1.7.2 Section 21c –impeding and diverting flow in a watercourse and Section 21i - altering the bed, banks, course or characteristics of a watercourse.

- **Kakamas North Settlement no 2435, 387, 1248 and 2108, Augrabies.**

The Lower Orange River is flanked by numerous drainage lines, which are mostly dry and only contain water during the occasional thunderstorm. These drainage lines are a part of the arid landscape. These are nevertheless drainage lines with water flows strong enough to maintain its morphological integrity. These sudden and intense storms occur only occasionally, perhaps once in several years. Refer to the Fresh Water Assessment Report from Watsan Africa cc, included in Appendix F.

The drainage lines are poorly demarcated by vegetation. The scrub and small trees are the same as those further afield away from the drainage lines. Only the stand of higher vegetation is denser around drainage lines.

One such drainage line runs through the Triple D property that is now earmarked for development into vineyards. It is this drainage line that triggered the legal requirement for a Water Use License Application.

There will be NO planting of vineyards within the **larger drainage channels** as far as possible and a buffer of at least 15m of the larger drainage systems will always be kept. It is also the intension to keep the bigger stream areas open and not to develop so has to minimise impact on the larger streams.

- **Present Ecological Status (PES) & Ecological Importance Sensitivity (EIS)**

Reference is made to the Draft Department of Water and Sanitation (DWS) Report (dated August 2016): "Determination of Ecological Water Requirements for Surface Water (rivers, estuaries and wetlands) and groundwater in the Lower Orange WMA; Report No. RDM/WMA06/00/CON/COMP/2016)1.

This Report provides the PES and EIS of the Orange River at EWR 02, located upstream of the confluence of the water courses that flow into the Orange River from the project site, and at EWR 03, downstream of the Augrabies Falls and downstream of the confluence of the watercourses that flow into the Orange River from the project sites.

Refer to **Figure 6** below for the location of the Project Site (Kakamas South Settlement no 2185, 2092 and 2193,) in relation to EWR 02 and EWR 03.

EWR 02 and EWR 03 both have a:

- PES of C (Moderately Modified); and,
- EIS as High (the river in terms of biota and habitat may be sensitive to flow modifications but in some cases may have a substantial capacity for use.)

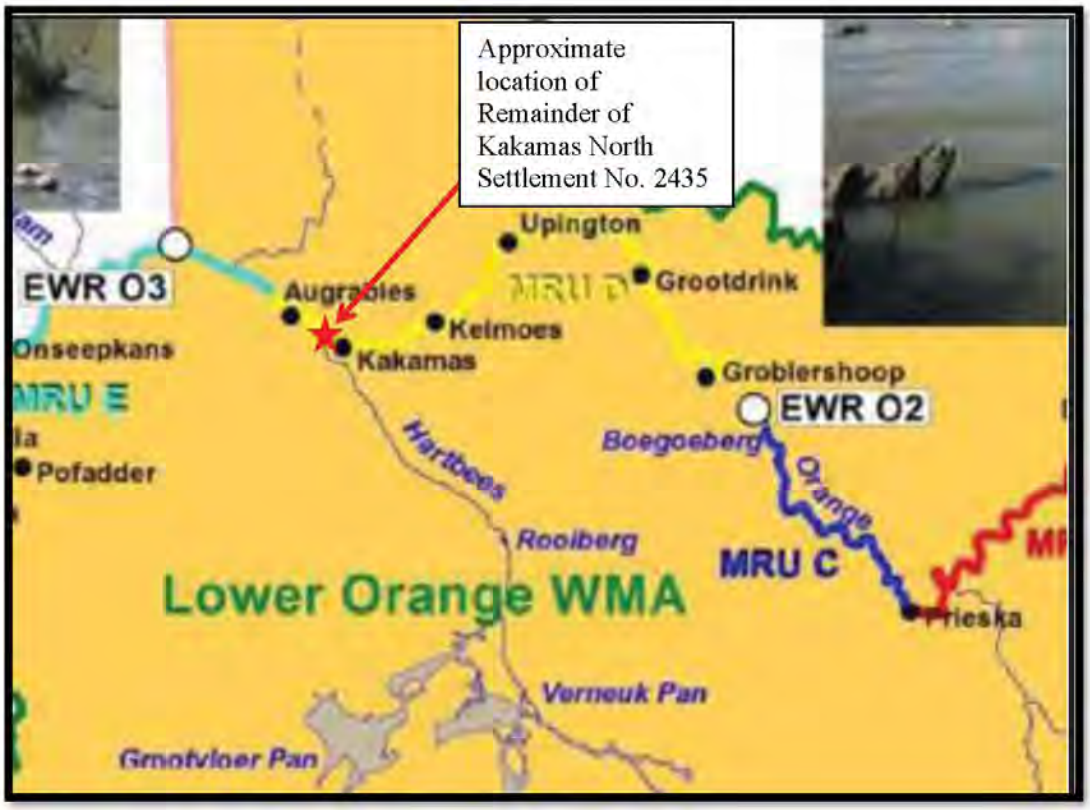


Figure 6: Extract of map that shows the locality of the EWR sites in context of the MRUs (referenced from Figure 3.1 in Report No. RDM/WMA06/00/CON/COMP/2016).

The drainage channel system is in a sub-catchment of an unnamed tributary, the tributary is not really a river, but more fits the description of a mostly dry drainage line. The sub-catchment covers 415 hectares. It is 10.4 km in circumference, 4.7km long and 114 m at its widest. The N14 trunk road cuts the sub-catchment off from its natural confluence with the Orange River.

From the N14 trunk road the drainage line has been partially formalised and where it flows through the vineyards along the Orange River, it has been channelled into a straight furrow. The drainage line passes underneath the N14 road through a bridge. A dense stand of Phragmitis reeds covers the bottom of the drainage line upstream and adjacent to the road bridge. These reeds are maintained by the scant agricultural return flow and not natural flow down the drainage line. Further up the drainage line conditions are more natural. There are not any signs of riparian vegetation or hydromorphic soils.

The Triple D drainage line was assigned a class B for the instream assessment. Only a part of the sub-catchment has been lost to agriculture, while a large part still remains intact. This would obviously change when the site is developed, probably to class D or E, with the original morphology significantly altered.

The riparian zone was placed into a category C, not only because of the loss of habitat due to agriculture, but because of clear signs that earth moving machinery has been active in some parts of the area. There was not much of a riparian zone to begin with, with no typical riverine riparian vegetation or hydromorphic soils.

The overall all analysis according to DWS: PES & EIS Desktop Assessment is that the site was not assessed, and the ecological importance of the River is very low. Because it was not assessed fall back to the overall assessment for the EWR:02, which refers to moderately modified.

1.7.3 Pump stations and Pipelines

- **Pipelines:**

Water will be required for the drip irrigation for the proposed vineyards. A pipeline will be used to pump water from the Orange River to the proposed dam. From there, other smaller pipelines will be used to distribute the water for irrigation purposes.
Approvals from SANRAL with regards to the crossing over the N14 is currently underway.
Please see Figure 7 below:

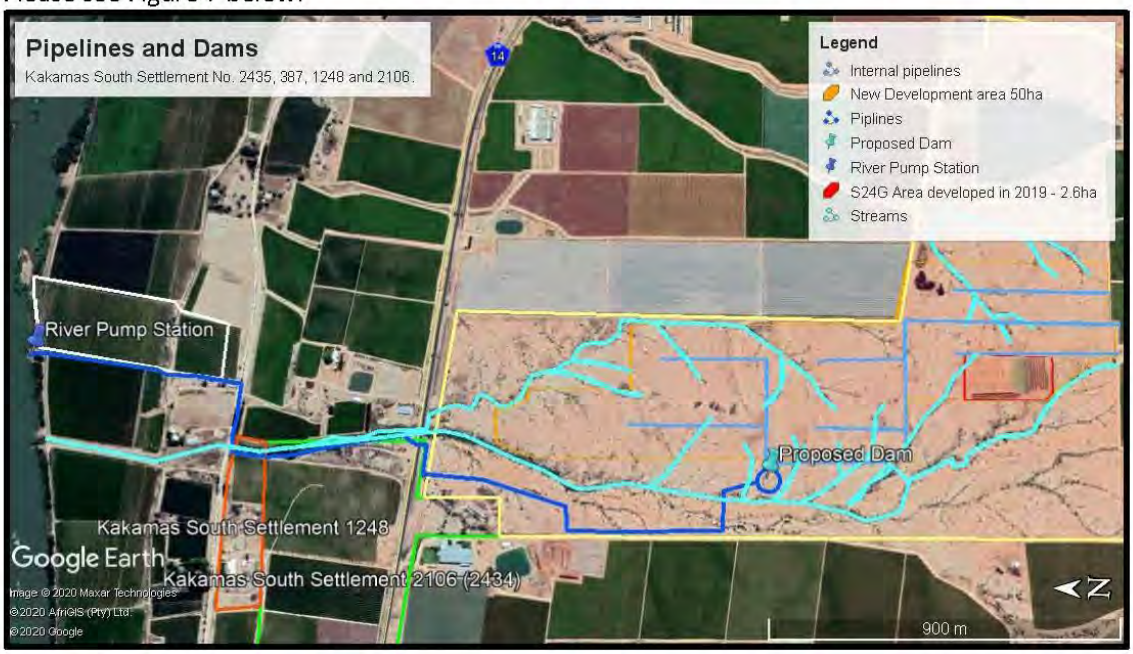


Figure 7: Pipelines

- **Water abstraction:**

There is an existing pump station at the Orange River. As part of the expansion of agricultural activities that is taking place the pump station will be upgraded (a pump would have to be added), see the design below in Figure 8.

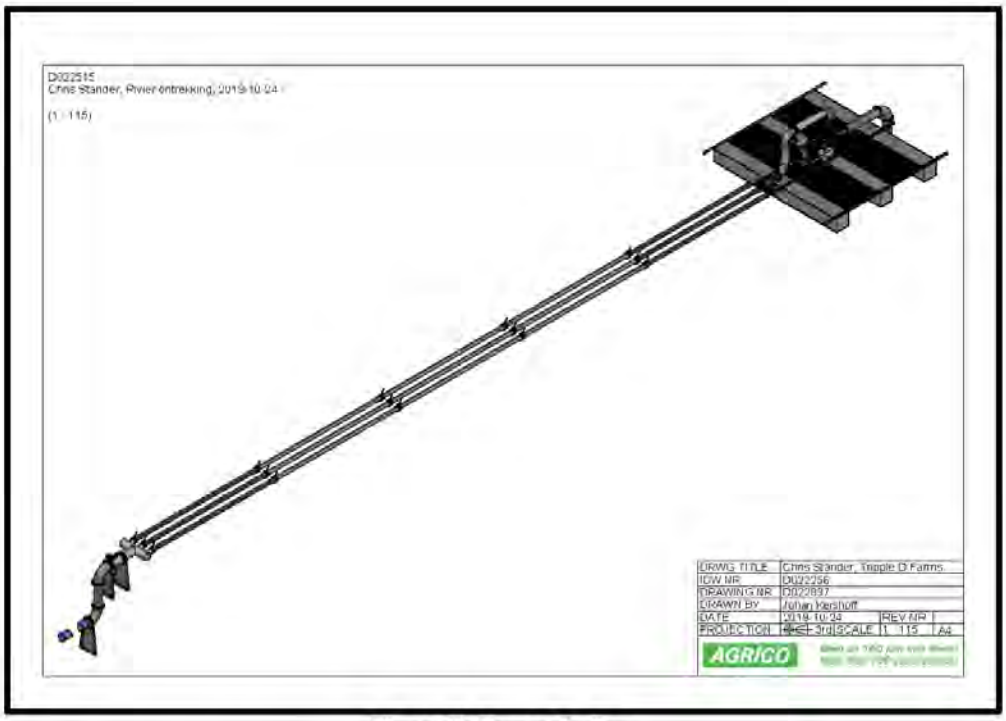


Figure 8: Pump design.

1.7.4 Plough certificate

There are is an existing Plough Certificate for Remainder of Kakamas North Settlement No. 355. Find included in Appendix M the existing Plough certificate.

1.7.5 Irrigation of any land

The proposed development triggered the section 24G process due to due to the unlawful clearing of vegetation and development within 32m of a stream without authorisation that took place on Kakamas south Settlement No. 2435.

- **Illegal Development:**

- Construction took place during 2016/2017 for the infrastructure development associated with the cultivation of the vineyards of approximately 2.6ha.
- 2.6ha indigenous vegetation was cleared for the construction to take place.
- The construction took place over small ephemeral streams without authorisation.

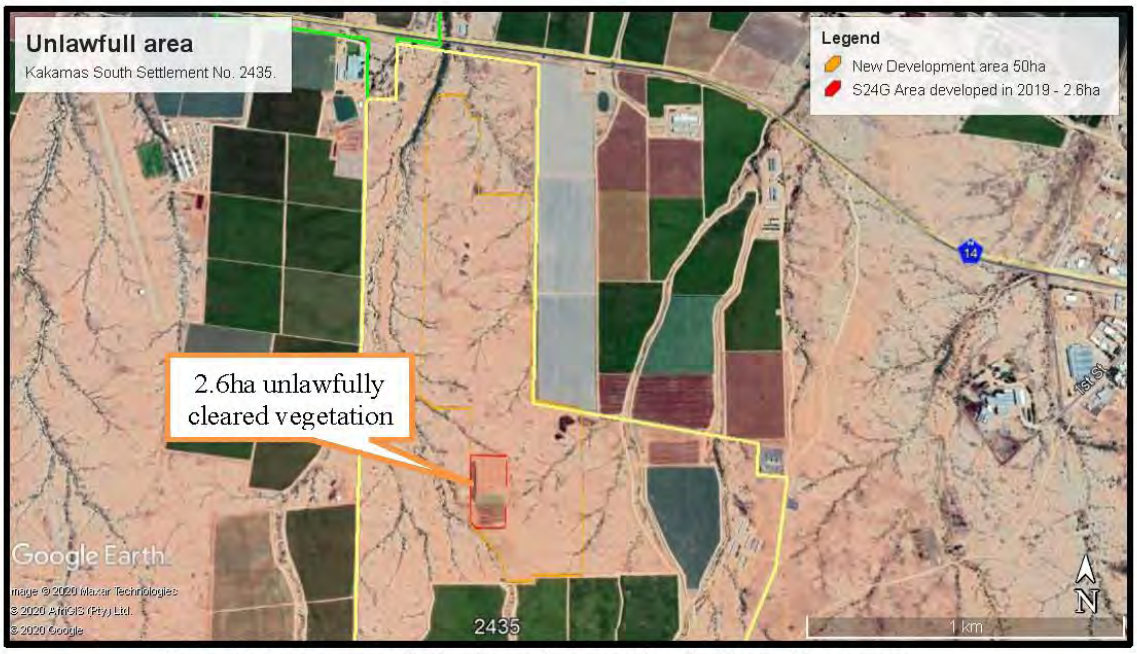


Figure 9: 2.6ha unlawfully cleared vegetation indicated in orange

- **Proposed further developments**

The proposed development will include:

- the construction of a dam with a volume of 10 539m^3 and pump room.
- An extension of the pump station at the Orange River.
- The development of 50ha of vineyards, this includes the 2.6ha constructed illegally.
- 315mm uPVC pipeline of about 2.4km from the river to the proposed dam.
- Internal irrigation pipelines.

As a result of this, about 50ha indigenous vegetation will be removed from the area. Please see Figure 10 below:

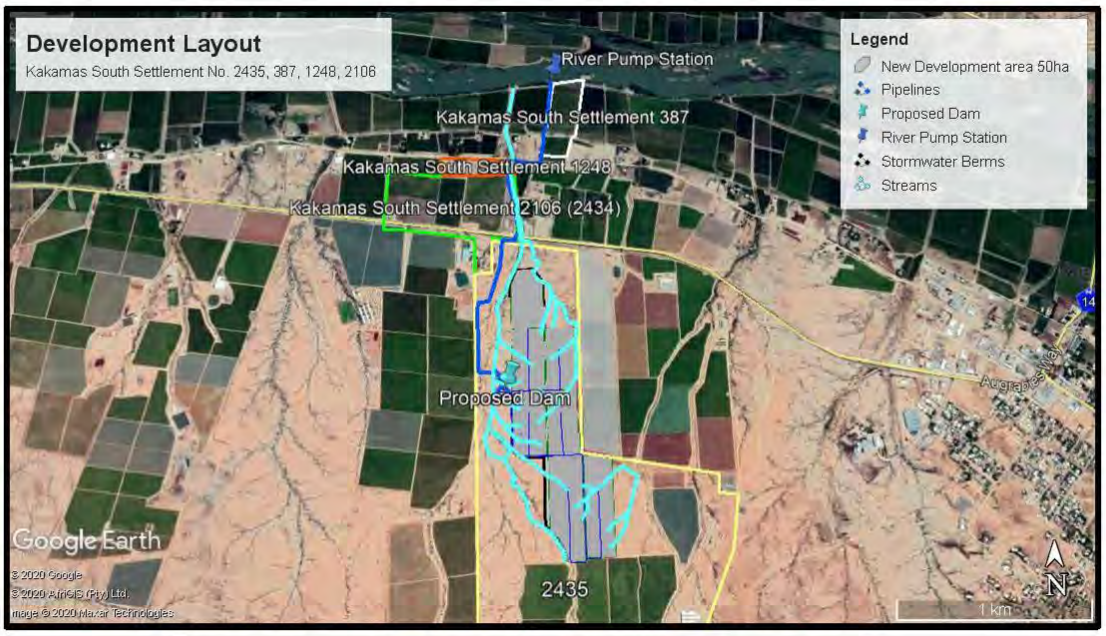


Figure 10: Proposed development layout

1.8 Stormwater Management

1.8.1 Introduction

This section in the report is intended to provide the Department of Water Affairs with all necessary information to assess the suitability of the measures to be taken by Triple D Farms (Pty) Ltd regarding the successful storm water management of the proposed irrigation/agricultural development. This section describes the various infrastructure items that are/were to be constructed and the storm water management objectives that the landowner will undertake to ensure sustainable management of the constructed storm water infrastructure. Find attached Appendix F2 the Storm Water Management Plan.

1.8.2 Mitigation Measures:

The main issues to be addressed with mitigation measures include

1. Design
2. Irrigation
3. Nutrients (fertilisers)
4. Spraying (pesticides)
5. Storm water channels
6. Pipelines
7. Erosion control
8. River pump station

- **Design**

The design of vineyard blocks considered the natural flows and minimise impacts on the ephemeral streams. A storm water channels divert flow around the planted blocks towards the diversion channel. Flow entering the diversion channel will then flow downstream and naturally enter an existing stream.

- **Irrigation**

In order to prevent over irrigation, which might lead to water flows creating erosion and or transporting nutrients to the retained ephemeral streams, good farming practises such as irrigation on demand should be utilised.

In addition, the use of mulching should be used to reduce evaporation losses. The mulch also serves to retain moisture and prevent erosion near the plants at the source of irrigation; microjet or drip.

A typical example with mulching along the planted rows and planting between rows is shown below in **Figure 11**.

Figure 11: Mulching and planting between rows

- **Nutrients**

Nutrients are usually applied in the irrigation water. Every effort must be made to only apply as required by the plant and soil.

Should fertiliser powder or pellets be used and applied by hand or machine it must only be placed along the vine plants and no mess or waste between rows should be allowed.

Powder or pellet fertiliser may not be spilled between vine rows or on access roads between the vine blocks. Should this happen it must be picked up and removed immediately.

- **Spraying**

Spraying of pesticide is normally applied by machine as a vapour. The main potential source of pollution would be from spillages. Therefore, filling of the spray machine must be done in a safe area where pollution of the soil would not be possible. The best place would be on a concrete area where the pesticide is mixed with water.

- **Storm water channels**

As shown in the Storm water management Layout Plan, the black lines indicated are the storm water berms constructed to accumulate the storm water and divert flow to the existing streams that will not form part of the development.

It should be noted that no dissipation/retention structures other than the storm water channels and drainage pipelines are included to prevent erosion and storm water accumulation. However, natural vegetation has over time accumulated within the channels and does reduce flow. The storm water channels are deep enough to prevent overflow and erosion.

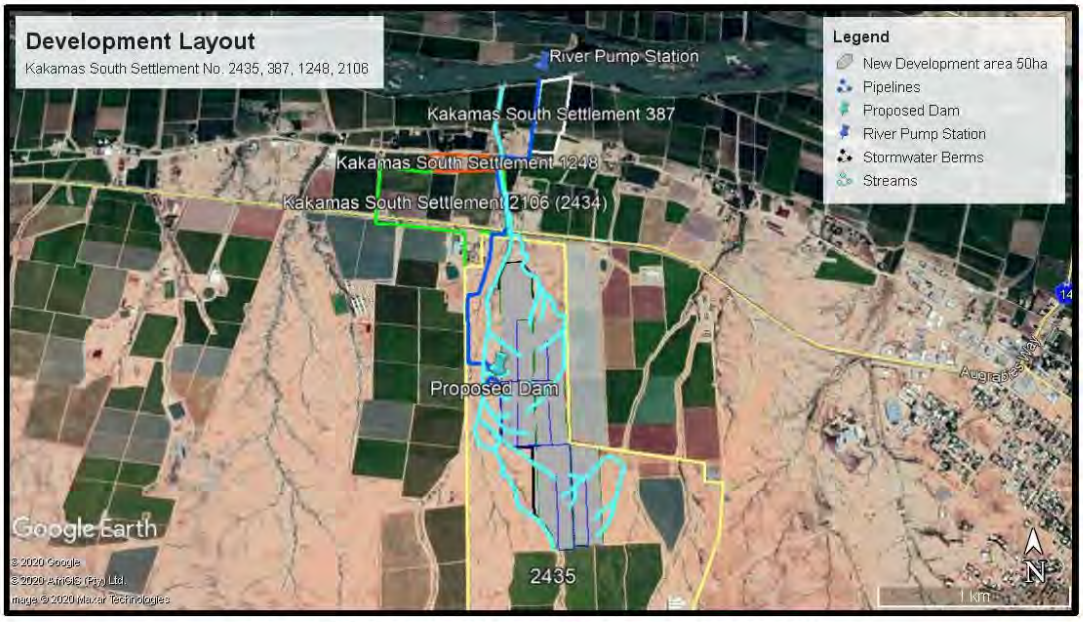


Figure 12: Storm water management plan layout

- **Pipelines**

The proposed new pipelines to the irrigation areas will run along road reserve, the only section of the pipeline that will affect one of the streams is shown in Figure 12: Storm water management plan layout, this is within the new proposed development areas. Care will be taken to prevent any future impediment of flow related to these pipes, as the pipes will be constructed below the ground. Find included in Appendix F.5: Method Statements for Pipelines the pipeline method statement for construction of pipelines (PVC Pipes) below ground. The following mitigation measures should be implemented for work on the pipelines: Care will be taken to only construct the pipelines during the dry seasons

- As far as possible the section of the pipeline across/within the stream should be done manually, no machinery, resulting in the lowest possible impact.
- Infilling with original soils (as per method statement)
- Flow meters must be equipped on the pipelines. -protective measurement on water losses. This must be monitored on a regular basis and records kept on site.

- **Erosion control**

Erosion would normally occur with the following:

1. Over irrigation which create water flows from the planted rows to the area between the rows and then to roads between the blocks.
    a. For mitigation see (3) below.
2. Pipe breakages where water will wash from the plants to the area between the rows to the roads between blocks and from where water can flow towards the retained ephemeral streams – thereby causing erosion gulley's.
    a. For mitigation see (3) below.
3. Rain events where the water will flow down slope to reach the ephemeral streams and along the way cause erosion where development took place; that is – between the planted rows and along the roads between blocks.
    a. Mitigation include the following:
        i. Mulching and planting/mulching between rows – see **Figure 11** for typical example.
        ii. Scarifying of soil between planted blocks and roads to create a soft/rough area to retain moisture and prevent erosion – see **Figure 13**.

Figure 13: Scarifying of soil

iii. Create a buffer with natural vegetation between the planted blocks and roads as shown in **Figure 14**.

Figure 14: Buffer areas with natural vegetation between blocks and roads

Overall, therefore, the natural approach is preferred whereby mulching, planting and natural buffer areas are used to serve as mitigation to prevent flows that could create erosion. This has the further advantage that it also acts against spreading of nutrients and pesticides.

2. Description of the Environment

2.1 Climate

The climatic conditions of this region of the Northern Cape are typical of conditions characteristics of semi-desert/arid savannah areas. The area is characterised by fluctuating temperatures, low and unpredictable rainfall and high evaporation rates. The low annual rainfall (average of 170-240 mm in Upington, or even lower in some surrounding areas) is significantly lower than the evaporation rate. Rainfall usually occurs during the late spring and summer months.

The area experiences high temperatures, especially in the summer months, where daily maximums of >42°C are experienced. The annual evaporation in the area is approximately 2 281 mm. Winter temperatures can drop to below 4°C. Frost is rare but occurs occasionally in most years (usually not severely).

Weather data was received for the Augrabies area for the time period 2001-2005. Figure 15 gives an indication of the average monthly temperatures and humidity over the 5-year period.

