clearly show that they are new elements to the heritage place.

To avoid any confusion, the distinction between old and new fabric should be distinguishable. While being sympathetic and respecting original fabric, the detail of new work should, on close observation or through additional interpretation, be identifiable from the old fabric.

#### **Sympathetic changes**

Generally, new work in a heritage place should be sympathetic to the features of importance in terms of character and context. Matters such as siting, size, height, setback, materials, form, and colours are all important considerations when undertaking new work in heritage places.

#### **Respecting earlier changes**

Changes to a heritage place over time offer evidence of its historical development and may have acquired their own significance. Emphasis should not be placed on one period of a place's development at the expense of others unless that period is much more significant.

#### **Retaining context**

The context or setting of a place is often an important part of its significance. Changes to the visual setting and other relationships of a place should be sympathetic to its character and appearance.

**Compatible uses**

A historic place should preferably continue to be used for the purposes for which it was designed or for a use with which it has had a long association.

Otherwise a compatible use should be found which requires minimal alteration to the fabric of the place.

**Above all - Understand Significance**

An understanding of what is significant about the place, how significant it is, why it is significant and which are the significant components should underpin any conservation or development work. This information should be encapsulated in a Statement of Significance which should exist for most places that are subject to the Heritage Overlay control. Some early listings may not have a detailed or adequate Statement of Significance. Where no analysis of significance has been undertaken, further research may be necessary to establish the importance of the place and to be able to plan any development or works. Major development of places of heritage significance may first benefit from a Conservation Management Plan prepared by a qualified heritage practitioner in accordance with the Guidelines to the Burra Charter.