Month	Average Temperature (°C)	Maximum Temperature (°C)	Minimum temperature (°C)	Humidity (%)
January	28.22	41.30	14.04	31.42
February	28.37	39.90	15.96	36.00
March	25.76	38.74	11.48	41.84
April	21.24	34.36	6.92	50.39
May	16.80	31.16	1.66	46.22
June	12.62	26.60	-2.78	47.97
July	12.42	27.26	-2.16	41.22
August	14.10	32.00	-2.10	38.96
September	18.64	36.38	2.42	32.95
October	22.95	38.32	6.00	30.07
November	25.45	39.14	10.72	32.27
December	27.41	40.16	14.04	26.65
Average	**21.16**	**35.44**	**6.35**	**38.00**

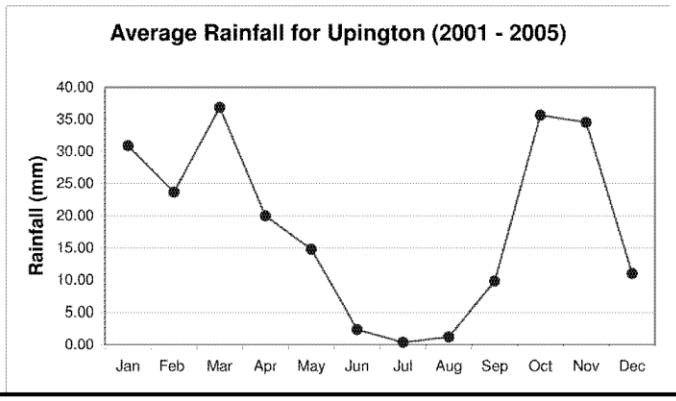


Figure 15: Average monthly rainfall and daily temperatures

2.2 Topography

The area is characterised by flat terrain and is, in general, an area of little topographical relief. Isolated hills and mountains can be found in the area surrounding Upington, which can be described as large, sandy plans with windblown sand dunes and low hills breaking the flat relief. The area to the south of Upington becomes more mountainous as one travel towards Groblershoop.

2.3 Geology and soils

Soils with negligible to weak profile development, usually occurring on deep alluvial deposits.

The soils of most of the area are red yellow apedal soils, freely drained, with a high base status and <300 mm deep, with about one fifth of the area deeper than 300 mm, typical of Ag and Ae land types.

The soil classification for Kakamas South Settlement No 2435, consists of low-potential soils for the establishment of certain cultivations. With high rock percentage, with large areas of weathered rock which will result in high cost soil preparation.

2.4 Natural vegetation and plant life

The following summary was taken from the Botanical Assessment Report, included in Appendix F:

Approximately 120ha of veld was evaluated, of which the landowner would like to develop 60 ha. The vegetation encountered conforms to Bushmanland Arid Grassland. Two definite communities were encountered namely a sparse (semi-desert type) low shrubland with grasses sometimes present (expected to be more prominent after rain) on the open undulating plains, while a denser and higher riparian vegetation was encountered next to the watercourses. The more pronounce these water courses the more established the riparian zone became. Because of the arid nature of the region (and the unpredictability of rainfall) the carrying capacity of the veld is very low and much of the natural veld is expected to have suffered from incorrect grazing or overgrazing practices since the early 19th century (after farms became fenced).

The Open plains

The vegetation encountered on the open gravelly plains can be described as a sparse low shrubland (sometimes even a dwarf shrub layer) (Figure 16 and Figure 17], with surface rocks and sometimes even small/low rocky outcrops (Figure 18) showing above ground (to the north of the site, larger rocky outcrops were also encountered). The vegetation varied from a sparse low shrubland dominated by *Tetraena decumbens (=Zygophyllum*) (Figure 16) to a very sparse open low shrubland (Figure 17) either dominated by either *Tetraena decumbens* or by *Justicia australis (=Monechma),* in the calcrete patches (Figure 17).

Figure 16: Sparse shrubland dominated by *Tetraena decumbens* with *Aloe claviflora* present in the foreground.

The following plant species were observed scattered throughout the site (never dominating, but sometimes encountered in patches); the small *Acanthopsis disperma*, the common *Aloe claviflora*, two individuals of *Aloidendron* dichotomum (a third was observed outside of the proposed footprint), *Aptosimum spinescens, Asparagus cf. cooperi, Avonia cf. papyracea, Berkheya fruticosa, Blepharis mitrata,* two individuals of *Boscia albitrunca* (one in poor and one in fairly good condition), scattered individuals of *Boscia foetida,* patches of *Cynanchum viminale, Euphorbia gariepina,* and occasionally the smaller *Euphorbia cf. rhombifolia, Forsskaolea candida*, the common *Galenia africana, Geigeria filifolia, Justicia spartioides, Kleinia longiflora, Leucosphaera bainesii, Limeum aethiopicum, Lycium cinereum*, the succulent *Mesembryanthemum coriarium (=Psilocaulon coriarium), Monsonia cf. patersonii, Ptycholobium biflorum, Rhigozum trichotomum,* the common *Rogeria longiflora, Salsola aphylla, Sericocoma avolans, Senegalia mellifera* and *Tapinanthus oleifolius.*

Figure 17: Very sparse open low shrubland with *Justicia australis* prominent.

The vegetation encountered at the small rocky outcrops (Photo 3) did not differ in species from that of its surroundings (although vegetation cover was sometimes slightly denser, as a result of the shelter given by the outcrops). The only plant that was not observed elsewhere

and that was only found near one of the rocky outcrops to the north was *Berkheya glabrata*. Other species commonly associated with these outcrops were *Aloe dichotoma, Boscia foetida, Forsskaolea candida, Galenia africana* and *Tetraena decumbens.*

Figure 18: One of the small rocky outcrops towards the south of the site.

The riparian vegetation

The vegetation along the small ephemeral drainage lines and small seasonal water courses did not varied much, apart from becoming denser and larger, the more pronounce the water course becomes. Agrimotion, 2017 did a very good job of mapping the most prominent of these water courses on their soil potential map for the Triple D farm. The following plants were commonly observed in association with these seasonal water courses: *Asparagus cf. cooperi, Boscia foetida,* the herb *Chascanum garipense, Hermannia stricta, Jamesbrittenia glutinosa, Justicia spartioides, Montinia caryophyllacea, Osteospermum scariosum, Ozoroa dispar, Parkinsonia africana, Rhigozum trichotomum Senegalia mellifera, Tapinanthus oleifolius, Tetragonia reduplicata* and *Ziziphus mucronata.*

Figure 19: One of the larger seasonal water courses to the north of the site

The pipeline route:

The proposed pipeline route includes the establishment of a new pump station at the banks of the Orange River. From there it will be placed in or next to existing farm roads through transformed agricultural area (as is the case along most of the banks of the Orange River in this area), with only the last section passing along an area with some very disturbed natural veld next to a seasonal water course.

The proposed location for the placement of the extraction pump is located on a disturbed portion of the Orange River, already used as an access point / jetty for the small boats. As long as the pipeline is located within the existing disturbance footprint, the impact on vegetation will be minimal (Please note that a Freshwater specialist report was commissioned, who will address the impact on the river system). Next to the disturbance footprint, disturbance indicator plants, alien invasive species (Prosopis species) and some remaining natural vegetation was encountered, the most important of which was *Phragmites australis* stands stabilizing the river banks and the small indigenous trees, *Vachellia karroo (=Acacia karroo)* and *Tamarix usneoides.* Other species included disturbance indicators like *Mesembryanthemum guerichianum, Mesembryanthemum coriarium* and the herb *Jamesbrittenia glutinosa.*

Figure 20: The proposed pump station location looking from south onto the Orange River. Note the disturbance footprint.

Figure 21: The banks of the Orange River at the proposed pump station location (looking from the disturbed area eastwards).

Figure 22: The banks of the Orange River at the proposed pump station location (looking from the disturbed area westwards).

From the banks of the Orange River the pipeline will follow existing roads for the next 1.7 km through areas under intensive cultivation (mostly vineyards). Through this section the impact there should be no impact on any natural veld (transformed land) and as long as the pipeline stays next to or within the existing roads, impact on agriculture should be minimal.

Figure 23: The proposed pipeline route will follow existing roads. This picture depicts the last section of agricultural land towards the banks of the Orange River, looking from south to north (towards the Orange River in the background).

The final section of the pipeline will be located next to a badly disturbed area, but with some natural plants still remaining, next to a seasonal stream. Unfortunately, this area is very disturbed and degraded, and the riparian vegetation is mostly replaced by the alien Prosopis trees, Beefwood (Casuarina species), with the occasional indigenous *Vachellia karroo,* patches of *Phragmites australis* and some disturbance indicator species remaining (e.g. *Mesembryanthemum guerichianum, Mesembryanthemum coriarium, Lycium* species, *Rhigozum trichotomum* and *Senegalia mellifera).*

Figure 24: The section of the pipeline next to the water course from the N14

Figure 25: The section of the proposed pipeline, crossing underneath the N14 (through an existing culvert) and then running next to the seasonal stream towards Picture above).

Since this area is very disturbed with very little remaining natural veld and running next to a seasonal stream, the exact location of the pipeline should be advised by the Freshwater Specialist report. Impact on any significant vegetation or species should be minimal, especially if the pipeline route is placed as near to or within the existing farm roads to the west of the stream.

Critical Biodiversity area:

The Northern Cape CBA Map (2016) identifies biodiversity priority areas, called Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs), which, together with protected areas, are important for the persistence of a viable representative sample of all ecosystem types and species as well as the long-term ecological functioning of the landscape as a whole (Holness & Oosthuysen, 2016). The 2016 Northern Cape Critical Biodiversity Area (CBA) Map updates, revises and replaces all older systematic biodiversity plans and associated products for the province (including the Namakwa District Biodiversity Sector Plan, 2008). Priorities from existing plans such as the Namakwa District Biodiversity Plan, the Succulent Karoo Ecosystem Plan, National Estuary Priorities, and the National Freshwater Ecosystem Priority Areas were incorporated. Targets for terrestrial ecosystems were based on established

national targets, while targets used for other features were aligned with those used in other provincial planning processes.

Critical biodiversity areas (CBA's) are terrestrial and aquatic features in the landscape that are critical for retaining biodiversity and supporting continued ecosystem functioning and services (SANBI 2007). The primary purpose of CBA's is to inform land-use planning in order to promote sustainable development and protection of important natural habitat and landscapes. CBA's can also be used to inform protected area expansion and development plans.

Critical biodiversity areas (CBAs) are areas of the landscape that need to be maintained in a natural or near-natural state in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. In other words, if these areas are not maintained in a natural or near-natural state then biodiversity conservation targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity-compatible land uses and resource uses.

Ecological support areas (ESAs) are areas that are not essential for meeting biodiversity representation targets/thresholds but which nevertheless play an important role in supporting the ecological functioning of critical biodiversity areas and/or in delivering ecosystem services that support socio-economic development, such as water provision, flood mitigation or carbon sequestration. The degree of restriction on land use and resource use in these areas may be lower than that recommended for critical biodiversity areas.

Figure 26: The Northern Cape Critical Biodiversity Areas (2016) showing the location of the proposed development

2.5 Land use of surroundings

Most areas in the wider study area do not have a high agricultural potential, except for the portions in the alluvial zones close to the Orange River, where irrigation is practiced. In

addition, there are also severe climatic restrictions to agricultural potential, except for areas adjacent to the Orange River. Rainfall is very low, while evaporation is extremely high, due to the high temperatures.

Land use of the uncultivated areas is predominantly livestock farming, with overgrazing evident in many areas. The grazing capacity of the natural grasslands of the plains can vary between 25 and 35 hectares per large stock unit (equal to 3.5 to 5 hectares per small livestock unit).

2.6 Surface water

The development is located within the D73F catchment management area, adjacent to the Orange River.

Names of watercourses:

The Orange River is located adjacent the site. No perennial rivers flow through the property, only small unnamed non-perennial tributaries. The sub-catchment covers 415 hectares. It is 10.4 km in circumference, 4.7km long and 114 m at its widest. The N14 trunk road cuts the sub-catchment off from its natural confluence with the Orange River.

From the N14 trunk road the drainage line has been partially formalised and where it flows through the vineyards along the Orange River, it has been channelled into a straight furrow

The Orange River is the primary water resource for the area. This river is used extensively for irrigation and is heavily cultivated along its banks. Crop production is reliant on water availability and irrigation potential, and therefore the reliance on the available water supply is great. Abstraction from the river and water storage in reservoirs is common at many sites, where it is mainly used for irrigation purposes in the areas flanking the Orange River.

Surface water use:

No additional surface water will be used during the operation of this project. The application is for additional storage capacity and for storage. The existing

Presence of wetlands:

No specific wetland areas have been identified.

2.7 Groundwater

No ground water will be used.

2.8 Air quality

No significant impact on the present conditions, which could be classed as fairly good air quality.

2.9 Noise

There will be no significant contribution to noise from any planned activities.

2.10 Sites of archaeological interest

The site is already disturbed by the existing development.

2.11 Sensitive landscapes

The site is already disturbed by the existing development, no other sensitive landscapes.

2.12 Visual aspects

The site is already disturbed by the existing development.

2.13 Regional socio-economic structure

Population:

The total population of Kai! Garib Municipality is 65 869. The total households are estimated at 16 703 and of these 34.6% are female-headed households. The average household size is 2.9 people.

Economic activities:

The Orange River played an enormous role in the formation of the municipal area and most of the towns and settlements are to be found close to or adjacent thereto. The economy is heavily dependent on the intensive and extensive agricultural sector. The major roads (N14, R27 and R359) assist in the growth the municipal area experience.

It is important to note that new opportunities have opened up for the Kai! Garib municipal area since the need for the generation of sustainable energy in South Africa was introduced by Eskom and the South African government. According to SDF, Kai! Garib Municipality immediately became a hotspot for solar energy developments and numerous developments are currently in process. The resulting economic spin-offs are eagerly anticipated. Although the 'solar corridor' as identified by the PGDS and NCPSDF, does not include the N14 between Upington and Kakamas, current developments indicate that this area will form the centre of solar development. Figure 27 below shows the most active economic sectors.

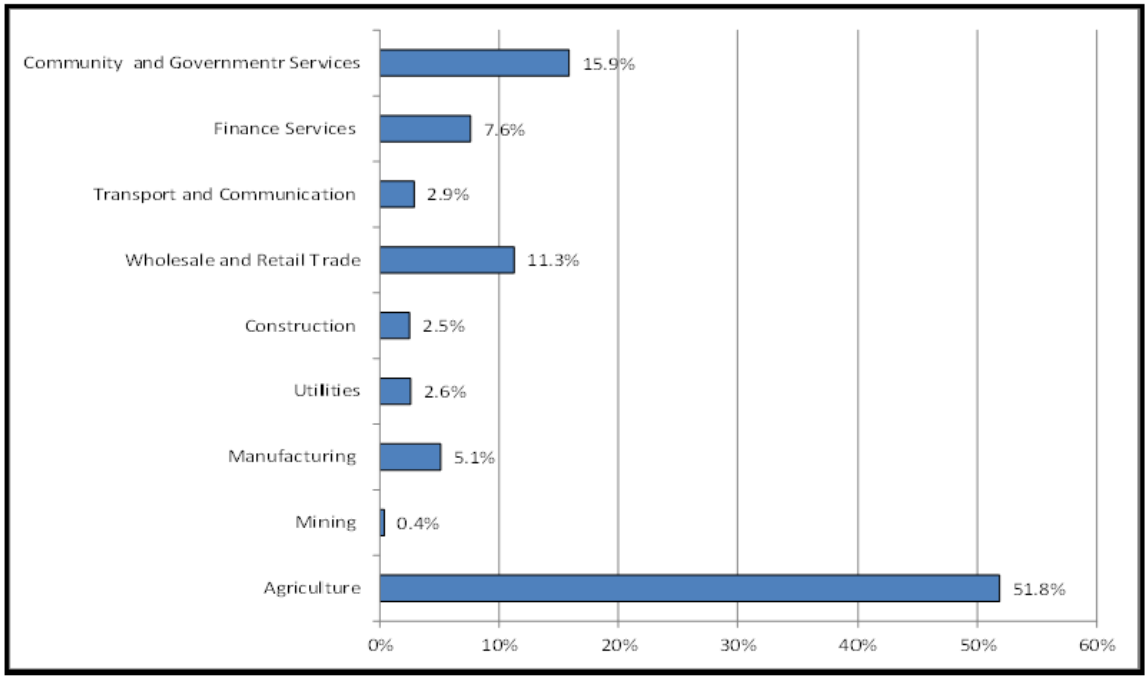
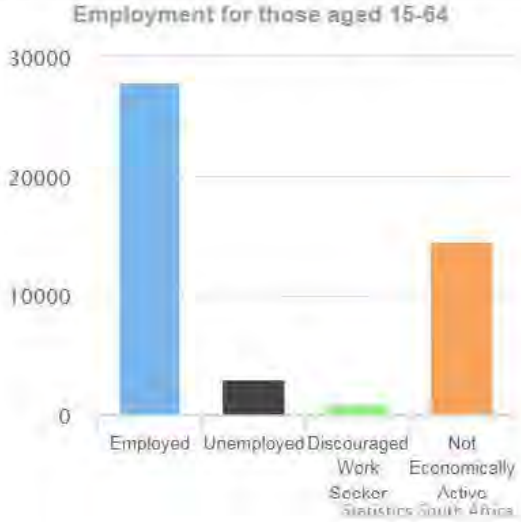


Figure 27: Active economic sectors in the area

Employment and income

Currently, 30 949 people are economically active (employed or unemployed, but looking for work), and of these, 10% are unemployed. Of the 19 375 economically active youth (15-35 years) in the area, 10% are unemployed, as shown in Figure 28.



Income	Percentage
None income	6,1%
R1 - R4,800	2,3%
R4,801 - R9,600	4,5%
R9,601 - R19,600	25,7%
R19,601 - R38,200	26,7%
R38,201 - R76,4000	18,1%
R76,401 - R153,800	8,1%
R153,801 - R307,600	4,9%
R307,601 - R614,400	2,6%
R614,001 - R1,228,800	0,6%
R1,228,801 - R2,457,600	0,3%
R2,457,601+	0,2%

Figure 28: Economic profile of the area

Water supply and sanitation:

The Kai! Garib Municipality experiences huge problems with sanitation in all of its nine wards. Many settlements are currently making use of the ventilated improved pit (VIP) systems, which are currently full and posing health risks to communities. The worse-affected areas are Riemvasmaak, Keimoes, Alheit, Augrabies, Lutzburg and Marchand. Almost all informal settlements in Kai! Garib do not have a decent sanitation system.

The municipality launched a pilot programme to address the situation. The programme proved successful but could not be fully implemented due to a lack of funding. It is also important to note that none of the informal settlements have any form of sanitation. The sewerage systems within the formal areas or the main towns Keimoes, Kakamas and Kenhardt are currently under much strain, and need to be upgraded. Figure 29 summarises the needs in terms of sanitation in the various wards.

Toilet Facility	Percentage
None	11,9%
Flush toilet (connected to sewerage system)	59,6%
Flush toilet (with septic tank)	12,4%
Chemical toilet	0,1%
Pit toilet with ventilation	5,5%
Pit toilet without ventilation	9,1%
Bucket toilet	0,5%
Other	0,9%

Figure 29: Water supply and sanitation in the area

Power supply:

The municipality are currently only distributing electricity within the three main towns. The smaller settlements around the three main towns are served by Eskom directly. The challenge, however, still exists that some of the households within the settlements don't have any access to electricity. The informal areas within the municipality are posing a great challenge in terms of providing electricity. Households without access to electricity usually make use of wood for fire, and candles and paraffin for lighting. All the informal settlements are not fully connected to an electricity grid.

The need of bulk electricity services also poses a challenge in areas such as Kakamas, Keimoes and to a lesser extends Kenhardt. Greenfields plots in Kakamas need installation of bulk services before any reticulation connections can take place. These sources pose various dangers and are environmentally unsustainable. The municipality is, however, very optimistic about the future, due to the rise of solar energy developments in the municipal area.

Housing:

The municipality has indicated that there is a pressing need for houses, especially low-cost houses, as well as serviced plots within all the communities of the Kai! Garib Municipal Area. It is quite satisfying to see that a great deal of progress was made in the delivering brick houses

to communities since 1994, but unfortunately, the communities' needs for houses exceed the speed at which houses are built.

According to Census 2011 (Stats SA), 88.4 % of the population live in formal dwellings and 43.1% of households live in houses which they own and have paid off fully. However, according to service delivery data from the municipality, the number of informal settlements is growing overnight and the demand for service provision in these areas poses great challenges. The Housing Sector Plan is currently under review. According to the Human Settlement Plan 2012, the housing need is as follow in Figure 30.

Table 14. : Population & Households per ward in 2015

WARD	Population 2015	Households 2015
Ward 1	11 408	3 044
Ward 2	8 191	1 892
Ward 3	9 317	2 044
Ward 4	6 375	1 680
Ward 5	5 499	1 566
Ward 6	7 684	1 730
Ward 7	4 856	1 299
Ward 8	5 660	1 782
Ward 9	6 679	1 666
Total	65 869	16 703

Source: StatsSA, Census 2011

Figure 30: Housing need in the area

In summary, this proposed development will not put further strain on the services infrastructure, as these services are provided on site. The development's focus is more on a retirement village with a frail care unit, rather than low cost housing. Nevertheless, the rest of this development has already been functioning since 2002, and the proposed further development will take pressure off the Municipality in terms of providing a safe environment for the retirement sector of the public. This development's location is also such that it will provide job opportunities in the area.

2.14 Interested and affected parties

The WULA was advertised in *The Gemsbok* on the 13 March 2020. The WULA was made available online from 17 March 2020 until 18 May 2020.

3. CONSIDERATIONS AND ASSESSMENT CRITERIA

Management actions in the development of an integrated water quality management strategy for the Upper and Lower Orange water management areas include the following:

Area 1: Boegoeberg to Kanoneiland

It is the vision of all interested and affected parties within Visioning Area 1...

...to contribute towards the integrated management of the surface and groundwater resources in all LOWMA catchments between Douglas and Boegoeberg Dam, to secure sufficient water that is fit for all beneficial uses, specifically including domestic and variable agricultural use, and to support a healthy aquatic ecosystem, particularly for ecological sensitive areas such as the Douglas Conservancy.

Area 2: Boegoeberg to Kanoneiland

It is the vision of all interested and affected parties within Visioning Area 2: (Kakamas/Augrabies/Keimoes)...

... to contribute towards securing suitable water supplies of quality for all LOWMA catchments between Boegoeberg and Kanoneiland, that will sustain:

- a thriving table grape export marked and wine production;
- local agricultural activities via an extensive irrigation canal system;
- a thriving stock farming industry;
- domestic and light industrial water use in all towns, specifically including Upington;
- supplying water to rural communities via both the Kalahari West and Karos-Geelkoppan water supply schemes.

Area 3: Kanoneiland to Pella

It is the vision of all interested and affected parties within Visioning Area 3...

...to promote the participatory and integrated management of all water resources pertaining to the LOWMA catchments between Kanoneiland and Pella in order to ensure that water supplies are of an acceptable quality to all water users, to sustain a prominent conservation and eco-tourism industry, as well as livestock and private game farming, while allowing room for beneficial water use.

Other legislation and guidelines that have been considered include the following:

- The Constitution of South Africa Act No.108 Of 1996
- The National Environmental Management Act, 1998 (Act No. 107 Of 1998)
- The National Heritage Resources Act, 1999 (Act No. 25 Of 1999)
- Conservation of Agricultural Resources Act No 43 Of 1983
- Subdivision of Agricultural Land Act, 1970 (Act No. 70 Of 1970)
- Urban Structure Plan for the Cape Metropolitan Area, Volume 4: Paarl/Wellington Region
- National Environmental Management: Biodiversity Act (Act 10 Of 2004)
- Planning Legislation and Guideline.

3.1 The reserve

The Department of Water Affairs and Forestry has recently completed the reserve determination for the Berg River: Directorate of Scientific Services in Pretoria.

This application is not for additional water from the Orange River within the WUA jurisdiction, managed by DWS: Upington. Therefore, this will have little effect on the quantity of water available from within the catchment.

3.2 The class and resource quality objectives of the water resource

These aspects could only be addressed and commented on by the Department of Water Affairs.

3.3 The strategic importance of the water to be authorised

This water use has no strategic importance.

3.4 The existing lawful water use in the catchment under consideration

This authorisation will have no impact on any existing lawful water use within the investigation area.

3.5 The likely effect of the water uses to be authorised on the water resource and on other water users in the catchment

This authorization will have no impact on any existing lawful water use within the investigation area. Please see attached the Water Use Licenses confirming the existing water allocation (Appendix B).

3.6 The impact on the environment

The development will not have a negative impact on the existing water use within the catchment region. The water can be accommodated, as confirmed in the water Use License. The impacts and mitigation measures are summarised in the table below:

Table 3: Impacts table

Water Uses	Potential Impact on	Proposed Mitigation Measures	Review of the adequacy of suggested mitigation measures
	New irrigation areas.	Low positive • Measures should be implemented to reduce water use within the proposed development, such as the use of	Mitigation measures adequate to ensure positive impact takes place.

		tension meters to avoid over irrigation of the soils. • Environmental education programs for workers will ensure that they will be sensitive to the environment and report incidents such as leaking taps, broken irrigation systems, etc. • The irrigation system to be used is DFM method along with irri-check calibrations and recommendations. • Test pits and data collections from these pits are taken on a regular basis to determine the moisture content for soil etc. • Soil coverage within the vineyards with chaff. • Regular monitoring and checks from specialists in the field to introduce best possible irrigation practices.	
Section 21 (c&i)	Water Quality	• No impact on water quality, as construction will be conducted outside the rainfall season (Replanting). • No flow from agricultural areas as storm water berms will be constructed as far as possible (Replanting). • Measures should be implemented to reduce water use within the proposed development, such as the use of tension meters to avoid over irrigation of the soils.	Mitigation measures adequate to ensure impacts are fully mitigated.

	Impeding and diverting flow within ephemeral streams.	Low negative • The natural drainages areas and small ephemeral stream will be filled in and vineyards established on these areas, therefore a low negative impact on surface water flow. • This will however be mitigated by establishing a storm water management mitigation measures, outlined in the SWMP. • No activities should be allowed outside of the demarcated agricultural development area. Machinery, waste and rubble should not be allowed to accumulate anywhere in the natural vegetation. • The main threat because of the establishment of the agricultural development is the movement of sediments down the drainage line and into the Orange River. The land would be entirely transformed by heavy earth moving machinery, as is required for the establishment of vineyards in virgin land. This	Mitigation measures adequate to ensure impacts are fully mitigated.

		transformation should be affected during the dry season, when the likelihood of sudden thunderstorms is at its least. • Any signs of erosion in the altered drainage line should be addressed immediately after downpours. Eroded areas should be filled in and the compacted. It should be planted with suitable vegetation. Irrigation may be required to establish this vegetation. If necessary, berm and contours should be constructed to direct storm water away to less susceptible areas. • The flow path of the drainage line should remain the same as far as possible, despite of the agricultural development. • Agricultural waste and other waste and litter should not be allowed to pass down the channel. • Vehicles and other disturbances should be kept out of the altered drainage lines as to prevent any disturbance that could result in erosion.	

		The following mitigation measures should be implemented for work on the pipelines: • Care will be taken to only construct the pipelines during the dry seasons • As far as possible the section of the pipeline across/within the stream should be done manually, no machinery, resulting in the lowest possible impact. • Infilling with original soils (as per method statement) • Flow meters must be equipped on the pipelines. - protective measurement on water losses. This must be monitored on a regular basis and records kept on site.	
Section 21 (b)	For the construction of a dam	• The dam was constructed in 2015, this application is only for the legalisation of the dam. • The new and old dam is not located within a stream, therefore not an impact as storing has been and will be taking place.	• No mitigation necessary. • Fixing of dam, but this might have a highly negative financial impact.

3.6.1 Assessment of the impacts associated with the water use:

The impacts associated with the development (already took place) and that of agricultural areas across stream is low negative, however mitigation measure taken into account can prevent any further negative impacts, see The development will not have a negative impact on the existing water use within the catchment region. The water can be accommodated, as confirmed in the water Use License. The impacts and mitigation measures are summarised in the table below:

Table 3 above.

3.7 The need to redress the results of the past racial and gender discrimination

3.7.1 Ownership of the enterprise

Triple D Farms was established in 1995 and is wholly owned by the PTD Familie Trust. In 25 years, the company has grown to a substantial entity and provides employment to more than 1 000 people and once the development under review is completed it will provide a further 500 job opportunities.

3.7.2 Management Control

The company is led by its exco team assisted by 4 midlevel managers. The workforce is managed by 3 highly capable black managers assisted by 8 black foreman which in turn manages 26 black supervisors. The junior and midlevel management team is well trained and extremely capable in their respective fields of knowledge. The proposed new development will provide 100 skilled and 400 unskilled opportunities. All new opportunities will be for black people.

3.7.3 Skills Development

Triple D Farms strongly believes in the importance of training and during 2019 training was provided for machine operation, first aid and occupational health and safety as well as food safety and basic management training.

3.7.4 Socio-Economic Development

Triple D Farms provides housing for its labour force at reasonable, below market prices. To support extracurricular activities a soccer field and netball court was established. Once a month worker's have the option to be taken to town. Triple D realises the importance of good day care and established a creche managed by 3 trained employees to look after the children of the labour force at no cost to them.

<u>Healthcare</u>

The company has set arrangements with local clinics to visit the farm at pre-arranged times. All workers can see a healthcare specialist on the set days. On other occasions workers can be taken to health-care providers if and when necessary. The company also provides extensive information on HIV/AIDS and alcoholism as part of its induction process.

Funeral aid

For its permanent labour force, Triple D Farms negotiated favourable funeral aid at a respectable financial advisor providing funeral plans that cover up to 6 family members at competitive rates. The company has a similar plan in place for seasonal workers where the company is committed to cover 30% of their funeral plan.

Provident fund

Triple D Farms administers a provident fund for those in its permanent labour force who wishes to contribute to such a fund.

3.7.5 Preferential Procurement

The company is in the process of re-evaluating its BBBEE position and is considering a new procurement policy as part thereof. Under such a new policy bigger effort will be made to find, help develop and support upcoming black owned and black women owned enterprises.

Employment:

The new water use licence will lead to the expansion of the farming operation and will create a demand for new staff and new skills, e.g.

- Skilled agricultural labourers
- Specific knowledge of vineyards and citrus fruit production will be needed
- Specific knowledge of fruit packing will be needed
- Support staff will be needed: Admin, forklift drivers, tractor operators and Code 14 drivers.

Preference will be given to black/coloured people for these positions, and more specific **black/coloured women** where possible.

Existing employees with experience on the farm, plus the potential to be leaders, will in the first place be identified for new supervisory positions. See Figure 31.

Occupational Levels	Male				Female				Foreign Nationals		Total
	A	C	I	W	A	C	I	W	Male	Female	
Top management	0	0	0	1	0	0	0	0	0	0	1
Senior management	0	0	0	2	0	0	0	0	0	0	2
Professionally qualified and experienced specialists and mid-management	0	0	0	[illegible]	0	0	0	0	0	0	[illegible]
Skilled technical and academically qualified workers, junior management, supervisors, foreman, and superintendents	41	0	0	0	4	0	0	0	0	0	45
Semi-skilled and discretionary decision making	30	0	0	0	0	0	0	0	0	0	30
Unskilled and defined decision making	4	0	0	0	3	0	0	0	0	0	7
TOTAL PERMANENT	75	0	0	7	7	0	0	0	0	0	[illegible]
Temporary employees	175	0	0	0	113	0	0	0	0	0	[illegible]
GRAND TOTAL	250	0	0	7	120	0	0	0	0	0	377

Figure 31: Employment summary

3.8 Efficient and beneficial use of the water in public interest

The new water use will have the following benefits:
Enough water will directly secure existing and new job opportunities.

- Planting new varieties that can spread the preparation, pruning, harvesting and packing seasons over longer periods. This will support the entity in their efforts to convert as much as possible seasonal job opportunities into permanent job opportunities. Especially black females from the farm and neighbouring towns will benefit here. The positive impact on their lives will even be more as more of them will now also be promoted to supervisor level to help manage the increased production as well as the increase in value-adding volume.
- The increase in production of export produce will bring more foreign capital to South Africa which is much needed to strengthen our economy and as such fully supported by Government.

3.9 Socio-economic impact of water use to be authorised

In a rural area such as this with a high unemployment rate, any new employment positions have a huge impact on the immediate and extended families of such new workers. Add then also the impact of more people with proper housing, undergoing skills training and going to church, sport, etc. and children going to school, to understand the positive impact on this rural community. Even seasonal work opportunities have the advantage of extra income plus the opportunity to gain skills that can in future be used to gain permanent employment on the farm or elsewhere.
Not only are the new employment opportunities important, but also the fact that:

- Existing jobs can be secured: Enough water will directly secure existing and new job opportunities.

- Planting new varieties that can spread the preparation, pruning, harvesting and packing seasons over longer periods. This will support the entity in their efforts to convert as much as possible seasonal job opportunities into permanent job opportunities. Especially black females from the farm and neighbouring towns will benefit here. The positive impact on their lives will even be more as more of them will now also be promoted to supervisor level to help manage the increased production as well as the increase in value-adding volume.
- The increase in production of export produce will bring more foreign capital to South Africa which is much needed to strengthen our economy and as such fully supported by Government. See Appendix H for the Section 27 Report.

3.10 Investment already made and to be made by the water user in respect of the water use in question

The following investments have been made:

- Currently Kakamas South Settlement 2435, is owned by Triple D Farms Pty Ltd. Additional water rights were recently acquired and included in a WUL.
- All investments made already for the construction of the existing development areas as this is part of an existing farming unit with existing infrastructure on Kakamas South Settlement 2435.
- Investments related to the construction of the existing dam.

The future investments to be made:

- New investments to be made for the new pipelines, additional pumps at the Orange River, new dam and new agricultural areas on Kakamas South Settlement No. 2435.
- No additional investments, other than mentioned above.

3.11 The period for which the licence is to be issued

The licence should be issued for the maximum possible period, as the water use will be of a permanent nature.

3.12 Failure to authorise the water use

Failure to authorize the water use will result in the following:

- Financial loss due to existing investments already made, for construction of dams, existing infrastructure for water distribution and existing water use rights lost,
- The design and processes implemented to obtain authorisation also has a high financial implication that will be lost.
- Loss in current and future employment opportunities and skills development and training opportunities.

4. CONCLUSION

The authorisation of the vineyards across streams and the legalisation of the existing dam on the farm, thereby complying with the necessary legislation will have numerous positive socio-economic impacts not only on the farm but also the region and result in job security, job creations, skills development, social upliftment and earning of foreign currency.

5. CONDITIONS

- The water abstracted/used in terms of this licence may only be used for the authorised purposes.
- This licence is not a permanent, lawful right and is not transferable from one user to another or from one property to another.
- Officers from the Department of Water Affairs will always have free access to the property and the water works for supervision and control purposes.
- The local representative of the Department or Responsible Authority will issue the necessary instructions to the user regarding the keeping of proper registers of water use and quality, and the owner must at all times comply with such instructions.
- The Department accepts no liability for any damage, loss or inconvenience of whatever nature suffered as a result of shortage of water; inundation or flood; siltation of the river or dam basin; and/or the shifting of water works in the event of a rise or drop in the water level of river or dam.
- The quality or suitability of the water for any purpose is not guaranteed.
- When instructed to do so by the Responsible Authority, the user must fit a self-registering meter at the user's own expense to measure water use and wastewater use, and the user must maintain the meter in satisfactory working condition at his expense.
- The user must take every possible precaution to the satisfaction of the Department to prevent pollution of water resources.
- The Department of Water Affairs reserves the right to withdraw this licence in the event of failure to comply with any of the said conditions or provisions.
- The applicant has a period of 2 (two) years within which to commence/implement this water use, failing which, the licence will lapse.

6. RECOMMENDATION

The following recommendations should be adhered to:

- Any further recommendations outlined in the Environmental Authorisation and the Water Use Licence issued.
- This licence is not a permanent, lawful right and is not transferable from one user to another or from one property to another.
- The water abstracted/used in terms of this licence may only be used for the authorised purposes.
- Officers from the Department of Water Affairs will at all times have free access to the property and the water works for supervision and control purposes.
- The local representative of the Department or Responsible Authority will issue the necessary instructions to the user with regard to the keeping of proper registers of water use and quality, and the owner must at all times comply with such instructions.

- The Department accepts no liability for any damage, loss or inconvenience of whatever nature suffered as a result of shortage of water; inundation or flood; siltation of the river or dam basin; and/or the shifting of water works in the event of a rise or drop in the water level of river or dam.
- The quality or suitability of the water for any purpose is not guaranteed.
- When instructed to do so by the Responsible Authority, the user must fit a self-registering meter at the user's own expense to measure water use and wastewater use, and the user must maintain the meter in satisfactory working condition at his expense.
- The user must take every possible precaution to the satisfaction of the Department to prevent pollution of water resources.
- The Department of Water Affairs reserves the right to withdraw this licence in the event of failure to comply with any of the said conditions or provisions.
- The applicant has a period of 2 (two) years within which to commence/implement this water use, failing which, the licence will lapse.

It is recommended that the development across small ephemeral streams on Remainder of Kakamas South Settlement No. 2435, 387, 2106 and 1248 be approved.

7. APPENDICES

APPENDIX A: Completed Licence Application Forms

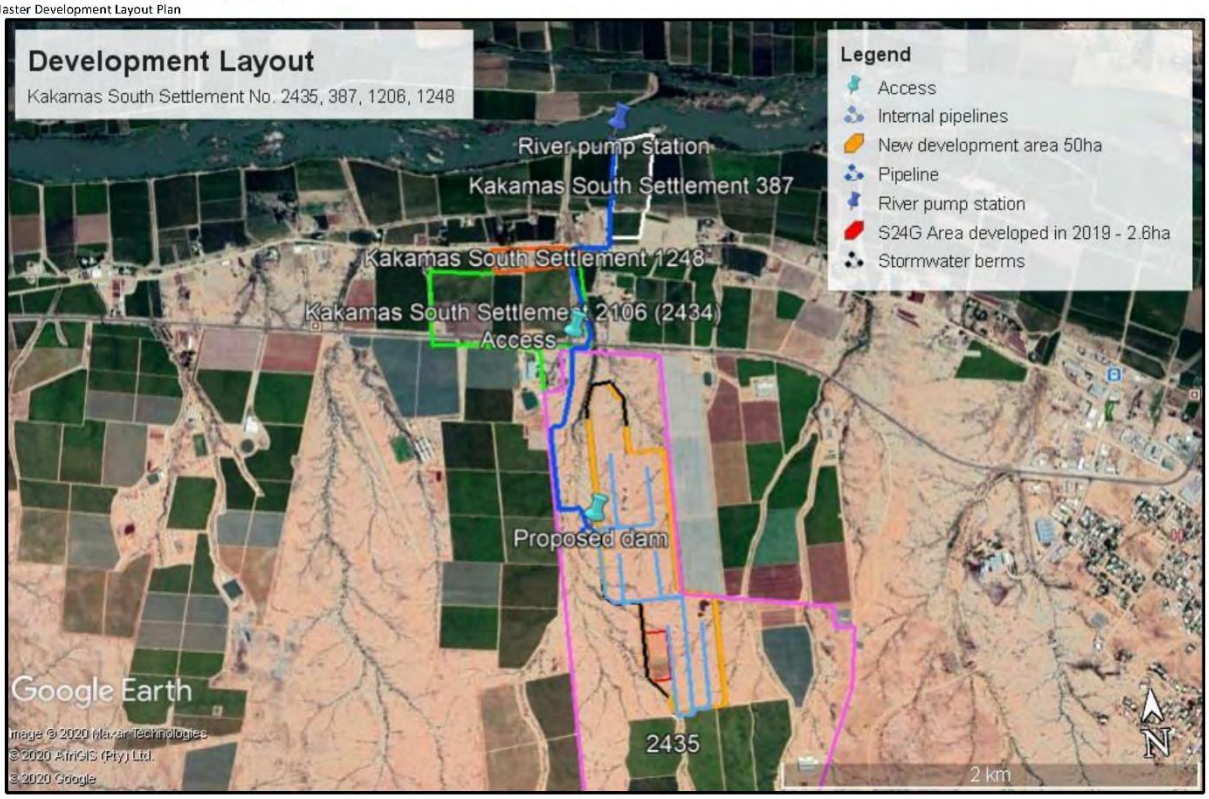
APPENDIX B: Existing Water Use License/Confirmation

APPENDIX C: Deed Search and Title Deeds

APPENDIX D: Power of Attorney

APPENDIX E1: Proposed Locality and Development layout

Master Development Layout Plan



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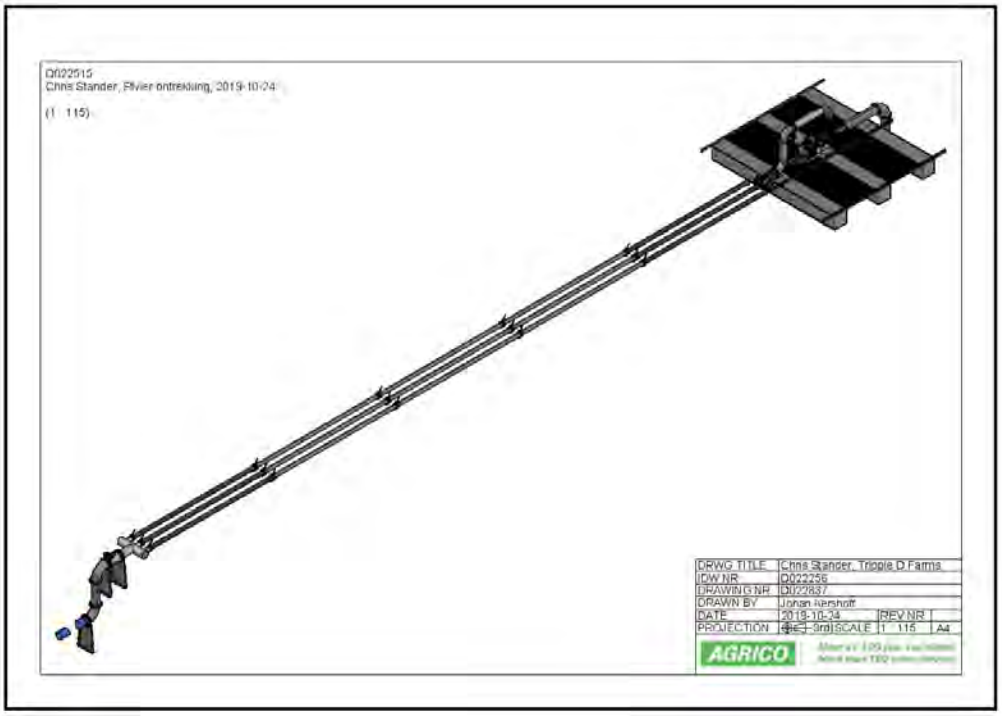
Engineering Drawings



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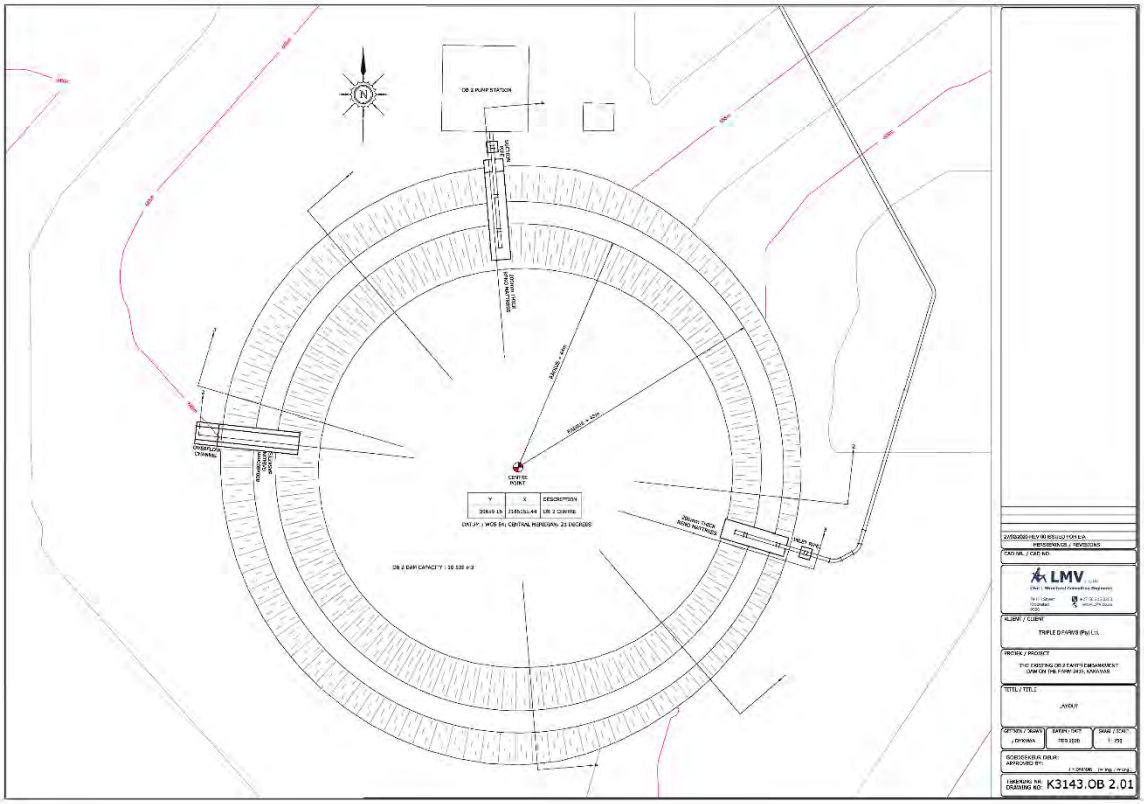
OB 2 PUMP STATION
CENTRE POINT
DATUM : WGS 84; CENTRAL MERIDIAN: 21 DEGREES
OB 2 DAM CAPACITY : 10 130 m3
LMV
TRIPLE D FARMS (Pty) Ltd.
LAYOUT
K3143.OB 2.01

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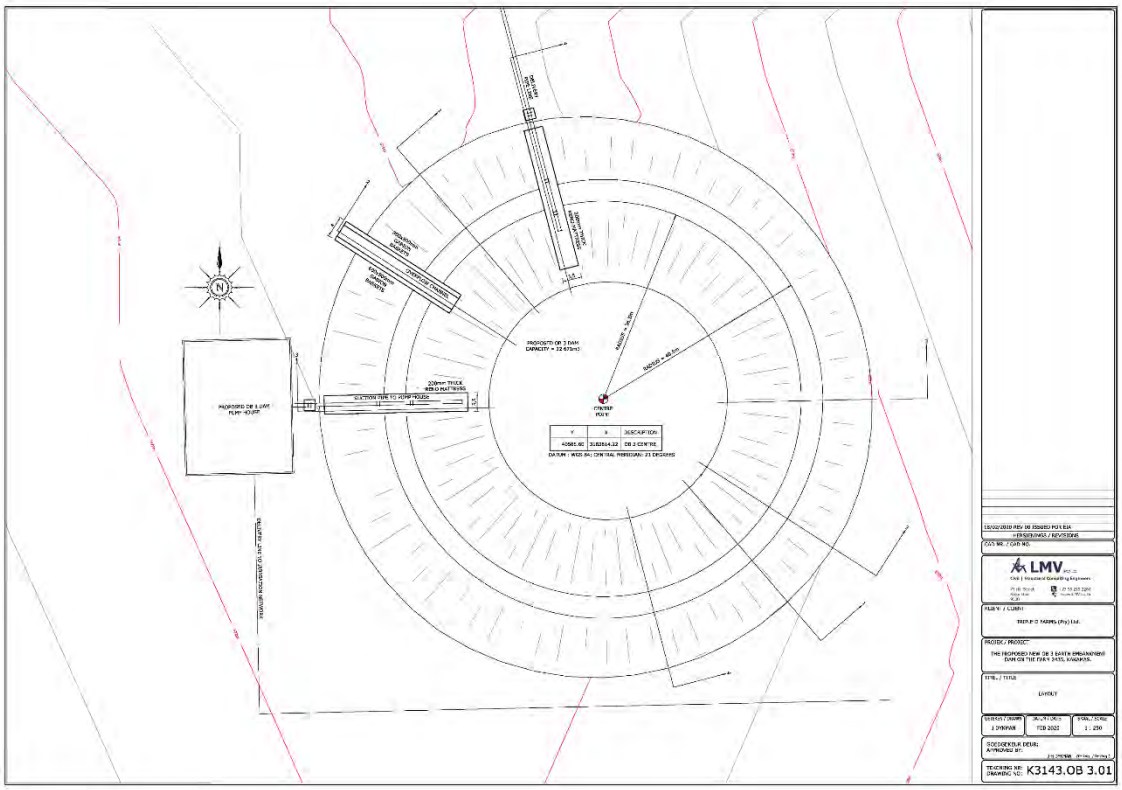
PROPOSED OB 3 DAM CAPACITY = 10 875m3
CENTRE POINT
DATUM : WGS 84; CENTRAL MERIDIAN: 21 DEGREES
LMV
TRIPLE D FARMS (Pty) Ltd.
LAYOUT
K3143.OB 3.01

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APPENDIX F: Technical Documents
Appendix F.1: S24G Assessment Report

Appendix F.2: Storm Water Management Report

Appendix F.3: Fresh Water Ecology Report

Appendix F.4: Botanical Report

Appendix F.5: Method Statements for Pipelines

APPENDIX G: Proof of Public Participation

APPENDIX H: Section 27 Report

APPENDIX I: Certified copy of ID

APPENDIX J: Company Registration certificates

APPENDIX K: Copy of Receipt

Appendix L: Section 21c and i

Appendix M: Land Claim Letters

Appendix N: Plough Certificate

APPENDIX H4: BOTANICAL ASSESSMENT

PB CONSULT
ENVIRONMENTAL MANAGEMENT SERVICES

BOTANICAL ASSESSMENT

TRIPLE D FARMS AGRICULTURAL DEVELOPMENT

PROPOSED DEVELOPMENT OF A FURTHER 60 HA OF VINEYARDS, ERF 1178, KAKAMAS KHAI !GARIB LOCAL MUNICIPALITY, NORTHERN CAPE PROVINCE.

8 October 2018

PJJ Botes (Pri. Sci. Nat.)

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SUMMARY - MAIN CONCLUSIONS

VEGETATION TYPE	**Bushmanland Arid Grassland** Bushmanland Arid Grassland is not considered a threatened vegetation type, with more than 99% remaining. However only 4% is formally conserved (Augrabies Falls National Park). Further conservation options must thus be investigated. The Northern Cape CBA Map (2016) identifies biodiversity priority areas, called Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs), which, together with protected areas, are important for the persistence of a viable representative sample of all ecosystem types and species as well as the long-term ecological functioning of the landscape as a whole (Holness & Oosthuysen, 2016). The NCCBA maps were used to guide the identification of potential significant sites.
VEGETATION ENCOUNTERED	The vegetation on site conforms to a slightly disturbed version of Bushmanland Arid Grassland, with the most significant feature the denser riparian zones associated with the larger water courses (Refer Figure 8). The proposed development will result in the transformation of approximately 60 ha of this vegetation within a proposed CBA area.
CONSERVATION PRIORITY AREAS	According to the Northern Cape Critical Biodiversity Areas (2016), the proposed site will impact on a CBA area, but it is also located within an area that is characterised by intensive farming, with little connectivity remaining to the northern parts of the site. The site will not impact on any recognised centre of endemism.
CONNECTIVITY	The proposed activity will have a long term impact on 60 ha of land within a CBA. The vegetation of the larger footprint is still partially connected to the south, west and east. However the northern parts of the footprint are surrounded by existing vineyards to the west, north and east. Connectivity will be impacted but it is already compromised towards the Orange River. Corridors along the most significant water courses would help to retain some connectivity (Figure 8).
LAND-USE	At present the land seems to be fallow land (not currently used for grazing). The possible impact on socio-economic activities will be localised and will only impact on the owner himself.
PROTECTED PLANT SPECIES	The following protected or endangered species was encountered: • **One red-listed species** (*Aloidendron dichotomum*) (Heading 4.6.1). • No NEM: BA protected plant species (Heading 4.6.2). • **One NFA protected tree** (*Boscia albitrunca*) (Heading 4.6.3) • **Ten NCNCA protected plant species** (Heading 4.6.4).
WATER COURSES AND WETLANDS	As with almost all areas in the Northern Cape the site is criss-crossed by the normal ephemeral drainage lines, but some larger water courses, with well-established riparian zones, were also encountered. They have an important ecological and drainage function. Protection of the most significant water courses and its riparian vegetation will ensure protection of the majority of larger trees, observed on site (Refer to Figure 8).
MAIN CONCLUSION	The proposed development will result in the transformation of approximately 60 ha of natural vegetation (Least Threatened) within a proposed CBA area. It will also potentially impact on a number of significant water courses and its associated riparian vegetation, as well as 2 *Boscia albitrunca* (Protected in terms of the NFA) and 2 *Aloidendron dichotomum* trees (a red listed plant, and protected in terms of the NCNCA). In addition it is also likely to impact on a number of other NCNCA plant species (Refer to Table 5).

According to the impact assessment given in Table 8 the development could have a medium/high impact on the environment, but with mitigation it can be reduced significantly to medium/low. **It is thus very important that the mitigation actions described below are implemented.**

With the correct mitigation it is likely that the development will then not contribute significantly to any of the following:

- Significant loss of vegetation type and associated habitat.
- Loss of ecological processes (e.g. migration patterns, pollinators, river function etc.) due to construction and operational activities.
- Loss of local biodiversity and threatened plant species.
- Loss of ecosystem connectivity.

WITH THE AVAILABLE INFORMATION IT IS RECOMMENDED THAT PROJECT BE APPROVED, BUT ONLY IF THE PROPOSED MITIGATION ACTIONS ARE IMPLEMENTED (IN ORDER TO MINIMISE THE ENVIRONMENTAL IMPACT.

NO-GO OPTION

The development may result in potential significant beneficial socio-economic gain, while the no-go option will not contribute significantly to national or provincial conservation targets.

INDEPENDENCE & CONDITIONS

PB Consult is an independent entity with no interest in the activity other than fair remuneration for services rendered. Remunerations for services are not linked to approval by decision making authorities and PB Consult have no interest in secondary or downstream development as a result of the authorization of this proposed project. There are no circumstances that compromise the objectivity of this report. The findings, results, observations and recommendations given in this report are based on the author's best scientific and professional knowledge and available information. PB Consult reserve the right to modify aspects of this report, including the recommendations if new information become available which may have a significant impact on the findings of this report.

RELEVANT QUALIFICATIONS & EXPERIENCE OF THE AUTHOR

Mr. Botes holds a BSc. (Hons.) degree in Plant Ecology from the University of Stellenbosch (Nature Conservation III & IV as extra subjects). Since qualifying with his degree, he had worked for more than 20 years in the environmental management field, first at the Overberg Test Range (a Division of Denel) managing the environmental department of OTB and being responsible for developing and implementing an ISO14001 environmental management system, ensuring environmental compliance, performing environmental risk assessments with regards to missile tests and planning the management of the 26 000 ha of natural veld, working closely with CapeNature (De Hoop Nature Reserve). In 2005 he joined Enviroscientific, an independent environmental consultancy specializing in wastewater management, botanical and biodiversity assessments, developing environmental management plans and strategies, environmental control work as well as doing environmental compliance audits and was also responsible for helping develop the biodiversity part of the Farming for the Future audit system implemented by Woolworths. During his time with Enviroscientific he performed more than 400 biodiversity and environmental legal compliance audits. During 2010 he joined EnviroAfrica in order to move back to the biodiversity aspects of environmental management. Experience with EnviroAfrica includes EIA applications, environmental compliance audits and environmental control work (ECO) as well as more than 70 biodiversity or botanical studies.

Mr. Botes is also a registered Professional Botanical, Environmental and Ecological Scientists at SACNASP (South African Council for Natural Scientific Professions) as required in terms of Section 18(1)(a) of the Natural Scientific Professions Act, 2003, since 2005.

Yours sincerely,

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1. INTRODUCTION

Kakamas is a small town founded in 1898 and located in the Kai !Garib Municipality of the Northern Cape province of South Africa, on the banks of the Orange River. It originated as at a place where the Orange River could be relatively easily crossed (and was first known as Bassonsdrif). In 1898 a proper settlement was established and under the auspices of the Dutch Reformed Church the area was developed as an agricultural spot. It became a municipality in 1954. The name Kakamas was originally given to a drift that was known as Takemas or T'Kakamas since 1779. The name means "place of the raging cow". The economy of this town is based on farming, and thanks to irrigation from the Orange River farmers from the Kakamas area are now prime exporters of table grapes peaches, dried fruit, raisins, oranges and dates (https://en.wikipedia.org/wiki/Kakamas).

Triple D Farms is a large agricultural farm just west of Kakamas (just off the N14) focusing on the production of table grapes and raisins. The owners would like to develop a further 60 ha on Erf 1178, Kakamas South Settlement. An area of approximately 120 ha was evaluated in the larger footprint. The development will also the construction of a new pump station on the banks of the Orange River, pipelines from the Orange River to the property, an off-stream storage dam (reservoir) on the property, a packing shed and labour housing. The proposed pump station and pipelines will be located within registered servitudes.

The proposed development will trigger listed activities under the National Environmental Management Act, (Act 107 of 1998) (NEMA) and the EIA regulations (as amended). EnviroAfrica was appointed to perform the NEMA EIA application. The new development will be located in veld still supporting natural veld and PB Consult was appointed to conduct a botanical assessment of the larger property.

Only one vegetation type is expected, namely Bushmanland Arid Grassland (considered "Least Threatened" in terms of the National list of ecosystems that are threatened and in need of protection). As with almost all areas in the Northern Cape the site is criss-crossed by the normal ephemeral drainage lines, but some larger water courses were also encountered. These drainage lines are often associated with slightly larger shrubs and small trees that are only found near such water ways.

1.1. TERMS OF REFERENCE

The terms of reference for this appointment were to:

- Evaluate the proposed site(s) in order to determine whether any significant botanical features will be impacted as a result of the proposed development.
- Determine and record the position of any plant species of special significance (e.g. protected tree species, or rare or endangered plant species) that should be avoided or that may require "search & rescue" intervention.
- Locate and record sensitive areas from a botanical perspective within the proposed development footprint that may be interpreted as obstacles to the proposed development.
- Make recommendations on impact minimization should it be required
- Consider short- to long-term implications of impacts on biodiversity and highlight irreversible impacts or irreplaceable loss of species.

2. STUDY AREA

2.1. LOCATION & LAYOUT

The town of Kakamas is located along the N14, on the banks of the Orange River along the, between Pofadder and Upington (Kai !Garib Local Municipality, ZF Mgcawu District Municipality) in the Northern Cape Province (Figure 1). Triple D is located just west of Kakamas (approximately 2.5 km), just off the N14 (Figure 2).

Figure 1: Map showing the location of Kakamas in the Northern Cape Province

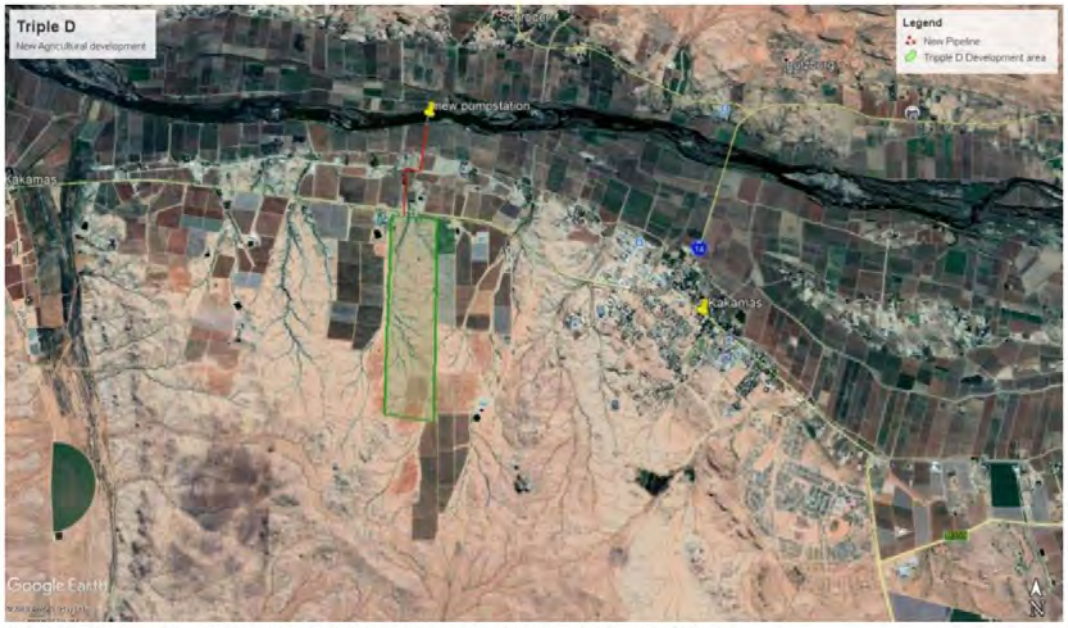

Figure 2: The location of the proposed development footprint in relation to Kakamas

2.2. CLIMATE

All regions with a rainfall of less than 400 mm per year are regarded as arid. This area normally receives about 106 mm of rain per year (the climate is therefore regarded as arid to very arid). Kakamas normally receives about 134 mm of rain per year, with rainfall largely in late summer/early autumn (major peak) and very variable from year to year. It receives the lowest rainfall (3 mm) in June and the highest (27 mm) in March.

Table 1: Average rainfall and temperatures at Kakamas (https://en.climate-data.org/location/911655/)

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature (°C)	27.3	26.4	24.4	21.1	16	13.1	12.2	14.5	17.3	20.9	23.5	26.3
Min. Temperature (°C)	18.9	18.3	16.7	12.8	7.8	4.0	3.7	5.4	8.1	11.6	14.3	17.2
Max. Temperature (°C)	35.7	34.5	32.2	29.5	24.3	21.7	20.8	23.6	28.5	30.3	32.8	35.4
Avg. Temperature (°F)	81.1	79.5	75.9	70.0	60.8	55.6	54.0	58.1	63.1	69.6	74.3	79.3
Min. Temperature (°F)	66.0	64.9	62.1	55.0	46.0	40.3	38.7	41.7	46.6	52.9	57.7	63.0
Max. Temperature (°F)	96.3	94.1	90.0	85.1	75.7	71.1	69.4	74.5	79.7	86.5	91.0	95.7
Precipitation / Rainfall (mm)	17	21	27	17	9	3	4	3	3	7	13	10

The monthly distribution of average daily maximum temperatures shows that the average midday temperatures for Kakamas range from 20°C in July to 35°C in January. The region is the coldest during July with temperatures as low as 3.7°C on average during the night (www.saexplorer.co.za). Table 1 gives a summary of temperatures and rainfall recorded at Kakamas (https://en.climate-data.org/location/911655/).

2.3. GEOLOGY AND SOILS

Geology is dominated by mudstones and shales of the Ecca Group (Prince Albert and Volksrust Formations) and Dwyka tillites, both of the early Karoo age. About 20% of rock outcrops are formed by Jurassic intrusive dolerite sheets and dykes.

Figure 3: General soils map for the area (SANBI BGIS)

Soils (Refer to Figure 3) are described as soils with minimal development, usually shallow on hard or weathering rock, Glenrosa and Mispah forms, with lime generally present in the entire landscape (Fc land type) and, to a lesser extent, red-yellow apedal, freely drained soils with a high base status and usually <15% clay (Ah and Ai land types) are also found. The salt content in these soils is very high (Mucina & Rutherford, 2006).

Please note that Agrimotion did a detailed soil and development potential report for the proposed development (Agrimotion, 2017).

2.4. TOPOGRAPHY

The larger footprint (approximately 120 ha in size) is mostly located on a level to slightly undulating plain, sloping slightly from south to north (towards the Orange River). The proposed site is about 1 km away from (to the south) of the Orange River with the N14 between the Orange River and the site. However, the northern parts of the proposed site (next to the N14) is traversed by a number of more pronounced seasonal water courses cutting through the landscape and resulting in a number of deeper runnels (coupled with a number of rocky outcrops). The rocky outcrops are mostly very small and did not support any specialised vegetation, but will make development more costly. Elevation drops from south to north approximately 687 m to 664 m (above sea level) over a distance of approximately 2.2 km with an average slope of 0.3% (very gentle slope). In general aspect is not expected to have any significant influence on the vegetation, but differences in geographical features such as the seasonal watercourses results in differences in vegetation combination. In terms of vegetation, the smaller ephemeral streams is not seen as significant features, but the larger watercourses have an important function in terms of drainage and also supports the most significant riparian vegetation (associated with larger trees).

3. EVALUATION METHOD

Desktop studies coupled with a site visit were performed. The site visit was conducted during August of 2018. The timing of the site visit was reasonable in that essentially all perennial plants were identifiable. Bulb and annual herbs were mostly absent (the possibility remains that some of these species may have been missed).

Figure 4: The proposed larger footprint (green) that was studied during the site visit

However, the author has done a number of botanical assessments in this vegetation type and is confident that a fairly good understanding of the biodiversity status of the site was obtained. The survey was conducted by walking the site and examining, marking and photographing any area of interest. Confidence in the findings is high. During the site visit the author endeavoured to identify and locate all significant biodiversity features, including rivers, streams or wetlands, special plant species and or specific soil conditions which might indicate special botanical features (e.g. rocky outcrops or silcrete patches).

4. THE VEGETATION

The Northern Cape contains about 3500 plant species in 135 families and 724 genera, with about 25% of this flora endemic to the region. It is also home to an exceptionally high level of insect and reptile endemism, with new species still being discovered. However, it must be noted that this remarkable diversity is not distributed evenly throughout the region, but is concentrated in many local centres of endemism (NDBSP, 2008).

The Kakamas area would be classified as a desert region. In accordance with the Vegetation map of South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2006, as updated in the 2012 beta version) only one broad vegetation type is expected in the proposed area and its immediate vicinity, namely **Bushmanland Arid Grassland**. More than 99% of this vegetation still remains, but only 4% is formally conserved (Augrabies Falls National Park). According to the National list of ecosystems that are threatened and in need of protection (GN 1002, December 2011), Bushmanland Arid Grassland, remains classified as *Least Threatened*.

According to Mucina and Rutherford (20016), Bushmanland Arid Grassland is found in the Northern Cape Province spanning about one degree of latitude from around Aggeneys in the west to Prieska in the east. The southern border of the unit is formed by edges of the Bushmanland Basin while in the north-west this vegetation unit borders on desert vegetation (north-west of Aggeneys and Pofadder). The northern border (in the vicinity of Upington) and the eastern border (between Upington and Prieska) are formed with often intermingling units of Lower Gariep Broken Veld, Kalahari Karroid Shrubland and Gordonia Duneveld. Most of the western border is formed by the edge of the Namaqualand hills. Altitude varies from 600 – 1 200 m.

Figure 5: Vegetation map of South Africa (2012 beta 2 version), showing the larger area and expected vegetation

4.1. THE VEGETATION IN CONTEXT

Bushmanland Arid Grassland is part of the Nama-Karoo Biome, which is a large arid landlocked region on the central plateau of the western half of South Africa, extending into Namibia. It is flanked by the Succulent

Karoo to the west and south, desert to the northwest, arid Kalahari Savanna to the north, Grassland to the northeast, Albany Thicket to the southeast and small parts of Fynbos to the south. In South Africa, only the Desert Biome has a higher variability in annual rainfall and only the Kalahari Savanna greater extremes in temperature. The Nama-Karoo receives most of its rainfall in summer, especially in late summer (Mucina *et. al.*, 2006).

Climate is essentially continental and with almost no effect of the ameliorating influences of the oceans. Rainfall is low and unreliable, peaking in March. Droughts are unpredictable and often prolonged. Summers are hot and winters cold with temperature extremes ranging from -5°C in winter to 43°C in summer. However, rainfall intensity can be high (e.g. episodic thunderstorm and hail storm events). This coupled with the generally low vegetation cover associated with aridity and grazing pressure by domestic stock over the last two centuries, raises the potential for soil erosion. In semi-arid environments such as the Nama-Karoo, nutrients are generally located near the soil surface, making it vulnerable to sheet erosion (Mucina *et. al.*, 2006).

In contrast with the Succulent Karoo, the Nama-Karoo is not particularly rich in plant species and does not contain any centre of endemism. Local endemism is very low, which might indicate a relative youthful biome linked to the remarkable geological and environmental homogeneity of the Nama-Karoo. Rainfall seasonality and frequency are too unpredictable and winter temperatures too low to enable leaf succulent dominance (as in the Succulent Karoo). It is also too dry in summer for dominance by perennial grasses alone and the soils generally to shallow and rainfall too low for dominance by trees. But soil type, soil depth and local differences in moisture availability can cause abrupt changes in vegetation structure and composition (e.g. small drainage lines support more plant species than surrounding plains) (Mucina *et. al.*, 2006).

Because of its aridity and unpredictable rainfall patterns, the Nama-Karoo region favours free moving herbivores such as ostrich and springbok nomadic birds and invertebrates with variable dormancy cued by rain. Plant defence against herbivores and seed adaption for dispersal by mammals are relatively uncommon, except along rivers and seasonal pans, suggesting the transient nature of herbivores, except near water where they would have lingered longer. However, since the 19th century the vast herds of migratory ungulates indigenous to this biome have been almost completely replaced by domestic stock. Once farmers started fencing their properties into camps (following the Fencing Act of 1912), stock numbers were dramatically increased with dire consequences to plant diversity. Grazing during and immediately after droughts periods is regarded as a major cause of detrimental change in vegetation composition and were ultimately responsible for the decline of large numbers of palatable plants (Mucina *et. al.*, 2006).

In terms of status, very little of the Nama-Karoo has been transformed and the dominant land use is farming with small stock, cattle and game. Farms are fenced, but generally large, having a low grazing capacity. The biggest treat to this vegetation remains domestic livestock grazing pressure. Grazing by livestock particularly during the summer growing season, reduces the perennial grass component, while prolonged droughts kill a high proportion of perennial plants, rapidly changing vegetation composition in favour of short-lived species with soil stored seed banks. Overgrazing after drought periods can delay vegetation recovery, which will worsen the effect of subsequent droughts.

4.2. VEGETATION ENCOUNTERED

Approximately 120ha of veld was evaluated, of which the land owner would like to develop 60 ha. The vegetation encountered conforms to Bushmanland Arid Grassland. Two definite communities were encountered namely a sparse (semi-desert type) low shrubland with grasses sometimes present (expected to be more prominent after rain) on the open undulating plains, while a denser and higher riparian vegetation was encountered next to the watercourses. The more pronounce these water courses the more established

the riparian zone became. Because of the arid nature of the region (and the unpredictability of rainfall) the carrying capacity of the veld is very low and much of the natural veld is expected to have suffered from incorrect grazing or overgrazing practices since the early 19th century (after farms became fenced).

4.2.1. The Open plains

The vegetation encountered on the open gravelly plains can be described as a sparse low shrubland (sometimes even a dwarf shrub layer) (Photo 1 & 2), with surface rocks and sometimes even small/low rocky outcrops (Photo 3) showing above ground (to the north of the site, larger rocky outcrops were also encountered). The vegetation varied from a sparse low shrubland dominated by *Tetraena decumbens (=Zygophyllum)* (Photo 1) to a very sparse open low shrubland (Photo 2) either dominated by either *Tetraena decumbens* or by *Justicia australis (=Monechma)*, in the calcrete patches (Photo 2).

Photo 1: Sparse shrubland dominated by *Tetraena decumbens* with *Aloe claviflora* present in the foreground.

The following plant species were observed scattered throughout the site (never dominating, but sometimes encountered in patches); the small *Acanthopsis disperma*, the common *Aloe claviflora*, two individuals of *Aloidendron dichotomum* (a third was observed outside of the proposed footprint), *Aptosimum spinescens, Asparagus* cf. *cooperi, Avonia* cf. *papyracea, Berkheya fruticosa, Blepharis mitrata*, two individuals of *Boscia albitrunca* (one in poor and one in fairly good condition), scattered individuals of *Boscia foetida*, patches of *Cynanchum viminale, Euphorbia gariepina,* and occasionally the smaller *Euphorbia* cf. *rhombifolia, Forsskaolea candida*, the common *Galenia africana, Geigeria filifolia, Justicia spartioides, Kleinia longiflora, Leucosphaera bainesii, Limeum aethiopicum, Lycium cinereum,* the succulent *Mesembryanthemum coriarium* (=*Psilocaulon coriarium*), *Monsonia* cf. *patersonii, Ptycholobium biflorum, Rhigozum trichotomum,* the common *Rogeria longiflora, Salsola aphylla, Sericocoma avolans, Senegalia mellifera* and *Tapinanthus oleifolius.*

Photo 2: Very sparse open low shrubland with *Justicia australis* prominent.

The vegetation encountered at the small rocky outcrops (Photo 3) did not differ in species from that of its surroundings (although vegetation cover was sometimes slightly denser, as a result of the shelter given by the outcrops). The only plant that was not observed elsewhere and that was only found near one of the rocky outcrops to the north was *Berkheya glabrata*. Other species commonly associated with these outcrops were *Aloe dichotoma, Boscia foetida, Forsskaolea candida, Galenia africana* and *Tetraena decumbens*.

Photo 3: One of the small rocky outcrops towards the south of the site.

Please refer to Appendix 1 for a collage of pictures of the open plains area.

4.2.2. The riparian vegetation

The vegetation along the small ephemeral drainage lines and small seasonal water courses did not varied much, apart from becoming denser and larger, the more pronounce the water course becomes (e.g. Photo 4). Agrimotion, 2017 did a very good job of mapping the most prominent of these water courses on their soil potential map for the Triple D farm (Figure 6). The following plants were commonly observed in association with these seasonal water courses: *Asparagus* cf. *cooperi, Boscia foetida*, the herb *Chascanum garipense, Hermannia stricta, Jamesbrittenia glutinosa, Justicia spartioides, Montinia caryophyllacea, Osteospermum scariosum, Ozoroa dispar, Parkinsonia africana, Rhigozum trichotomum Senegalia mellifera, Tapinanthus oleifolius, Tetragonia reduplicata* and *Ziziphus mucronata*.

Photo 4: One of the larger seasonal water courses to the north of the site.

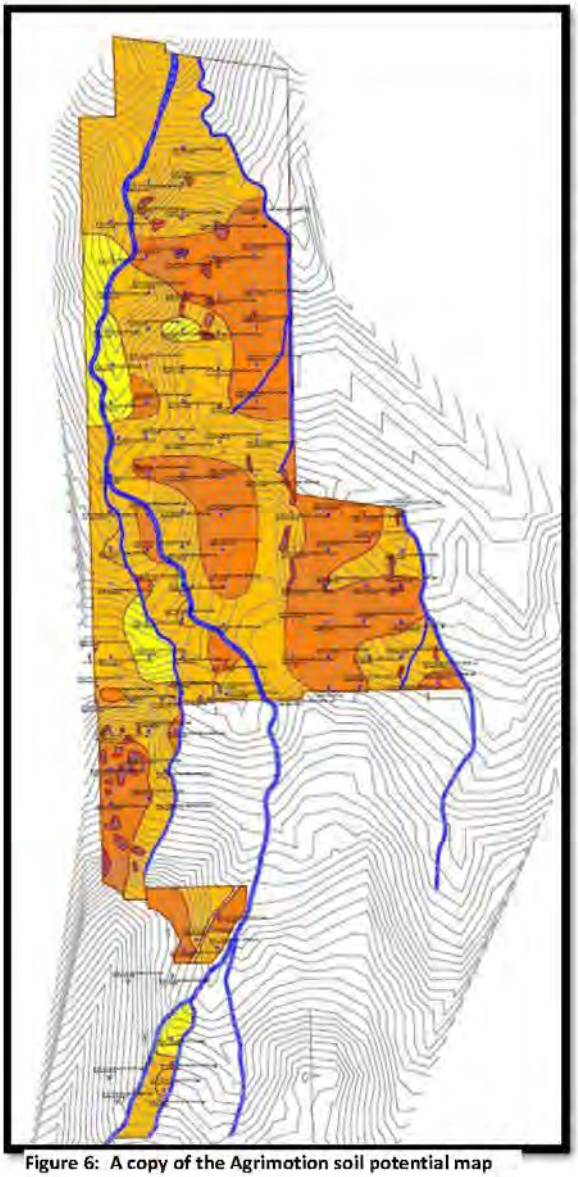

Figure 6: A copy of the Agrimotion soil potential map

Figure 6, was taken from the soil potential report done by Agrimotion (2017) for the same project. On the soil potential map (a copy of which is shown), the seasonal water courses are clearly indicated. The protection of these features is fully supported by this report. However, it is also recommended that a buffer zone of at least 3 – 5 m is established next to these main water courses (as indicated in Figure 6), measured from the edge of the water course (not the centre of the water course) in order to protect the existing riparian vegetation.

Farm/crop access roads may not be established or intrude into these buffer zones. In other words the access road may not form the buffer zone, but must be placed away from the water course and outside of this buffer zone.

4.2.3. The pipeline route

The proposed pipeline route includes the establishment of a new pump station at the banks of the Orange River. From there it will be placed in or next to existing farm roads through transformed agricultural area (as is the case along most of the banks of the Orange River in this area), with only the last section passing along an area with some very disturbed natural veld next to a seasonal water course.

The proposed location for the placement of the extraction pump (Photo 5- 7) is located on a disturbed portion of the Orange River, already used as an access point / jetty for the small boats. As long as the pipeline is located within the existing disturbance footprint, the impact on vegetation will be minimal (Please note that a Freshwater specialist report was commissioned, who will address the impact on the river system). Next to the disturbance footprint, disturbance indicator plants, alien invasive species (Prosopis species) and some remaining natural vegetation was encountered, the most important of which was *Phragmites australis* stands stabilizing the river banks and the small indigenous trees, *Vachellia karroo* (=*Acacia karroo*) and *Tamarix*

usneoides. Other species included disturbance indicators like *Mesembryanthemum guerichianum*, *Mesembryanthemum coriarium* and the herb *Jamesbrittenia glutinosa*.

Photo 5: The proposed pump station location looking from south onto the Orange River. Note the disturbance footprint.

S28° 45' 07.3" E20° 35' 15.8"

Photo 6: The banks of the Orange River at the proposed pump station location (looking from the disturbed area eastwards).

Photo 7: The banks of the Orange River at the proposed pump station location (looking from the disturbed area westwards).

From the banks of the Orange River the pipeline will follow existing roads for the next 1.7 km through areas under intensive cultivation (mostly vineyards) (Refer to Photo 8-10). Through this section the impact there

should be no impact on any natural veld (transformed land) and as long as the pipeline stays next to or within the existing roads, impact on agriculture should be minimal.

Photo 8: The proposed pipeline route will follow existing roads. This picture depicts the last section of agricultural land towards the banks of the Orange River, looking from south to north (towards the Orange River in the background).

Photo 9: This picture depicts the proposed pipeline route from south to north through agricultural land going towards Picture 8. Note the alien *Prosopis* trees to the left.

Photo 10: This picture depicts the pipeline route following a section of the road (from west to east) before it turns south towards the Orange River (Picture 9). Note the alien Beefwood windbreaks to the left and right of the road.

The final section of the pipeline will be located next to a badly disturbed area, but with some natural plants still remaining, next to a seasonal stream. Unfortunately, this area is very disturbed and degraded, and the riparian vegetation is mostly replaced by the alien *Prosopis* trees, Beefwood (*Casuarina* species), with the occasional indigenous *Vachellia karroo,* patches of *Phragmites australis* and some disturbance indicator species remaining (e.g. *Mesembryanthemum guerichianum*, *Mesembryanthemum coriarium, Lycium species, Rhigozum trichotomum* and *Senegalia mellifera).*

Photo 11: The section of the pipeline next to the water course from the N14 towards Picture 10.

Photo 12: The section of the proposed pipeline, crossing underneath the N14 (through an existing culvert) and then running next to the seasonal stream towards Picture 11).

Since this area is very disturbed with very little remaining natural veld and running next to a seasonal stream, the exact location of the pipeline should be advised by the Freshwater Specialist report. Impact on any significant vegetation or species should be minimal, especially if the pipeline route is placed as near to or within the existing farm roads to the west of the stream.

4.3. CRITICAL BIODIVERSITY AREAS MAPS

The Northern Cape CBA Map (2016) identifies biodiversity priority areas, called Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs), which, together with protected areas, are important for the persistence of a viable representative sample of all ecosystem types and species as well as the long-term ecological functioning of the landscape as a whole (Holness & Oosthuysen, 2016). The 2016 Northern Cape Critical Biodiversity Area (CBA) Map updates, revises and replaces all older systematic biodiversity plans and associated products for the province (including the Namakwa District Biodiversity Sector Plan, 2008). Priorities from existing plans such as the Namakwa District Biodiversity Plan, the Succulent Karoo Ecosystem Plan, National Estuary Priorities, and the National Freshwater Ecosystem Priority Areas were incorporated. Targets for terrestrial ecosystems were based on established national targets, while targets used for other features were aligned with those used in other provincial planning processes.

Critical biodiversity areas (CBA's) are terrestrial and aquatic features in the landscape that are critical for retaining biodiversity and supporting continued ecosystem functioning and services (SANBI 2007). The primary purpose of CBA's is to inform land-use planning in order to promote sustainable development and protection

of important natural habitat and landscapes. CBA's can also be used to inform protected area expansion and development plans.

- **Critical biodiversity areas (CBA's)** are areas of the landscape that need to be maintained in a natural or near-natural state in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. In other words, if these areas are not maintained in a natural or near-natural state then biodiversity conservation targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity-compatible land uses and resource uses.

- **Ecological support areas (ESA's)** are areas that are not essential for meeting biodiversity representation targets/thresholds but which nevertheless play an important role in supporting the ecological functioning of critical biodiversity areas and/or in delivering ecosystem services that support socio-economic development, such as water provision, flood mitigation or carbon sequestration. The degree of restriction on land use and resource use in these areas may be lower than that recommended for critical biodiversity areas.

Figure 7: The Northern Cape Critical Biodiversity Areas (2016) showing the location of the proposed development

From a land-use planning perspective it is useful to think of the difference between CBA's and ESA's in terms of where in the landscape the biodiversity impact of any land-use activity action is most significant:

- For CBA's the impact on biodiversity of a change in land-use that results in a change from the desired ecological state is most significant locally at the point of impact through the direct loss of a biodiversity feature (e.g. loss of a populations or habitat).

- For ESA's a change from the desired ecological state is most significant elsewhere in the landscape through the indirect loss of biodiversity due to a breakdown, interruption or loss of an ecological process pathway (e.g. removing a corridor results in a population going extinct elsewhere or a new

plantation locally results in a reduction in stream flow at the exit to the catchment which affects downstream biodiversity).

The 2016 Northern Cape Critical Biodiversity Areas (NCCBA) gives both aquatic and terrestrial Critical Biodiversity Areas (CBAs) and ecological support areas for the Northern Cape.

According to the NCCBA (Refer to Figure 7), the proposed development will be located within a CBA.

4.4. POTENTIAL IMPACT ON CENTRES OF ENDEMISM

The proposed development does not impact on any recognised centre of endemism. The Gariep Centre is located to the north (quite a distance away) associated with Augrabies, Pella and Onseepkans along the border of South Africa and Namibia, while the Griqualand West Centre of Endemism starts to the east of Upington Northern Cape Province (Van Wyk & Smith, 2001). **The proposed site does not fall within any recognised centre of endemism.**

4.5. FLORA ENCOUNTERED

Table 2 gives a list of the plant species encountered during this study. Because of the limitations (timing and a single site visit) a number of annuals might have been missed.

Table 2: List of species encountered within or near the proposed footprint

No.	Species name	FAMILY	Status	Alien & invader species (AIS)
1.	*Acanthopsis disperma*	ACANTHACEAE	LC	
2.	*Aloe claviflora*	ASPHODELACEAE	NCNCA, Schedule 2 Protected (all species in this Family)	**Apply for a NCNCA Flora permit (DENC)**
3.	*Aloidendron dichotomum*	ASPHODELACEAE	VU NCNCA, Schedule 1 Protected	**Apply for a NCNCA Flora permit (DENC)**
4.	*Aptosimum spinescens*	SCROPHULARIACEAE	LC	
5.	*Aristida adscensionis*	POACEAE	LC	
6.	*Aristida congesta*	POACEAE	LC	
7.	*Asparagus* cf. *cooperi* (no flowers)	ASPARAGACEAE	LC	
8.	*Avonia* cf. *papyracea*	ANACAMPSEROTACEAE	LC	
9.	*Berkheya fruticosa*	ASTERACEAE	LC	
10.	*Berkheya glabrata*	ASTERACEAE	LC	
11.	*Blepharis mitrata*	ACANTHACEAE	LC	
12.	*Boscia albitrunca*	BRASSICACEAE (CAPPARACEAE)	LC NFA protected species NCNCA, Schedule 2 Protected (all species of Boscia)	**Apply for a NFA Tree permit (DAFF)** **Apply for a NCNCA Flora permit (DENC)**
13.	*Boscia foetida*	BRASSICACEAE (CAPPARACEAE)	LC NCNCA, Schedule 2 Protected (all species in this Genus)	**Apply for a NCNCA Flora permit (DENC)**
14.	*Casuarina* species	CASUARINACEAE	Alien invasive plant species	
15.	*Chascanum garipense*	VERBENACEAE	LC	
16.	*Cynanchum viminale* (=*Sarcostemma viminale*)	APOCYNACEAE	NCNCA, Schedule 2 Protected (all species in this Family)	**Apply for a NCNCA Flora permit (DENC)**
17.	*Euphorbia gariepina*	EUPHORBIACEAE	NCNCA, Schedule 2 Protected	**Apply for a NCNCA**

No.	Species name	FAMILY	Status	Alien & invader species (AIS)
			(all species in this Genus)	Flora permit (DENC)
18.	*Euphorbia rhombifolia*	EUPHORBIACEAE	NCNCA, Schedule 2 Protected (all species in this Genus)	Apply for a NCNCA Flora permit (DENC)
19.	*Forsskaolea candida*	URTICACEAE	LC	
20.	*Galenia africana*	AIZOACEAE	NCNCA, Schedule 2 Protected (all species in this Family)	Apply for a NCNCA Flora permit (DENC)
21.	*Geigeria filifolia*	ASTERACEAE	LC	
22.	*Hermannia stricta*	STERCULIACEAE	LC	
23.	*Jamesbrittenia glutinosa*	SCROPHULACEAE	LC	
24.	*Justicia australis (=Monechma genistifolium)*	ACANTHACEAE	LC	
25.	*Justicia spartioides*	ACANTHACEAE	LC	
26.	*Kleinia longiflora*	ASTERACEAE	LC	
27.	*Leucosphaera bainesii*	AMARANTHACEAE	LC	
28.	*Limeum aethiopicum*	LIMEACEAE	LC	
29.	*Lycium cinereum*	SOLANACEAE	LC	
30.	*Mesembryanthemum coriarium (=Psilocaulon coriarium)*	AIZOACEAE	LC Protected in terms of schedule 2 of the NCNCA	Apply for a NCNCA Flora permit (DENC)
31.	*Monsonia cf. patersonii*	GERANIACEAE	LC	
32.	*Montinia caryophyllacea*	MONTINIACEAE	LC	
33.	*Osteospermum scariosum*	ASTERACEAE	LC	
34.	*Ozoroa dispar*	ANACARDIACEAE	LC	
35.	*Parkinsonia africana*	FABACEAE	LC	
36.	*Phragmites australis*	POACEAE	LC	
37.	*Prosopis* species	FABACEAE	Alien invasive plant species	
38.	*Ptycholobium biflorum*	FABACEAE	LC	
39.	*Rhigozum trichotomum*	BIGONACEAE	LC	
40.	*Rogeria longiflora*	PEDALIACEAE	LC	
41.	*Salsola aphylla*	AMARANTHACEAE	LC	
42.	*Senegalia mellifera (=Acacia mellifera)*	FABACEAE	LC	
43.	*Sericocoma avolans*	AMARANTHACEAE	LC	
44.	*Stipagrostis uniplumis*	POACEAE	LC	
45.	*Tamarix usneoides*	TAMARICACEAE	LC	
46.	*Tapinanthus oleifolius*	LORANTHACEAE	LC	
47.	*Tetraena decumbens (=Zygophyllum decumbens)*	ZYGOPHYLLACEAE	LC	
48.	*Tetragonia reduplicata*	AIZOACEAE	LC Protected in terms of schedule 2 of the NCNCA	Apply for a NCNCA Flora permit (DENC)
49.	*Vachellia karroo*	FABACEAE	LC	
50.	*Ziziphus mucronata*	RHAMNACEAE	LC	

4.6. THREATENED AND PROTECTED PLANT SPECIES

South Africa has become the first country to fully assess the status of its entire flora. Major threats to the South African flora are identified in terms of the number of plant taxa Red-Listed as threatened with extinction as a result of threats like, habitat loss (e.g. infrastructure development, urban expansion, crop cultivation and mines), invasive alien plant infestation (e.g. outcompeting indigenous plant species), habitat degradation (e.g.

overgrazing, inappropriate fire management etc.), unsustainable harvesting, demographic factors, pollution, loss of pollinators or dispersers, climate change and natural disasters (e.g. such as droughts and floods). South Africa uses the internationally endorsed IUCN Red List Categories and Criteria in the Red List of South African plants. However, due to its strong focus on determining risk of extinction, the IUCN system does not highlight species that are at low risk of extinction, but may nonetheless be of high conservation importance. As a result a SANBI uses an amended system of categories in order to highlight species that may be of low risk of extinction but are still of conservation concern (SANBI, 2015).

In the Northern Cape, species of conservation concern are also protected in terms of national and provincial legislation, namely:

- The National Environmental Management: Biodiversity Act, Act 10 of 2004, provides for the protection of species through the "*Lists of critically endangered, endangered, vulnerable and protected species*" (GN. R. 152 of 23 February 2007).
- National Forest Act, Act 84 of 1998, provides for the protection of forests as well as specific tree species through the "*List of protected tree species*" (GN 908 of 21 November 2014).
- Northern Cape Nature Conservation Act, Act of 2009, provides for the protection of "*specially protected species*" (Schedule 1), "*protected species*" (Schedule 2) and "*common indigenous species*" (Schedule 3).

4.6.1. Red list of South African plant species

The Red List of South African Plants online provides up to date information on the national conservation status of South Africa's indigenous plants (SANBI, 2015).

- **One red-listed species** was observed, namely *Aloidendron dichotomum* (Vulnerable) (Refer to Table 2 & 3).

Table 3: Plant species protected in terms of the NFA encountered within the study area

NO.	SPECIES NAME	COMMENTS	RECOMMENDATIONS
1.	*Aloidendron dichotomum* **Quiver tree**	Two Quiver trees were observed within the footprint	Refer to Table 5

4.6.2. NEM:BA protected plant species

The National Environmental Management: Biodiversity Act, Act 10 of 2004, provides for the protection of species through the "Lists of critically endangered, endangered, vulnerable and protected species" (GN. R. 152 of 23 February 2007).

- **No NEM: BA protected species was observed.**

4.6.3. NFA Protected plant species

The National Forests Act (NFA) of 1998 (Act 84 of 1998) provides for the protection of forests as well as specific tree species (as updated).

- **One species protected in terms of the NFA** was observed (Refer to Table 2 & 4).

Table 4: Plant species protected in terms of the NFA encountered within the study area

NO.	SPECIES NAME	COMMENTS	RECOMMENDATIONS
1.	*Boscia albitrunca* **Sheppard's tree**	Two Sheppard's trees were observed	Refer to Table 5.

4.6.4. NCNCA protected plant species

The Northern Cape Nature Conservation Act 9 of 2009 (NCNCA) came into effect on the 12th of December 2011, and also provides for the sustainable utilization of wild animals, aquatic biota and plants. Schedule 1 and 2 of the act give extensive lists of specially protected and protected fauna and flora species in accordance with this act. NB. Please note that all indigenous plant species are protected in terms of Schedule 3 of this act (e.g. any work within a road reserve).

- The following species are protected in terms of the NCNCA were encountered. Recommendations on impact minimisation also included.

Table 5: Plant species protected in terms of the NCNCA encountered within the study area

NO.	SPECIES NAME	COMMENTS	RECOMMENDATIONS
1.	*Aloe claviflora* **Schedule 2 protected**	Occasionally observed, but should be easy to avoid.	**Search & rescue:** Individuals within footprint to be transplanted to surrounding areas.
2.	*Aloidendron dichotomum* **Schedule 1 protected**	Two individuals observed at the following locations: S28° 46' 27.4" E20° 35' 05.5" S28° 46' 27.5" E20° 35' 18.9"	**Do not disturb:** Plants can be transplanted, but site layout should be adjusted if possible. Otherwise they must be transplanted outside of the footprint and a watering program must be implemented until they have established themselves. A NCNCA permit will be required.
3.	*Boscia albitrunca* **Schedule 2 protected**	Two individuals observed at the following locations: S28° 46' 43.7" E20° 35' 06.1" S28° 46' 31.8" E20° 35' 14.9"	**Do not disturb:** Plants transplant poorly. Development should avoid coming nearer than 1 m of the canopy cover (or drip line) of any of these trees. If they have to be removed, a NFA permit will be required as well as a NCNCA permit.
4.	*Boscia foetida* **Schedule 2 protected**	Occasionally observed within the footprint. However, they were mostly stumped or small species or associated with water courses.	**Search & rescue:** Individuals within footprint to be transplanted to surrounding area and a buffer zone to be established next to significant water courses (which will ensure the protection of the majority of these plants).
5.	*Cynanchum viminale* **Schedule 2 protected**	Occasionally observed within the footprint.	Larger *Cynanchum* plants are expected to transplant poorly. Species protection through topsoil conservation.
6.	*Euphorbia gariepina* **Schedule 2 protected**	All species in the genus *Euphorbia* protected by default. Locally common.	Larger *Euphorbia* transplant poorly. Species protection through topsoil conservation.
7.	*Euphorbia rhombifolia* **Schedule 2 protected**	Occasionally observed. All species in the genus *Euphorbia* protected by default.	**Search & rescue:** Individuals within footprint to be transplanted to surrounding area.
8.	*Galenia africana* **Schedule 2 protected**	This plant is weedy a disturbance indicator and commonly found in Erf 1654.	No special measures needed, this is a weedy pioneer species.
9.	*Mesembryanthemum coriarium* **Schedule 2 protected**	This plant is a weedy disturbance indicator and commonly found throughout.	No special measures needed, this is a weedy pioneer species.
10.	*Tetragonia reduplicata* **Schedule 2 protected**	Only observed in association with water courses.	A buffer zone to be established next to significant water courses (which will ensure the protection of the majority of these plants).

5. IMPACT ASSESSMENT METHOD

The objective of this study was to evaluate the botanical diversity of the property area in order to identify significant environmental features which might have been impacted as a result of the development. The Ecosystem Guidelines for Environmental Assessment (De Villiers *et. al.*, 2005), were used to evaluate the botanical significance of the property with emphasis on:

- Significant ecosystems
  - Threatened or protected ecosystems
  - Special habitats
  - Corridors and or conservancy networks
- Significant species
  - Threatened or endangered species
  - Protected species

5.1. DETERMINING SIGNIFICANCE

Determining impact significance from predictions of the nature of the impact has been a source of debate and will remain a source of debate. The author used a combination of scaling and weighting methods to determine significance based on a simple formula. The formula used is based on the method proposed by Edwards (2011). However, the criteria used were adjusted to suite its use for botanical assessment. In this document significance rating was evaluated using the following criteria (Refer to **Error! Reference source not found.**).

Significance = Conservation Value x (Likelihood + Duration + Extent + Severity) (Edwards 2011)

Table 6: Categories and criteria used for the evaluation of the significance of a potential impact

ASPECT / CRITERIA	LOW (1)	MEDIUM/LOW (2)	MEDIUM (3)	MEDIUM/HIGH (4)	HIGH (5)
CONSERVATION VALUE Refers to the intrinsic value of an attribute or its relative importance towards the conservation of an ecosystem or species or even natural aesthetics. Conservation status is based on habitat function, its vulnerability to loss and fragmentation or its value in terms of the protection of habitat or species	The attribute is transformed, degraded not sensitive (e.g. Least threatened), with unlikely possibility of species loss.	The attribute is in good condition but not sensitive (e.g. Least threatened), with unlikely possibility of species loss.	The attribute is in good condition, considered vulnerable (threatened), or falls within an ecological support area or a critical biodiversity area, but with unlikely possibility of species loss.	The attribute is considered endangered or, falls within an ecological support area or a critical biodiversity area, or provides core habitat for endemic or rare & endangered species.	The attribute is considered critically endangered or is part of a proclaimed provincial or national protected area.
LIKELIHOOD Refers to the probability of the specific impact occurring as a result of the proposed activity	Under normal circumstances it is almost certain that the impact will not occur.	The possibility of the impact occurring is very low, but there is a small likelihood under normal circumstances.	The likelihood of the impact occurring, under normal circumstances is 50/50, it may or it may not occur.	It is very likely that the impact will occur under normal circumstances.	The proposed activity is of such a nature that it is certain that the impact will occur under normal circumstances.
DURATION Refers to the length in time during which the activity is expected to impact on the environment.	Impact is temporary and easily reversible through natural process or with mitigation. Rehabilitation time is expected to be short (1-2 years).	Impact is temporary and reversible through natural process or with mitigation. Rehabilitation time is expected to be relative short (2-5 years).	Impact is medium-term and reversible with mitigation, but will last for some time after construction and may require on-going mitigation. Rehabilitation time is expected to be longer (5-15 years).	Impact is long-term and reversible but only with long term mitigation. It will last for a long time after construction and is likely to require on-going mitigation. Rehabilitation time is expected to be longer (15-50 years).	The impact is expected to be permanent.
EXTENT Refers to the spatial area that is likely to be impacted or over which the impact will have influence, should it occur.	Under normal circumstances the impact will be contained within the construction footprint.	Under normal circumstances the impact might extent outside of the construction site (e.g. within a 2 km radius), but will not affect surrounding properties.	Under normal circumstances the impact might extent outside of the property boundaries and will affect surrounding land owners or –users, but still within the local area (e.g. within a 50 km radius).	Under normal circumstances the impact might extent to the surrounding region (e.g. within a 200 km radius), and will regional land owners or –users.	Under normal circumstances the effects of the impact might extent to a large geographical area (>200 km radius).
SEVERITY Refers to the direct physical or biophysical impact of the activity on the surrounding environment should it occur.	It is expected that the impact will have little or no affect (barely perceptible) on the integrity of the surrounding environment. Rehabilitation not needed or easily achieved.	It is expected that the impact will have a perceptible impact on the surrounding environment, but it will maintain its function, even if slightly modified (overall integrity not compromised). Rehabilitation easily achieved.	It is expected that the impact will have an impact on the surrounding environment, but it will maintain its function, even if moderately modified (overall integrity not compromised). Rehabilitation easily achieved.	It is expected that the impact will have a severe impact on the surrounding environment. Functioning may be severely impaired and may temporarily cease. Rehabilitation will be needed to restore system integrity.	It is expected that the impact will have a very severe to permanent impact on the surrounding environment. Functioning irreversibly impaired. Rehabilitation often impossible or unfeasible due to cost.

5.2. SIGNIFICANCE CATEGORIES

The formal NEMA EIA application process was developed to assess the significance of impacts on the surrounding environment (including socio-economic factors), associated with any specific development proposal in order to allow the competent authority to make informed decisions. Specialist studies must advise the environmental assessment practitioner (EAP) on the significance of impacts in his field of specialty. In order to do this, the specialist must identify all potentially significant environmental impacts, predict the nature of the impact and evaluate the significance of that impact should it occur. Potential significant impacts are evaluated, using the method described above, in order to determine its potential significance. The potential significance is then described in terms of the categories given in Table 7.

Table 7: Categories used to describe significance rating (adjusted from DEAT, 2002)

SIGNIFICANCE	DESCRIPTION
Insignificant or Positive (4-22)	There is no impact or the impact is insignificant in scale or magnitude as a result of low sensitivity to change or low intrinsic value of the site, or the impact may be positive.
Low (23-36)	An impact barely noticeable in scale or magnitude as a result of low sensitivity to change or low intrinsic value of the site, or will be of very short-term or is unlikely to occur. Impact is unlikely to have any real effect and no or little mitigation is required.
Medium Low (37-45)	Impact is of a low order and therefore likely to have little real effect. Mitigation is either easily achieved. Social, cultural and economic activities can continue unchanged, or impacts may have medium to short term effects on the social and/or natural environment within site boundaries.
Medium (46-55)	Impact is real, but not substantial. Mitigation is both feasible and fairly easily possible, but may require modification of the project design or layout. Social, cultural and economic activities of communities may be impacted, but can continue (albeit in a different form). These impacts will usually result in medium to long term effect on the social and/or natural environment, within site boundary.
Medium high (56-63)	Impact is real, substantial and undesirable, but mitigation is feasible. Modification of the project design or layout may be required. Social, cultural and economic activities may be impacted, but can continue (albeit in a different form). These impacts will usually result in medium to long-term effect on the social and/or natural environment, beyond site boundary within local area.
High (64-79)	An impact of high order. Mitigation is difficult, expensive, time-consuming or some combination of these. Social, cultural and economic activities of communities are disrupted and may come to a halt. These impacts will usually result in long-term change to the social and/or natural environment, beyond site boundaries, regional or widespread.
Unacceptable (80-100)	An impact of the highest order possible. There is no possible mitigation that could offset the impact. Social, cultural and economic activities of communities are disrupted to such an extent that these come to a halt. The impact will result in permanent change. Very often these impacts cannot be mitigated and usually result in very severe effects, beyond site boundaries, national or international.

6. DISCUSSING BOTANICAL SENSITIVITY

The aim of impact assessment is to determine the vulnerability of a habitat to a specific impact. In order to do so, the sensitivity of the habitat should be determined by identifying and assessing the most significant environmental aspects of the site against the potential impact(s). For this development the following biodiversity aspects was considered:

- **Location**: The proposed development footprint is located on private property on slightly disturbed natural veld (stock grazing over a long period of time has likely altered the vegetation composition. As with almost all areas in the Northern Cape the site is criss-crossed by the normal ephemeral drainage lines, but some larger water courses were also observed.
- **Activity**: The proposed development is expected to result in a long term impact on approximately 60 ha of slightly disturbed Bushmanland Arid Grassland.
- **Geology & Soils**: The site is located on shallow gravelly soils, with surface rocks and sometimes even small/low rocky outcrops occasionally present. However, these rocky outcrops did not support any specialised vegetation. No other significant features such as true quarts patches or heuweltjies were observed in or near to the larger footprint area (rainfall in this area is too unpredictable to result in true quartz vegetation).
- **Land use and cover**: At present the land seems to be fallow land (not currently used for grazing). The possible impact on socio-economic activities will be localised and will only impact on the owner himself.
- **Vegetation status:** Bushmanland Arid Grassland is not considered a threatened vegetation type, with more than 99% remaining. However only 4% is formally conserved (Augrabies Falls National Park). The vegetation on site conforms to a slightly disturbed version of this vegetation type, with the most significant feature the denser riparian zone associated with the larger water courses (Refer Figure 8).
- **Conservation priority areas:** According to the NCCBA the proposed site will impact on a CBA area, but it is also located within an area that is characterised by intensive farming, with little connectivity remaining to the northern parts of the site. The site will not impact on any recognised centre of endemism.
- **Connectivity**: The proposed activity will have a long term impact on 60 ha of land within a CBA. The vegetation of the larger footprint is still partially connected to the south, west and east. However the northern parts of the footprint are surrounded by existing vineyards to the west, north and east. Connectivity will be impacted but it is already compromised towards the Orange River. Corridors along the most significant water courses would help to retain some connectivity (Figure 8).
- **Watercourses and wetlands**: As with almost all areas in the Northern Cape the site is criss-crossed by the normal ephemeral drainage lines, but some larger water courses were also encountered, that will be important for drainage and erosion prevention. Protection of the most significant water courses and its riparian vegetation will ensure protection of the majority of larger trees, observed on site.
- **Protected or endangered plant species**: A number of NCNCA protected species as well as one NFA protected species and one vulnerable species was observed on the site. The most significant of these are two *Boscia albitrunca* and two *Aloidendron dichotomum* individuals. The Aloidendron can be transplanted, but *Boscia* does not transplant well. Protection of these plants should be the main focus. Recommendations on impact minimisations are given in Table 5.
- **Invasive alien species**: Occasional *Prosopis* and *Casuarina* trees were observed along the pipeline route. Special care must be taken with the *Prosopis* tree removal to prevent re-sprouting.
- **Veld fires**: According to the National Veldfire risk classification (March 2010), Bushmanland Arid Grassland falls within an area with a Low fire risk classification. However, veld fire risk must be considered during construction.

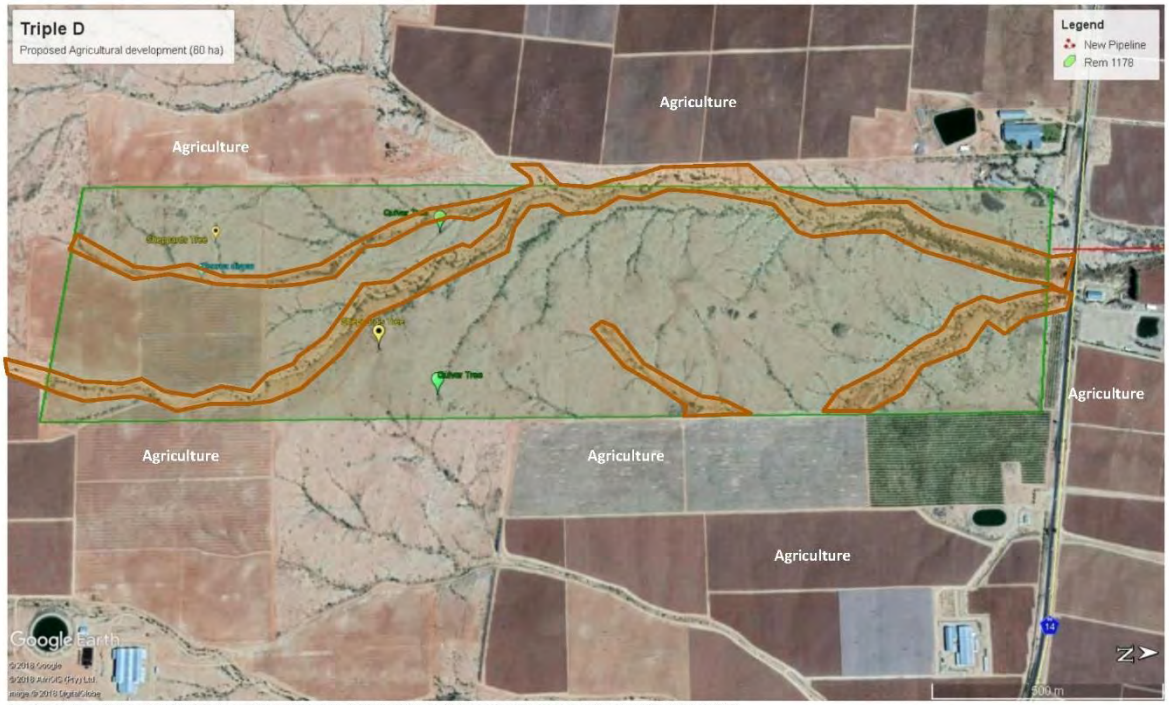

Figure 8: Botanical sensitivity Map based on the more significant water courses and its associated riparian vegetation

6.1. IMPACT ASSESSMENT

The following table rates the significance of environmental impacts associated with the proposed development. It also evaluates the expected accumulative effect of the proposed development as well as the No-Go option.

Table 8: Impact assessment associated with the proposed development

Impact assessment								
Aspect	**Mitigation**	**CV**	**Lik**	**Dur**	**Ext**	**Sev**	**Significance**	Short discussion
Geology & soils: Potential impact on special habitats (e.g. true quartz or "heuweltjies")	Without mitigation	2	1	4	1	1	14	No significant features such as true quarts patches or heuweltjies, supporting specialised vegetation were observed.
	With mitigation	2	1	4	1	1	14	No mitigation proposed.
Landuse and cover: Potential impact on socio-economic activities.	Without mitigation	2	1	4	1	1	14	Impacts on socio-economic activities will be localised, only impact the landowner, but may lead to job creation (potentially positive).
	With mitigation	2	1	4	1	1	14	Potential positive impact.
Vegetation status: Loss of vulnerable or endangered vegetation and associated habitat.	Without mitigation	3	4	4	2	4	42	Permanent impact on 60Ha of slightly disturbed Bushmanland Arid Grassland (Least Threatened) located within a proposed CBA. The most significant feature being the denser riparian vegetation associated with larger water courses.
	With mitigation	3	3	3	1	2	27	Establish ecological corridors next to significant water courses. Protect the 4 protected trees. Apply for permits for other protected species.
Conservation priority: Potential impact on protected areas, CBA's, ESA's or Centre's of Endemism.	Without mitigation	3	4	4	2	4	42	Site overlaps a proposed CBA (proposed future protection area). But does not impact on any centre of endemism.
	With mitigation	3	3	3	1	2	27	Establish ecological corridors next to the most significant water courses.
Connectivity: Potential loss of ecological migration corridors.	Without mitigation	3	4	4	2	4	42	The larger site is still partially connected to the south, west and east, but connectivity in the northern part is already compromised.
	With mitigation	3	3	3	1	2	27	Establish ecological corridors next to the most significant water courses.
Watercourses and wetlands: Potential impact on natural water courses and it's ecological support areas.	Without mitigation	4	4	4	3	4	60	The proposed development will impact on small ephemeral drainage lines and potentially larger water courses with well-established riparian vegetation.
	With mitigation	4	3	3	1	2	36	Establish ecological corridors of at least 3-5m next to the most significant water courses, which will ensure drainage and protect riparian vegetation.
Protected & endangered plant species: Potential impact on threatened or protected plant species.	Without mitigation	3	4	4	3	4	45	A number of protected plants may potentially be impacted, the most significant being the 2 Sheppard and 2 Quiver trees and the riparian vegetation.
	With mitigation	3	2	3	1	2	24	Establish ecological corridors next to significant water courses. Protect the 4 protected trees. Apply for permits for other protected species.

Impact assessment								
Aspect	**Mitigation**	**CV**	**Lik**	**Dur**	**Ext**	**Sev**	**Significance**	Short discussion
Invasive alien plant species: Potential invasive plant infestation as a result of the activities.	Without mitigation	3	2	3	2	4	33	Single Prosopis trees were observed.
	With mitigation	3	1	1	1	1	12	Special care must be taken during their removal (in order to avoid re-sprouting).
Veld fire risk: Potential risk of veld fires as a result of the activities.	Without mitigation	3	2	2	2	2	24	Veld fire risk very low
	With mitigation	3	1	1	1	1	12	Address fire danger throughout construction.
Cumulative impacts: Cumulative impact associated with proposed activity.	Without mitigation	4	4	4	3	4	60	The most significant impacts are associated with protected tree species, the potential impact on riparian vegetation and the potential impact on a CBA.
	With mitigation	4	3	3	2	2	40	Establish ecological corridors next to significant water courses. Protect the 4 protected trees. Apply for permits for other protected species.
The "No-Go" option: Potential impact associated with the No-Go alternative.	Without mitigation	3	2	2	2	2	24	No impact on the CBA or mature indigenous tree species, but also no social economic gain.
	With mitigation						0	The No-Go option will not significantly add to conservation targets, but will avoid impact on a number of small ephemeral streams and protected plant species.

According Table 8, the main impacts associated with the proposed development will be on:

- Watercourses with its associated riparian zone;
- Protected plant species, one of which is vulnerable (Aloidendron dichotomum); while
- the fact that the development site falls within a CBA contribute to significance of vegetation status, conservation priority and connectivity.

Without mitigation the cumulative impact is expected to be Medium?/High, which should be unacceptable, especially since the impact can easily be reduced to Medium/Low through the implementation of mitigation measures (as explained under recommendations).

7. IMPACT MINIMISATION RECOMMENDATIONS

The proposed development will result in the transformation of approximately 60 ha of natural vegetation (Least Threatened) within a proposed CBA area. It will also potentially impact on a number of significant water courses and its associated riparian vegetation, as well as 2 *Boscia albitrunca* (Protected in terms of the NFA) and 2 *Aloidendron dichotomum* trees (a red listed plant, and protected in terms of the NCNCA). In addition it is also likely to impact on a number of other NCNCA plant species (Refer to Table 5).

According to the impact assessment given in Table 8 the development could have a medium/high impact on the environment, but with mitigation it can be reduced significantly to medium/low. **It is thus very important that the mitigation actions described below are implemented.**

With the correct mitigation it is likely that the development will then not contribute significantly to any of the following:

- Significant loss of vegetation type and associated habitat.
- Loss of ecological processes (e.g. migration patterns, pollinators, river function etc.) due to construction and operational activities.
- Loss of local biodiversity and threatened plant species.
- Loss of ecosystem connectivity.

7.1. MITIGATION ACTIONS

The following mitigation actions should be implemented to ensure that the proposed development does not pose a significant threat to the environment:

- All construction must be done in accordance with an approved construction and operational phase Environmental Management Plan (EMP), which must include the recommendations made in this report.
- A suitably qualified Environmental Control Officer must be appointed to monitor the construction phase in terms of the EMP and any other conditions pertaining to specialist studies.
- The proposed 60 ha development must be located within the >100 ha area that was investigated in such a way that the impact on the more significant water courses (and its associated riparian vegetation) as depicted in Figure 8, and the 4 protected trees (Sheppard- and Quiver trees) are minimised.
- It is recommended that a **minimum buffer of at least 3 – 5 m is established next to these water courses** (Refer to Figure 8), measured from the edge of the water course (not the centre of the water course) in order to protect the existing riparian vegetation. Access road may not intrude into these buffer zones. In other words the access road may not form the buffer zone, but must be placed away from the water course and outside of this buffer zone.
- Ideally the development should be placed to minimise the impact on these water courses, while at the same time leaving a north-south migration corridor (for instance a 30m corridor associated with the main western water course).
- The two ***Boscia albitrunca* trees** (Refer to Figure 8) should be protected, in location, if at all possible. Since these trees transplant poorly, search & rescue is not considered a viable option. If they have to be removed, permits must be obtained in terms of the National Forest Act (NFA) and the Northern Cape Nature Conservation Act (NCNCA).
- The two ***Aloidendron dichotomum* trees** (Refer to Figure 8) should be protected, in location, if at all possible (First prize). However, these trees can be transplanted and search and rescue may be an option. However, if they are moved, a permit for their re-location must be obtained in terms of the NCNCA and they must be transplanted back within the immediate surroundings. The transplantation must be overseen by a botanist or suitably qualified person and a watering program must be implemented to support these trees until they have re-established themselves.

- The **Search & Rescue recommendations given in Table 5** must be implemented with regards to other protected species encountered and a DENC flora permit must be obtained in terms of the NCNCA.
- Future farm roads must be approved by the ECO and may not impact on the buffer zones next to the streams as proposed in Figure 8.
- **Before any work is done** the 60 ha development footprint, future roads and access routes must be clearly demarcated (to ensure the above mitigation measures are correctly interpreted) and approved by the ECO. The demarcation must include the total footprint necessary to execute the work, but must aim at minimum disturbance.
- Lay-down areas or construction sites must be located within already disturbed areas or areas of low ecological value and must be pre-approved by the ECO.
- Indiscriminate clearing of any area outside of the construction footprint must be avoided.
- All areas impacted as a result of construction must be rehabilitated on completion of the project.
  - This includes the removal of all excavated material, spoil and rocks, all construction related material and all waste material.
  - It also included replacing the topsoil back on top of the excavation as well as shaping the area to represent the original shape of the environment.
- An integrated waste management approach must be implemented during construction.
  - Construction related general and hazardous waste may only be disposed of at Municipal approved waste disposal sites.
  - All rubble and rubbish should be collected and removed from the site to a suitable registered waste disposal site.
- The pipeline route must be adjusted to minimise the impact on any large indigenous tree that might be encountered along its route and the construction footprint must be minimised as much as possible.

8. REFERENCES

Acocks, J.P.H. 1953. Veld types of South Africa. *Mem. Bot. Surv. .S. Afr.* No. 28: 1-192.

Agrimotion. 2017. Ontwikkelingsverslag – Triple De Farms. Tafeldruif ontwikkeling. Unpublished report dated, September 2017.

Anon, 2008. Guideline regarding the determination of bioregions and the preparation and publication of Bioregional Plans. April 2008. Government Notice No. 291 of 16 March 2009.

De Villiers C.C., Driver, A., Brownlie, S., Clark, B., Day, E.G., Euston-Brown, D.I.W., Helme, N.A., Holmes, P.M., Job, N. & Rebelo, A.B. 2005. Fynbos Forum Ecosystem Guidelines for Environmental Assessment in the Western Cape. Fynbos Forum, c/o Botanical Society of South Africa: Conservation Unit, Kirstenbosch, Cape Town.

DEAT, 2002. Impact significance. Integrated Environmental Management, Information series 5. Department of Environmental Affairs and Tourism (DEAT). Pretoria.

Driver A., Sink, K.J., Nel, J.N., Holness, S., Van Niekerk, L., Daniels, F., Jonas, Z., Majiedt, P.A., Harris, L. & Maze, K. 2012. National Biodiversity Assessment 2011: An assessment of South Africa's biodiversity and ecosystems. Synthesis Report. South African National Biodiversity Institute and Department of Environmental Affairs, Pretoria

Driver, A., Maze, K., Rouget, M., Lombard, A.T., Nel, J.L., Turpie, J.K., Cowling, R.M., Desmet, P., Goodman, P., Harris, J., Jonas, Z., Reyers, B., Sink, K. & Strauss, T. 2005. National spatial biodiversity assessment 2004: priorities for biodiversity conservation in South Africa. Strelitzia, 17. South African National Biodiversity Institute, Pretoria.

Edwards, R. 2011. Environmental impact assessment method. Unpublished report for SiVest (Pty) Ltd. Environmental division. 9 May 2011.

Holness, S. & Oosthuysen, E. 2016. Critical Biodiversity Areas of the Northern Cape: Technical Report. Available from the Biodiversity GIS website at http://bgis.sanbi.org/project.asp

Le Roux, A. 2015. Wild flowers of Namaqualand. A botanical society guide. Fourth revised edition. Struik Nature. Cape Town.

Low, A.B. & Rebelo, A.(T.)G. (eds.) 1996. *Vegetation of South Africa, Lesotho and Swaziland.* Department of Environmental Affairs and Tourism, Pretoria.

Manning, J. 2008. Namaqualand Eco Guide. Briza Publications. Pretoria

Mucina, L. & Rutherford, M.C. (eds.) 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria.

NDBSP. 2008. Namakwa District Biodiversity Sector Plan. A report compiled for the Namaqualand District Municipality in order to ensure that biodiversity information can be accessed and utilized by local municipalities within the Namakwa District Municipality (NDM) to inform land use planning and development as well as decision making processes within the NDM.

Rouget, M., Reyers, B., Jonas, Z., Desmet, P., Driver, A., Maze, K., Egoh, B. & Cowling, R.M. 2004. South Africa National Spatial Biodiversity Assessment 2004: Technical report. Volume 1: Terrestrial Component. Pretoria: South African National Biodiversity Institute.

South African National Biodiversity Institute. 2006. South African National Botanical Institute: Biodiversity GIS Home. http://bgis.sanbi.org (as updated).

South African National Biodiversity Institute. 2015. Statistics: Red List of South African Plants version (as updated). Downloaded from Redlist.sanbi.org on 2017/06/15.

South African National Biodiversity Institute. 2012. Vegetation map of South Africa, Lesotho and Swaziland [vector geospatial dataset] 2012.

Van Wyk, A.E., & Smith, G.F. 2001. Regions of floristic endemism in South Africa. A review with emphasis on succulents. Umdaus press. Hatfield.

APPENDIX 1: COLLAGE OF SITE PHOTOGRAPHS

Photo 13: A general view of the vegetation encountered at the southern part of the site (looking from north to south)

Photo 14: Typical vegetation associated with the more significant water courses (note the larger indigenous trees)

Photo 15: Riparian vegetation associated with smaller drainage lines (looking from north to south)

Photo 16: One of two the *Boscia albitrunca* trees encountered on site

Photo 17: *Ozoroa dispar* encountered (protected during the previous development)

Photo 18: A typical view of the north-eastern corner of the larger footprint (looking from east to west)

Photo 19: Typical vegetation encountered towards the middle of the site (looking from north to south)

Photo 20: Rocky outcrops encountered in the north-eastern corner of the larger footprint.

Photo 21: A view over the lower parts (northern parts) of the site, looking from north to south.

Photo 22: One of the significant water courses towards the lower (northern) part of the larger footprint.

APPENDIX H5: HERITAGE IMPACT ASSESSMENT

UBIQUE
HERITAGE CONSULTANTS

PHASE 1 HIA REPORT PLOT 1178 KAKAMAS SOUTH NORTHERN CAPE

PROPOSED AGRICULTURAL DEVELOPMENT (TRIPLE D FARMS), PLOT 1178, KAKAMAS SOUTH SETTLEMENT, KAI !GARIB MUNICIPALITY, MGCAWU DISTRICT MUNICIPALTY, NORTHERN CAPE.

PREPARED FOR:
ENVIROAFRICA

PREPARED BY:
JAN ENGELBRECHT & HEIDI FIVAZ
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27 SEPTEMBER 2018

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For this project, Mr Engelbrecht was responsible for the field survey of the development footprint, identification of heritage resources, and recommendations. Ms Fivaz was responsible for research and report compilation.

Declaration of independence:

We, Jan Engelbrecht and Heidi Fivaz, partners of UBIQUE Heritage Consultants, hereby confirm our independence as heritage specialists and declare that:

- we are suitably qualified and accredited to act as independent specialists in this application;
- we do not have any vested interests (either business, financial, personal or other) in the proposed development project other than remuneration for the heritage assessment and heritage management services performed;
- the work was conducted in an objective and ethical manner, in accordance with a professional code of conduct and within the framework of South African heritage legislation.

Signed: Date: 2018-09-27
J.A.C. Engelbrecht & H. Fivaz
UBIQUE Heritage Consultants

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EXECUTIVE SUMMARY

Technical summary

Project description	
Project name	PROPOSED AGRICULTURAL DEVELOPMENT (TRIPLE D FARMS), PLOT 1178, KAKAMAS SOUTH SETTLEMENT, NORTHERN CAPE
Description	Agricultural and irrigation infrastructure development Kakamas, Northern Cape
Developer	
Triple D Farms (Pty) Ltd	
Consultants	
Environmental	EnviroAfrica cc.
Heritage and archaeological	UBIQUE Heritage Consultants
Paleontological	Banzai Environmental
Property details	
Province	Northern Cape
District municipality	Z.F. McCawu District Municipality
Local municipality	Kai !Garib Local Municipality
Topo-cadastral map	2820DC
Farm name	Plot 1178
Closest town	Kakamas
GPS Co-ordinates	28° 45' 50.08" S, 20° 35' 39.35" E. (site access)
Development footprint size	60 ha

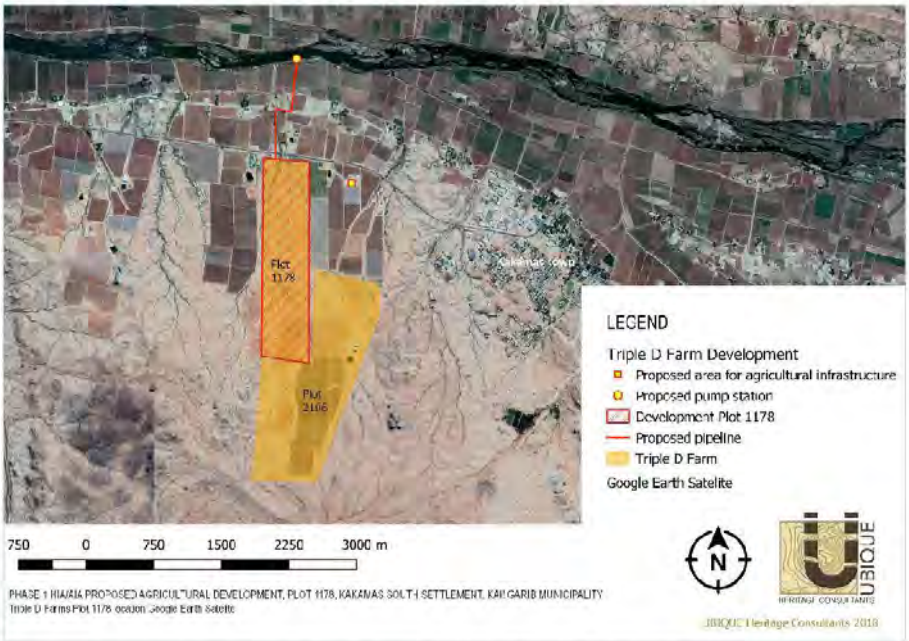

Figure 1 *Proposed agricultural development Triple D Farms (Pty) Ltd on Plot 1178, Kakamas South.*

Project description

UBIQUE Heritage Consultants were appointed by EnviroAfrica cc. as independent heritage specialists in accordance with Section 38 of the NHRA, to conduct a cultural heritage assessment to determine the impact of the proposed agricultural development on Plot 1178 Kakamas South, on any sites, features, or objects of cultural heritage significance. The site is located south of the N14, approximately 2.4 km West of Kakamas South Settlement in the Kai !Garib Local Municipality, Northern Cape. The proposed project will entail the utilisation of approximately 60 ha of land for the development of vineyards for table grape and raisin production by Triple D Farms (Pty) Ltd. The development will also include fixed infrastructure such as: a new pump station on the bank of the Orange River, pipelines, off-stream storage dam (reservoir), filtering system, fuel-depot and generator, a packing shed and labour housing. The proposed pump station and pipelines to the development area will be located within registered servitudes on Lot 387, 1248 and 2106 Kakamas South Settlement. Co-ordinates to Plot 1178 are 28° 45' 50.08" S, 20° 35' 39.35" E, and for the proposed pump station are 28° 45' 07.89" S, 20° 35' 15.73" E.

Findings and Impact on Heritage Resources

Description	Period	Location	Field rating/ Significance
Stone Age			
1. Two possible retouched flakes. Two lithics in 0.5 m² area, found in dry riverine. (Figure 9(a),9(b))	LSA/MSA	**28° 46' 02.4" S 20° 35' 12.4" E**	Field Rating IV C Low significance
2. Banded ironstone core. One lithic in 0.5 m² area, found in dry riverine. (Figure 9(c))	LSA/MSA	**28° 45' 59.7" S 20° 35' 15.4" E**	Field Rating IV C Low significance
3. Possible retouched flake. One lithic in 0.5 m² area, found in dry riverine close to northern border of study area. (Figure 9(d))	LSA/MSA	**28° 45' 47.4" S 20° 35' 13.0" E**	Field Rating IV C Low significance
4. Lithics with scraper. Three lithics in 0.5 m² area, found in dry riverine close to dolerite outcrop. (Figure 9(e))	LSA/MSA	**28° 45' 58.9" S 20° 35' 15.1" E**	Field Rating IV C Low significance
5. Flake. One lithic in 0.5 m² area, found in dry riverine. (Figure 9(f))	LSA/MSA	**28° 46' 00.5" S 20° 35' 14.1" E**	Field Rating IV C Low significance
6. Possible banded ironstone concave side scraper. One lithic in 0.5 m² area, found in dry riverine. (Figure 9(g))	LSA/MSA	**28° 46' 00.9" S 20° 35' 14.7" E**	Field Rating IV C Low significance
7. Collection of lithics collected in an area of approximately 100 m² area in close proximity to dolerite outcrop. (Figure 9(h))	LSA/MSA	**28° 45' 58.7" S 20° 35' 14.8" E**	Field Rating IV C Low significance

8. Possible retouched banded ironstone flake. One lithic in 0.5 m² area in close proximity to dolerite outcrop. (Figure 9(i))	LSA/MSA	**28° 45' 58.1" S 20° 35' 14.7" E**	Field Rating IV C Low significance
Historical			
9. No historical features were identified.			N/A
Graves			
10. No formal or informal graves were identified.			N/A

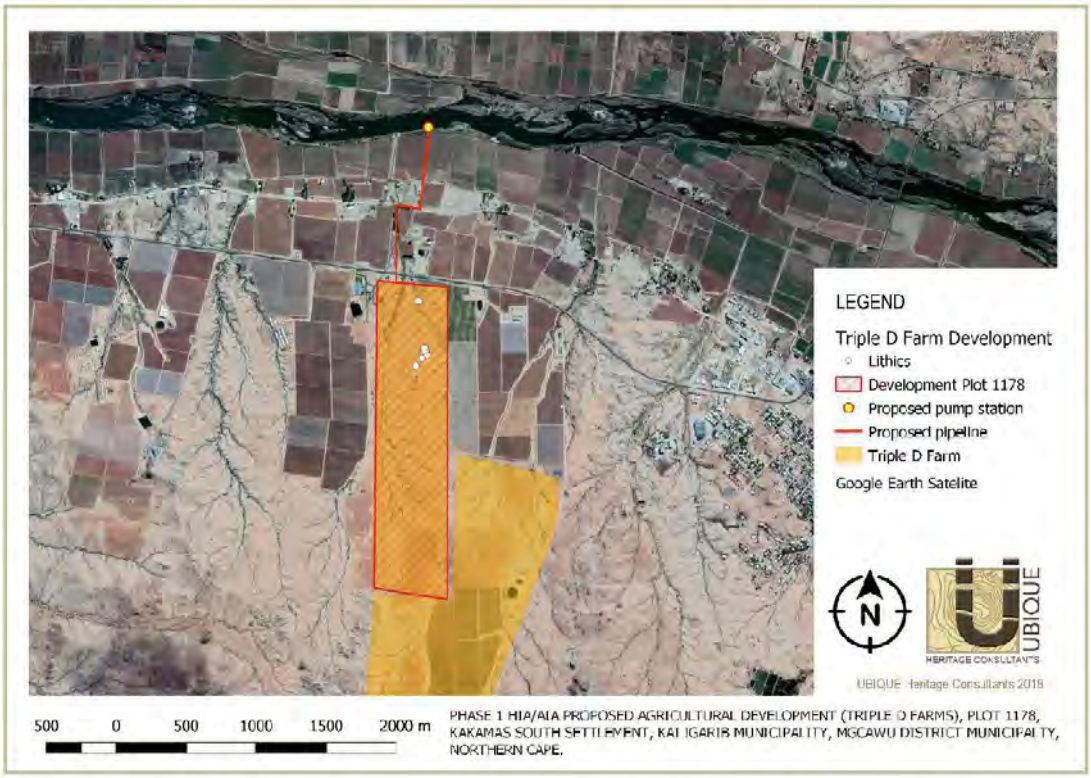

Figure 2 *Isolated occurrences of lithics across the study area, indicated on Google Earth Satellite image.*

Recommendations

Based on the assessment of the potential impact of the development on the identified heritage, the following recommendations are made, taking into consideration any existing or potential sustainable social and economic benefits:

1. The lithic traces on the landscape of the study area are of low significance and the impact of the development on these resources are inconsequential. No further

mitigation is required. Therefore, from a heritage point of view we recommend that the proposed development can continue.

2. Due to the low palaeontological significance of the area, no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required pending the discovery of newly discovered fossils. It is considered that the development of the proposed development is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area. If fossil remains are discovered during any phase of construction, either on the surface or unearthed by fresh excavations, the ECO in charge of these developments ought to be alerted immediately. These discoveries ought to be protected (preferably in situ) and the ECO must report to SAHRA so that appropriate mitigation (e.g. recording, collection) can be carry out by a professional palaeontologist (Butler 2018).

3. Although all possible care has been taken to identify sites of cultural importance during the investigation of study areas, it is always possible that hidden or sub-surface sites could be overlooked during the assessment. If during construction, any possible discovery of finds such as stone tool scatters, artefacts, human remains, or fossils are made, the operations must be stopped, and a qualified archaeologist must be contacted for an assessment of the find. UBIQUE Heritage Consultants and its personnel will not be held liable for such oversights or for costs incurred as a result of such oversights.

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ABBREVIATIONS

AIA:	Archaeological Impact Assessment
ASAPA:	Association of South African Professional Archaeologists
BIA:	Basic Impact Assessment
CRM:	Cultural Resource Management
ECO:	Environmental Control Officer
EIA:	Environmental Impact Assessment*
EIA:	Early Iron Age*

EMP:	Environmental Management Plan
ESA:	Earlier Stone Age
GPS:	Global Positioning System
HIA:	Heritage Impact Assessment
LIA:	Late Iron Age
LSA:	Later Stone Age
MEC:	Member of the Executive Council
MIA:	Middle Iron Age
MPRDA:	Mineral and Petroleum Resources Development Act
MSA:	Middle Stone Age
NEMA:	National Environmental Management Act
NHRA:	National Heritage Resources Act
OWC:	Orange River Wine Cellars
PRHA:	Provincial Heritage Resource Agency
SADC:	Southern African Development Community
SAHRA:	South African Heritage Resources Agency

**Although EIA refers to both Environmental Impact Assessment and the Early Iron Age both are internationally accepted abbreviations it must be read and interpreted in the context it is used.*

GLOSSARY

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

- rock art, being any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and is older than 100 years (as defined and protected by the National Heritage Resources Act (NHRA) (Act No. 25 of 1999) including any area within 10 m of such representation;
- wrecks, being any vessel or aircraft, or any part thereof, which were wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the culture zone of the Republic, as defined respectively in sections 3, 4 and 6 of the Maritime Zones Act, 1994 (Act No. 15 of 1994), and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation;
- features, structures and artefacts associated with military history, which are older than 75 years and the sites on which they are found.

Stone Age: The first and longest part of human history is the Stone Age, which began with the appearance of early humans between 3-2 million years ago. Stone Age people were hunters, gatherers and scavengers who did not live in permanently settled communities. Their stone tools preserve well and are found in most places in South Africa and elsewhere.

Earlier Stone Age:	>2 000 000 - >200 000 years ago
Middle Stone Age:	<300 000 - >20 000 years ago
Later Stone Age:	<40 000 - until the historical period

Iron Age:	(Early Farming Communities). Period covering the last 1800 years, when immigrant African farmer groups brought a new way of life to southern Africa. They established settled villages, cultivated domestic crops such as sorghum, millet and beans, and herded cattle as well as sheep and goats. As they produced their own iron tools, archaeologists call this the Iron Age. Early Iron Age: AD 200 - AD 900 Middle Iron Age: AD 900 - AD 1300 Later Iron Age: AD 1300 - AD 1850
Historic:	Period of arrival of white settlers and colonial contact. AD 1500 to 1950
Historic building:	Structures 60 years and older.
Fossil:	Mineralised bones of animals, shellfish, plants and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.
Heritage:	That which is inherited and forms part of the National Estate (historical places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999).
Heritage resources:	These mean any place or object of cultural significance, tangible or intangible.
Holocene:	The most recent geological period that commenced 10 000 years ago.
Palaeontology:	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 that contains such fossilised remains or traces
Cumulative impacts:	"Cumulative Impact", in relation to an activity, means the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity that may not be significant, but may become significant when added to existing and reasonably foreseeable impacts eventuating from similar or diverse activities.
Mitigation:	Anticipating and preventing negative impacts and risks, then to minimise them, rehabilitate or repair impacts to the extent feasible.
A 'place':	a site, area or region; – a building or other structure which may include equipment, furniture, fittings and articles associated with or connected with such building or other structure; – a group of buildings or other structures which may include equipment, furniture, fittings and articles associated with or connected with such group of buildings or other structures; an open space, including a public square, street or park; and – in relation to the management of a place, includes the immediate surroundings of a place.

'Public monuments and memorials': mean all monuments and memorials–

- erected on land belonging to any branch of central, provincial or local government, or on land belonging to any organisation funded by or established in terms of the legislation of such a branch of government; or
- which were paid for by public subscription, government funds, or a public-spirited or military organisation, and are on land belonging to any private individual;

'Structures': any building, works, device or other facility made by people and which are fixed to land, and include any fixtures, fittings and equipment associated therewith.

1. INTRODUCTION

1.1 Scope of study

The project involves the proposed agricultural development of vineyards and infrastructure on Plot 1178 near Kakamas South Settlement, in the Kai !Garib Local Municipality, Northern Cape. UBIQUE Heritage Consultants were appointed by EnviroAfrica cc as independent heritage specialists in accordance with the National Environmental Management Act 107 of 1998 (NEMA), and in compliance with Section 38 of the National Heritage Resources Act 25 of 1999 (NHRA), to conduct a cultural heritage assessment (AIA/HIA) of the development area.

The aim of the assessment is to identify and report any heritage resources that may fall within the development footprint; to determine the impact of the proposed development on any sites, features, or objects of cultural heritage significance; to assess the significance of any identified resources; and to assist the developer in managing the documented heritage resources in an accountable manner, within the framework provided by the National Heritage Resources Act (Act 25 of 1999) (NHRA).

South Africa's heritage resources are both rich and widely diverse, encompassing sites from all periods of human history. Resources may be tangible, such as buildings and archaeological artefacts, or intangible, such as landscapes and living heritage. Their significance is based upon their aesthetic, architectural, historical, scientific, social, spiritual, linguistic, economic or technological values; their representation of a time or group; their rarity; and their sphere of influence.

The integrity and significance of heritage resources can be jeopardized by natural (e.g. erosion) and human (e.g. development) activities. In the case of human activities, a range of legislation exists to ensure the timeous and accurate identification and effective management of heritage resources for present and future generations.

The result of this investigation is presented within this heritage impact assessment report. It comprises the recording of heritage resources present/ absent and offers recommendations for the management of these resources within the context of the proposed development.

Depending on SAHRA's acceptance of this report, the developer will receive permission to proceed with the proposed development, taking in account any proposed mitigation measures.

1.2 Assumptions and limitations

It is assumed that the description of the proposed project, as provided by the client, is accurate. Furthermore, it is assumed that the public consultation process undertaken as part of the Environmental Impact Assessment (EIA) is comprehensive and does not have to be repeated as part of the heritage impact assessment.

The significance of the sites, structures and artefacts is determined by means of their historical, social, aesthetic, technological and scientific value in relation to their uniqueness, condition of preservation and research potential. The various aspects are not mutually exclusive, and the evaluation of any site is done with reference to any number of these aspects. Cultural significance is site-specific and relates to the content and context of the site.

Although all possible care has been taken during the comprehensive field survey and intensive desktop study to identify sites of cultural importance within the development areas, it is important to note that some heritage sites may have been missed due to their subterranean nature, or due to dense vegetation cover. No subsurface investigation (i.e. excavations or sampling) were undertaken, since a permit from SAHRA is required for such activities. Therefore, should any heritage features and/or objects such as architectural features, stone tool scatters, artefacts, human remains, or fossils be uncovered or observed during construction, operations must be stopped, and a qualified archaeologist contacted for an assessment of the find. Observed or located heritage features and/or objects may not be disturbed or removed in any way until such time that the heritage specialist has been able to make an assessment as to the significance of the site (or material) in question.

2. TERMS OF REFERENCE

An HIA/ AIA must address the following key aspects:

- the identification and mapping of all heritage resources in the area affected;
- an assessment of the significance of such resources in terms of heritage assessment criteria set out in regulations;
- an assessment of the impact of the development on heritage resources;
- an evaluation of the impact of the development on heritage resources relative to the sustainable social and economic benefits to be derived from the development;
- if heritage resources will be adversely affected by the proposed development, the consideration of alternatives; and
- plans for mitigation of any adverse effects during and after completion of the proposed development.

In addition, the HIA/AIA should comply with the requirements of NEMA, including providing the assumptions and limitations associated with the study; the details, qualifications and expertise of the person who prepared the report; and a statement of competency.

2.1. Statutory Requirements

2.1.1 General

The Constitution of the Republic of South Africa Act 108 of 1996 is the source of all legislation. Within the Constitution the Bill of Rights is fundamental, with the principle that the environment should be protected for present and future generations by preventing pollution, promoting conservation and practising ecologically sustainable development. With regard to spatial planning and related legislation at national and provincial levels the following legislation may be relevant:

- Physical Planning Act 125 of 1991
- Municipal Structures Act 117 of 1998
- Municipal Systems Act 32 of 2000
- Development Facilitation Act 67 of 1995 (DFA)

The identification, evaluation and management of heritage resources in South Africa are required and governed by the following legislation:

- National Environmental Management Act 107 of 1998 (NEMA)
- KwaZulu-Natal Heritage Act 4 of 2008 (KZNHA)
- National Heritage Resources Act 25 of 1999 (NHRA)
- Minerals and Petroleum Resources Development Act 28 of 2002 (MPRDA)

2.1.2 National Heritage Resources Act 25 of 1999

The NHRA established the South African Heritage Resources Agency (SAHRA) together with its Council to fulfil the following functions:

- co-ordinate and promote the management of heritage resources at national level;
- set norms and maintain essential national standards for the management of heritage resources in the Republic and to protect heritage resources of national significance;
- control the export of nationally significant heritage objects and the import into the Republic of cultural property illegally exported from foreign countries;
- enable the provinces to establish heritage authorities which must adopt powers to protect and manage certain categories of heritage resources; and
- provide for the protection and management of conservation-worthy places and areas by local authorities.

2.1.3 Heritage Impact Assessments/Archaeological Impact Assessments

Section 38(1) of the NHRA of 1999 requires **the responsible heritage resources authority to notify the person who intends to undertake a development that fulfils the following criteria to submit an impact assessment report if there is reason to believe that heritage resources will be affected by such development:**

- the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;
- the construction of a bridge or similar structure exceeding 50m in length;
- any development or other activity that will change the character of a site—
    - exceeding 5000m² in extent; or
    - involving three or more existing erven or subdivisions thereof; or
    - involving three or more erven or divisions thereof which have been consolidated within the past five years; or
    - the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority;

- the re-zoning of a site exceeding 10 000m² in extent; or
- any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority.

2.1.4 Definitions of heritage resources

The NHRA defines a heritage resource as any place or object of cultural significance, i.e. of aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance. These include, but are not limited to, the following wide range of places and objects:

- living heritage as defined in the National Heritage Council Act No 11 of 1999 (cultural tradition; oral history; performance; ritual; popular memory; skills and techniques; indigenous knowledge systems; and the holistic approach to nature, society and social relationships);
- Ecofacts (non-artefactual organic or environmental remains that may reveal aspects of past human activity; definition used in KwaZulu-Natal Heritage Act 2008);
- places, buildings, structures and equipment;
- places to which oral traditions are attached or which are associated with living heritage;
- historical settlements and townscapes;
- landscapes and natural features;
- geological sites of scientific or cultural importance;
- archaeological and palaeontological sites;
- graves and burial grounds;
- public monuments and memorials;
- sites of significance relating to the history of slavery in South Africa;
- movable objects, but excluding any object made by a living person; and
- battlefields.

Furthermore, a place or object is to be considered part of the national estate if it has cultural significance or other special value because of—

- its importance in the community, or pattern of South Africa's history;
- its possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage;
- its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage;
- its importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects;
- its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;
- its importance in demonstrating a high degree of creative or technical achievement at a particular period;
- its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons; and
- its strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa.

2.1.5 Management of Graves and Burial Grounds

- **Graves younger than 60 years** are protected in terms of Section 2(1) of the Removal of Graves and Dead Bodies Ordinance 7 of 1925 as well as the Human Tissues Act 65 of 1983.

- **Graves older than 60 years, situated outside a formal cemetery administered by a local Authority are** protected in terms of Section 36 of the NHRA as well as the Human Tissues Act of 1983. Accordingly, such graves are the jurisdiction of SAHRA. The procedure for Consultation Regarding Burial Grounds and Graves (Section 36(5) of NHRA) is applicable to graves older than 60 years that are situated outside a formal cemetery administrated by a local authority. Graves in the category located inside a formal cemetery administrated by a local authority will also require the same authorisation as set out for graves younger than 60 years over and above SAHRA authorisation.

The **protocol for the management of graves older than 60 years situated outside a formal cemetery administered by a local authority** is detailed in Section 36 of the NHRA:

(3) *(a)* No person may, without a permit issued by SAHRA or a provincial heritage resources authority—

(a) destroy, damage, alter, exhume or remove from its original position or otherwise disturb the grave of a victim of conflict, or any burial ground or part thereof which contains such graves;

(b) destroy, damage, alter, exhume, remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority; or

(c) bring onto or use at a burial ground or grave referred to in paragraph *(a)* or *(b)* any excavation equipment, or any equipment which assists in the detection or recovery of metals.

(4) SAHRA or a provincial heritage resources authority may not issue a permit for the destruction or damage of any burial ground or grave referred to in subsection (3)*(a)* unless it is satisfied that the applicant has made satisfactory arrangements for the exhumation and re-interment of the contents of such graves, at the cost of the applicant and in accordance with any regulations made by the responsible heritage resources authority.

(5) SAHRA or a provincial heritage resources authority may not issue a permit for any activity under subsection (3)*(b)* unless it is satisfied that the applicant has, in accordance with regulations made by the responsible heritage resources authority—

(a) made a concerted effort to contact and consult communities and individuals who by tradition have an interest in such grave or burial ground; and

(b) reached agreements with such communities and individuals regarding the future of such grave or burial ground.

(6) Subject to the provision of any other law, any person who in the course of development or any other activity discovers the location of a grave, the existence of which was previously unknown, must immediately cease such activity and report the discovery to the responsible heritage resources authority which must, in co-operation with the South African Police Service and in accordance with regulations of the responsible heritage resources authority—

(a) carry out an investigation for the purpose of obtaining information on whether or not such grave is protected in terms of this Act or is of significance to any community; and

(b) if such grave is protected or is of significance, assist any person who or community which is a direct descendant to make arrangements for the exhumation and re-interment of the contents of such grave or, in the absence of such person or community, make any such arrangements as it deems fit.

3. STUDY APPROACH AND METHODOLOGY

3.1 Desktop study

The first step in the methodology was to conduct a desktop study of the heritage background of the area and the site of the proposed development. This entailed the scoping and scanning of historical texts/records as well as previous heritage studies and research around the study area.

By incorporating data from previous CRM reports done in the area and an archival search, the study area is contextualised. The objective of this is to extract data and information on the area in question, looking at archaeological sites, historical sites and graves of the area.

No archaeological site data was available for the project area. A concise account of the archaeology and history of the broader study area was compiled from sources including those listed in the bibliography.

3.1.1 Literature review

A survey of literature was undertaken to obtain background information regarding the area. Researching the SAHRA APM Report Mapping Project records and the SAHRIS online database (http://www.sahra.org.za/sahris), it was determined that several other archaeological or historical studies have been performed within the wider vicinity of the study area. Sources consulted in this regard are indicated in the bibliography.

3.2 Field study

The Phase 1 (AIA/HIA) requires the completion of a field study to establish and ensure the following:

3.2.1 Systematic survey

A systematic survey of the proposed project area to locate, identify, record, photograph and describe sites of archaeological, historical or cultural interest, was completed.

UBIQUE Heritage Consultants inspected the proposed development and surrounding areas on 22nd and 23rd of August 2018 and completed a controlled-exclusive, pre-planned, pedestrian survey. We conducted an inspection of the surface of the ground, wherever the surface was visible. This was done with no substantial attempt to clear brush, sand, deadfall, leaves or other material that may cover the surface and with no attempt to look beneath the surface beyond the inspection of rodent burrows, cut banks and other exposures fortuitously observed.

The survey was tracked with a handheld Garmin global positioning unit (Garmin eTrex 10).

3.2.2 Recording significant areas

GPS points of identified significant areas were recorded with a handheld Garmin global positioning unit (Garmin eTrex 10). Photographs were taken with a Sony Coolpix 10-megapixel camera. Detailed fieldnotes were taken to describe observations. The layout of the area and plotted by GPS points, tracks and coordinates, were transferred to Google Earth and QGIS, and maps were created.

3.2.3 Determining significance

Levels of significance of the various types of heritage resources observed and recorded in the project area will be determined to the following criteria:

Cultural significance:

- Low	A cultural object being found out of context, not being part of a site or without any related feature/structure in its surroundings.
- Medium	Any site, structure or feature being regarded less important due to several factors, such as date and frequency. Likewise, any important object found out of context.
- High	Any site, structure or feature regarded as important because of its age or uniqueness. Graves are always categorized as of a high importance. Likewise, any important object found within a specific context.

Heritage significance:

- Grade I	Heritage resources with exceptional qualities to the extent that they are of national significance
- Grade II	Heritage resources with qualities giving it provincial or regional importance although it may form part of the national estate
- Grade III	Other heritage resources of local importance and therefore worthy of Conservation

Field ratings:

i.	National Grade I	significance should be managed as part of the national estate
ii.	Provincial Grade II	significance should be managed as part of the provincial estate
iii.	Local Grade IIIA	should be included in the heritage register and not be mitigated (high significance)
iv.	Local Grade IIIB	should be included in the heritage register and may be

		mitigated (high/ medium significance)
v.	General protection A (IV A)	site should be mitigated before destruction (high/ medium significance)
vi.	General protection B (IV B)	site should be recorded before destruction (medium significance)
vii.	General protection C (IV C)	phase 1 is seen as sufficient recording and it may be demolished (low significance)

Heritage value, statement of significance:

a. its importance in the community, or pattern of South Africa's history;

b. its possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage;

c. its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage;

d. its importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects;

e. its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;

f. its importance in demonstrating a high degree of creative or technical achievement at a particular period;

g. its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons;

h. its strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa; and

i. sites of significance relating to the history of slavery in South Africa.

3.3 Oral history

Where possible, people from local communities were interviewed to obtain information relating to the surveyed area.

3.4 Report

The results of the desktop research and field survey are compiled in this report. The identified heritage resources and anticipated and cumulative impacts that the development of the proposed project may have on the identified heritage resources will be presented objectively. Alternatives, should any significant sites be impacted adversely by the proposed project, are offered. All effort

will be made to ensure that all studies, assessments and results comply with the relevant legislation and the code of ethics and guidelines of the Association of South African Professional Archaeologists (ASAPA). The report aims to assist the developer in managing the documented heritage resources in a responsible manner, and to protect, preserve, and develop them within the framework provided by the National Heritage Resources Act of 1999 (Act 25 of 1999).

4. PROJECT OVERVIEW

UBIQUE Heritage Consultants were appointed by EnviroAfrica cc. as independent heritage specialists in accordance with Section 38 of the NHRA and the National Environmental Management Act 107 of 1998 (NEMA), to conduct a cultural heritage assessment to determine the impact of the proposed agricultural development on Plot 1178 Kakamas South, on any sites, features, or objects of cultural heritage significance. The site is located south of the N14, approximately 2.4 km west of Kakamas South Settlement in the Kai !Garib Local Municipality, Northern Cape.

The proposed project will entail the utilisation of approximately 60 ha of land for the development of vineyards for table grape and raisin production by Triple D Farms (Pty) Ltd. The area will be divided into two sections of 30 ha, each section with its own irrigation scheme that will include a pump, filtration system and mainline to the irrigation blocks. A new pump station on the bank of the Orange River, pipelines, and an off-stream storage dam (reservoir) will be built to feed the irrigation system. The development will also include fixed infrastructure such as a fuel-depot and generator, a packing shed and labour housing. The proposed pump station and pipelines to the development area will be located within registered servitudes on Lot 387, 1248 and 2106 Kakamas South Settlement. Co-ordinates to Plot 1178 are 28° 45' 50.08" S, 20° 35' 39.35" E, and for the proposed pump station are 28° 45' 07.89" S, 20° 35' 15.73" E.

4.1 Technical information

Project description	
Project name	PROPOSED AGRICULTURAL DEVELOPMENT (TRIPLE D FARMS), PLOT 1178, KAKAMAS SOUTH SETTLEMENT, NORTHERN CAPE
Description	Agricultural and irrigation infrastructure development Kakamas, Northern Cape
Developer	
Triple D Farms (Pty) Ltd	
Contact information	piet@dddfarms.net www.ddd-farms.com
Development type	Agricultural
Land owner	
Triple D Farms (Pty) Ltd	
Contact information	piet@dddfarms.net www.ddd-farms.com

Consultants	
Environmental	EnviroAfrica cc
Heritage and archaeological	UBIQUE Heritage Consultants
Paleontological	Banzai Environmental
Property details	
Province	Northern Cape
District municipality	Z.F. McCawu District Municipality
Local municipality	Kai !Garib Local Municipality
Topo-cadastral map	2820DC
Farm name	Plot 1178
Closest town	Kakamas South Settlement
GPS Co-ordinates	28° 45' 50.08" S, 20° 35' 39.35" E (site access)
Property size	100 ha
Development footprint size	60 ha
Land use	
Previous	
Current	
Re- zoning required	No
Sub-division of land	No

Development criteria in terms of Section 38(1) NHRA	Yes/No
Construction of a road, wall, power line, pipeline, canal or other linear form of development or barrier exceeding 300m in length.	Yes
Construction of bridge or similar structure exceeding 50m in length.	No
Construction exceeding 5000m ^{2}.	Yes
Development involving three or more existing erven or subdivisions.	Yes
Development involving three or more erven or divisions that have been consolidated within the past five years.	No
Rezoning of site exceeding 10 000m ^{2}.	No
Any other development category, public open space, squares, parks, recreation grounds.	No

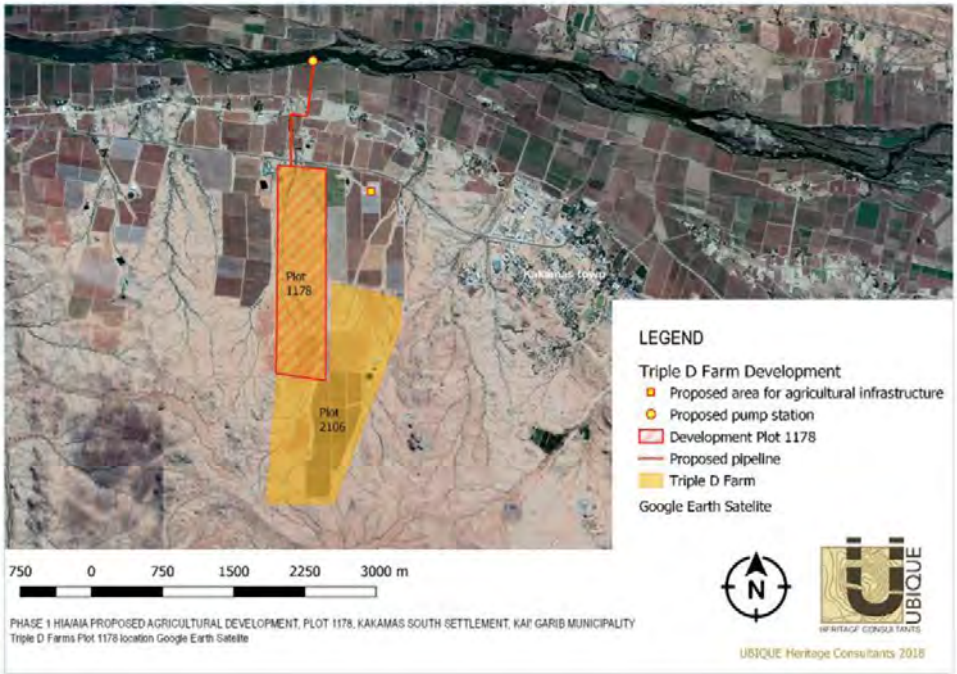

Figure 3 *Proposed agricultural development plot 1178, Kakamas South. Google Earth Satellite.*

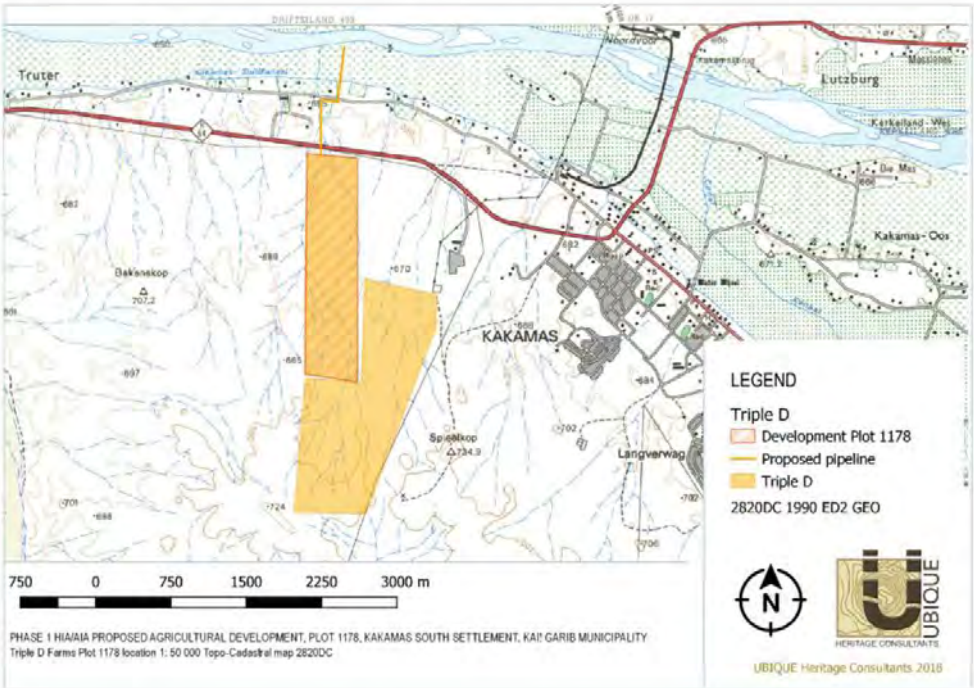

Figure 4 *Proposed agricultural development Plot 1178, Kakamas South.1:50 000 Topo-cadastral map WGS2820DC, Surveyor General.*

4.2 Description of affected environment

The Kai !Garib Local Municipality falls predominantly within the Nama-Karoo biome (Mucina & Rutherford 2006), and the majority of the vegetation type in the study area is typical Kalahari Karroid Shrubland interspersed with Arid Bushmanland Grassland. The landscape is characterised by flat plains with dwarf shrubs (*Salsola* sp.) and white grasses (*Stipagrostis* spp.). Karoo-related elements (shrubs) meet with northern floristic elements, indicating a transition to the Kalahari region and sandy soils (Mucina & Rutherford 2006). Vegetation observed in the study area include Driedoring (*Rhigozum trichotomum*), Swarthaak (*Senegalia mellifera*), Namaqua-bossie (*Searsia undulata*), Melkbos (*Gomphocarpus fruticosus*), Boesmangras (*Stipagrostis* spp.), Wildelusern (*Monechma divaricatum*), Quiver trees (*Aloe dichotoma*), and Lemoendoring (*Parkinsonia Africana*). The area consists of flat open quartzite and Dwyka tillite gravel plains with sandy loam and calcrete soils, and several dolerite outcrops. The site slopes from the south towards the N14 and the Gariep/Orange River in the north. Dry riverine and drainage lines traverse the property, running from south to north towards the Gariep/Orange River.

The town of Kakamas is situated in the midst of an intensive Irrigation Farming Community stretching from Groblershoop in the east up to Blouputs in the west. The Gariep/Orange River, the economic life vain of the community, is characterised by Lower Gariep Alluvial vegetation. Unpredictable flooding events cause high disturbance and soil movement. The river cuts through a great variety of Precambrian metamorphic rocks and is subjected to floods, especially in summer, as a result of high precipitation on the highveld. The soil of these areas is very fertile resulting in various grapes and other crops such as pecan nut- and citrus plantations being planted along the Gariep/Orange River (Mucina & Rutherford 2006). The study area is surrounded by established agricultural developments.

Due to previous developments adjacent to the site, there are several access roads to the site. Roads vary from two-track field paths, to graded roads constructed to provide access for construction vehicles. The N14 forms the northern boundary of Plot 1178. A recently erected Eskom line runs through the site, from east to west. Several disturbed areas are present on site which could be related to development and road construction. There is a soccer field and houses in the north-western corner of the site, close to the N14. The proposed pipeline trajectory from the planned pump station on the Gariep/Orange River shore will run through existing vineyards.

Figure 5 *Views of the affected development area.*

5. HISTORICAL AND ARCHAEOLOGICAL BACKGROUND

5.1 Region

The Northern Cape is rich in archaeological sites and landscapes that reflect the complex South African heritage from the Stone Age to Colonial history.

5.1.1 Stone Age

The Stone Age is the period in human history when lithic material was mainly used to produce tools (Coertze & Coertze 1996). In South Africa the Stone Age can be divided in three periods. It is, however, important to note that dates are relative and only provide a broad framework for interpretation. The division of the Stone Age according to Lombard et al. (2012) is as follows:

Earlier Stone Age:	>2 000 000 - >200 000 years ago
Middle Stone Age:	<300 000 - >20 000 years ago
Later Stone Age:	<40 000 - until the historical period.

Each of the sub-divisions is formed by a group of industries where the assemblages share attributes or common traditions (Lombard et al. 2012). Prominent sites that exemplify these periods in the Nama-Karoo Biome are Rooidam and Bundu Farm (Earlier Stone Age and Middle Stone Age), and Biesje Poort 2, Bokvasmaak 3, Melkboom 1, Vlermuisgat, and Jagtpan 7 (Later Stone Age) (Lombard et al. 2012).

Within the region, Stone Age sites and complexes have been, and are still being investigated in some detail. This includes, but are not limited to, the landscape near Kathu, where numerous Stone Age sites have been documented and excavated, representing the longest preserved lithostratigraphic and archaeological sequence of human occupation at the pan through the ESA, MSA, and LSA and with evidence for 500 000-year-old hafted stone points; ancient specularite working (and mining) on the eastern side of Postmasburg, Doornfontein; and associated Ceramic Later Stone Age material, and also the older transitional ESA/MSA Fauresmith sites at Lyly Feld, Demaneng, Mashwening, King, Rust & Vrede, Paling, Gloucester and Mount Huxley (Beaumont 2004; Beaumont 2013; Beaumont & Morris 1990; Beaumont & Vogel 2006; Morris 2005; Morris & Beaumont 2004; Porat et al. 2010; Thackeray et al. 1983; Walker et al. 2014; Wilkins et al. 2012).

Beaumont et al. (1995) commented that thousands of square kilometres of Bushmanland are covered by low-density lithic scatters. It is therefore not surprising that Stone Age sites and lithic scatters were identified by CRM practitioners between the Garona substation and the Gariep/Orange River in numerous surveys conducted during the recent years. Scatters of MSA material have been recorded close to Griekwastad, Hotazel, Postmasburg and Kenhardt, Pofadder, Marydale, and in the Upington district (Dreyer 2006, 2012, 2014; Pelser & Lombard 2013; PGS Heritage 2009, 2010; Webley 2013). MSA and LSA tools as well as rock engravings were also found at Putsonderwater, Beeshoek and Bruce (Morris 2005; Snyman 2000; Van Vollenhoven 2012b; Van Vollenhoven 2014).

Archaeological surveys have shown rocky outcrops and hills, drainage lines, riverbanks and confluences to be prime localities for archaeological finds and specifically Stone Age sites since these areas where utilized for base camps close to water and hunting ranges. If any such features occur in the study area, Stone Age manifestations can be anticipated (Lombard 2011).

5.1.2 Historical period

The historical period within the region coincides with the incursion of white traders, hunters, explorers, and missionaries into the interior of South Africa. Buildings and structures associated with the early missionaries, travellers, and traders such as PJ Truter's and William Somerville (arriving in 1801), Donovan, Burchell and Campbell, James Read (arriving around 1870) William Sanderson, John Ryan and John Ludwig's (De Jong 2010; Snyman 2000) arrival during the 19th century, and the settlement of the first white farmers and towns, are still evident in the Northern Cape. Numerous heritage reports that provide a synthesis of the incursions of travellers, missionaries and the early European settlers have been captured on the SAHRIS database.

San hunter-gatherer groups utilised the landscape for thousands of years and Khoi herders moved into South Africa with their cattle and sheep approximately 2000 years ago. With the arrival of the Dutch settlers in the Cape in the mid-17th century, clashes between the Europeans and Khoi tribes in the Cape Peninsula resulted in the Goringhaiqua and Goraxouqua migrating north towards the Gariep/Orange River in 1680. These tribes became collectively known as the Korannas, living as small tribal entities in their own separate areas (Penn 2005).

According to Breutz (1953, 1954), and Van Warmelo (1935), several Batswana tribes, including the different Thlaping and Thlaro sections as well as other smaller groups, take their 18th and 19th century roots back to the area around Groblershoop, Olifantshoek, the Langeberg (Majeng) and Korannaberg ranges in the western part of the region. After Britain annexed Bechuanaland in 1885, the land of the indigenous inhabitants was limited to a few reserves. In 1895, when British Bechuanaland was incorporated into the Cape Colony, the land inside the reserves remained the property of the Tswana and could only be alienated with the consent of the British Secretary of State.

Because of its distance from the Cape Colony, this arid part of South Africa's interior was generally not colonised until relatively recent. According to history, the remote northern reaches of the Cape Colony were home to cattle rushers, gun-runners, river pirates and various manner of outlaws. Distribution of land to colonial farmers only occurred from the 1880s onwards when Government-owned land was surveyed, divided into farms, and transferred to farmers. More permanent large-scale settlement however only started in the late 1920s and the first farmsteads were possibly built during this period. The region remained sparsely populated until the advent of the 20th century (De Jong 2010, Penn 2005).

The region has been the backdrop to various incidents of conflict. The arrival of large numbers of Great Trek Boers from the Cape Colony to the borders of Bechuanaland and Griqualand West in 1836 caused conflict with many Tswana groups and the missionaries of the London Mission Society. The conflict between Boer and Tswana communities escalated in the 1860s and 1870s

when the Korana and Griqua communities and the British government became involved. The Northern Cape was very important in the Anglo-Boer War (1899-1902) and major battles took place within 120 km of Kimberley, including the battle of Magersfontein. Boer guerrilla forces roamed the entire Northern Cape region and skirmishes between Boer and Brits were regular occurrences. Furthermore, many graves in the region tell the story of battles fought during the 1914 Rebellion (Hopkins 1978).

5.2 Local

During 1778, Swedish-born traveller and explorer Hendrik Wikar, reached the middle and lower reaches of the Orange River after a long land journey that started in Cape Town. As a deserter from the service of the Dutch East India Company, Wikar spent several years within the area, and compiled a report of his experiences in exchange for a pardon (Ross 1975). He documented his encounters with Khoisan communities who called themselves the *Einiqua*, or *River People*. The *Einiqua* were divided into three "kraals": the *Namnykoa* near the Augrabies Falls, the *Kaukoa* on islands west of Keimoes, and the *Aukokoa* of Kanoneiland and other islands to the east. Their kraals consisted of considerable amount of sheep and cattle, they collected plants, hunted game, and cultivated dagga but no other crops according to Wikar (Ross 1975). Amongst the pastoralist communities living on the islands were the *Anoe eis* people who Wikar characterised as "Bushmen". They possessed no domesticated stock, subsisted by fishing, game-trapping, hunting and the gathering of plant foods (Morris & Beaumont 1991). Colonel Robert Jacob Gordon who visited the area in 1779, however remarked that they were actually *Einiqua* (i.e. Khoi) who had "lost their cattle as a result of an argument with the *Namneiqua* village (Morris & Beaumont 1991).

The name of the area originates with the *Einiqua* and there are several theories as to the meaning of the word Kakamas:

- *Bad Grazing*: Before canals and irrigation schemes were developed, the area was notorious for its poor grazing pastures.
- *Angry/Charging Cow/Chasing Cows*: This may derive from the Korana word *kagamas*, which could have become associated with the place because the river banks nearby had sloping banks making it an easy crossing place for cattle herds. Most herds were reluctant to enter the river and would apparently turn on their herdsmen.
- *Thakemas*, meaning *drink place*. This would refer to the ease with which livestock could be herded to the area to drink
- *Swimming water*: Possibly the San word, given to the place because it was possible to swim across the river at this point. (De Jong 2010).

Numerous Heritage Impact Assessments have been conducted in the wider Kakamas landscape. These include, but are not limited to, studies involving agricultural developments at Steynmond Boerdery on Kakamas North Farm 339 (Beaumont 2007), and at the Cillie cemetery and township extensions (Dreyer 2013; Van Schalkwyk 2013). De Jong (2010) and Morris (2016; 2017) assessed areas for intended agricultural development to the north and south of the Orange River on Kakamas North and Kakamas South Settlements respectively.

Scatters of stone artefacts around Kakamas have been reported by ACRM (2012), Beaumont (2008), Kaplan (2012; 2013; 2016; 2017), Morris (2011; 2012; 2017), and Van Schalkwyk (2010c; 2011; 2013), to name a few. The lithics documented are predominantly associated with the MSA, with a few localities attributed to the LSA. The incidences of lithics have little to no context and are largely described as of poor preservation and of low significance (Morris 2012). ACRM (2012) noted that 95% of the tools documented are made from locally available, fine-grained banded ironstone, which is a favoured raw material on many sites in the Northern Cape. The remainder are in indurated shale, chert, quartzite and quartz, and hornfels.

To the north west of the study area on agricultural lot 2371 Kakamas South Settlement, Morris (2017b) reports the unexpected occurrence of a rock gong on a rocky granite-gneiss outcrop. Rock gongs (or lithophones) are rocks that ring when struck and are characterised by beating marks that reflect ancient use (Morris 2017b). According to Morris (2017b), the find is significant as it is the first rock gong to be identified from this part of the Northern Cape and on granite-gneiss. Often found in association with rock art, they are a feature of the LSA, with alleged ritual connotations (Morris 2017b).

Another interesting prehistoric find in the greater vicinity is the discovery of two kite-like features 22km north of Keimoes (Van der Walt & Lombard 2018). The large funnel-shaped features of undetermined age were constructed and shaped by organising local dolerite stones, sometimes incorporating in-situ dolerite outcrops/boulders. Kites are widely accepted as being utilised as hunting traps (Holzer *et al.* 2010 in Van der Walt & Lombard 2018). The ethno-historical records documented various kinds of hunting traps used by San hunter-gatherers, but the use of these funnel-shaped stone features by Stone Age herding communities (who also hunted) cannot be conclusively discounted (Van der Walt & Lombard 2018).

Furthermore, Morris (2014; Morris & Beaumont 1991) hypothesizes that the archaeological footprint of substantial herder and short-term hunter-gatherer encampments along the floodplain of the Orange River, have been disrupted and destroyed by intensive farming alongside the river since colonial settlement.

The town of Kakamas grew out of an irrigation scheme that was established in 1898 by the community. The town was laid out in 1931 and attained full municipal status in 1964 (Van Schalkwyk 2013).

The historic irrigation scheme set up by the Dutch Reformed Mission Church community in Kakamas was developed to alleviate the need of farmers left destitute by the severe drought and rinderpest epidemic of 1895-1897. Led by Rev. Schroder, the irrigation scheme included canals dug by hand, beginning at the upper end of Neus Island (Hopkins 1978; Van Vuuren 2011). Four

historic water wheels situated along the *Noordvoor*, or northern furrow on Erven 103, 1057, 268 and 1467 Kakamas South Settlement, have been designated as provincial heritage sites (http://sahra.org.za/sahris/sites). The development of canal systems played an important role in irrigating extensive vineyards and orchards within the region and the development of substantial agricultural initiatives within the area.

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 old transformer in Voortrekker Street has been ear-marked as a museum (Morris 2010; 2017; http://sahra.org.za/sahris/sites).

De Jong (2010) classifies the cultural landscape of Kakamas as predominantly historic farmland. The affected area consists of working (operating) irrigation and grazing farms located in a typical Lower Orange River environment. These farms display heritage features that typically occur in the district, such as their large size, irrigation furrows and pipelines, fences, tracks, farmsteads, and irrigated fields. Farmsteads are clustered close to rivers and main roads (De Jong 2010). According to De Jong (2010) this class of landscape is of relatively low heritage sensitivity because it can absorb adverse effects of new development through some mitigation.

Just outside the town of Kakamas North on Lot 189 is a monument that commemorates First World War German troops killed in a battle against South African Union forces on the 4th of February 1915 on this site. Union troops assembled near Upington to launch an attack on German South West Africa, while the German forces prepared an attack on Kakamas. A heavy battle ensued between two unevenly matched forces at Kakamas that resulted in seven dead, six wounded and sixteen prisoners of war amongst the Germans. The memorial was erected by the '*Volksbund Deutschen Kriegs-graberfflrsorge*' (http://sahra.org.za/sahris/sites/).

5.2.3 Oral history

No interviews with locals were conducted regarding the history of the area.

6. IDENTIFIED RESOURCES AND HERITAGE ASSESSMENT

6.1 Surveyed area

The area surveyed for the impact assessment was dictated by the Google Earth map of the development footprint provided by the client. The pedestrian survey commenced on the southern boundary of the site and was completed at the North-western corner of the site at the N14 national road. Survey was conducted in 30m transects throughout the entire 60ha footprint. The route of the proposed pipeline was followed from its point of origin on the Orange River towards the N14 and on to the site. The pipeline will run through existing vineyards on the northern side of the N14.

Figure 6 *Google Earth image showing survey track for Plot 1178 Kakamas South.*

Figure 7 *Google Earth image showing survey track of proposed pipeline.*

6.2 Identified heritage resources

Description	Period	Location	Field rating/ Significance
Stone Age			
11. Two possible retouched flakes. Two lithics in 0.5 m² area, found in dry riverine. (Figure 9(a),9(b))	LSA/MSA	**28° 46' 02.4" S 20° 35' 12.4" E**	Field Rating IV C Low significance
12. Banded ironstone core. One lithic in 0.5 m² area, found in dry riverine. (Figure 9(c))	LSA/MSA	**28° 45' 59.7" S 20° 35' 15.4" E**	Field Rating IV C Low significance
13. Possible retouched flake. One lithic in 0.5 m² area, found in dry riverine close to northern border of study area. (Figure 9(d))	LSA/MSA	**28° 45' 47.4" S 20° 35' 13.0" E**	Field Rating IV C Low significance
14. Lithics with scraper. Three lithics in 0.5 m² area, found in dry riverine close to dolerite outcrop. (Figure 9(e))	LSA/MSA	**28° 45' 58.9" S 20° 35' 15.1" E**	Field Rating IV C Low significance
15. Flake. One lithic in 0.5 m² area, found in dry riverine. (Figure 9(f))	LSA/MSA	**28° 46' 00.5" S 20° 35' 14.1" E**	Field Rating IV C Low significance
16. Possible banded ironstone concave side scraper. One lithic in 0.5 m² area, found in dry riverine. (Figure 9(g))	LSA/MSA	**28° 46' 00.9" S 20° 35' 14.7" E**	Field Rating IV C Low significance
17. Collection of lithics collected in an area of approximately 100 m² area in close proximity to dolerite outcrop. (Figure 9(h))	LSA/MSA	**28° 45' 58.7" S 20° 35' 14.8" E**	Field Rating IV C Low significance
18. Possible retouched banded ironstone flake. One lithic in 0.5 m² area in close proximity to dolerite outcrop. (Figure 9(i))	LSA/MSA	**28° 45' 58.1" S 20° 35' 14.7" E**	Field Rating IV C Low significance
Historical			
19. No historical features were identified.			N/A
Graves			
20. No formal or informal graves were identified.			N/A

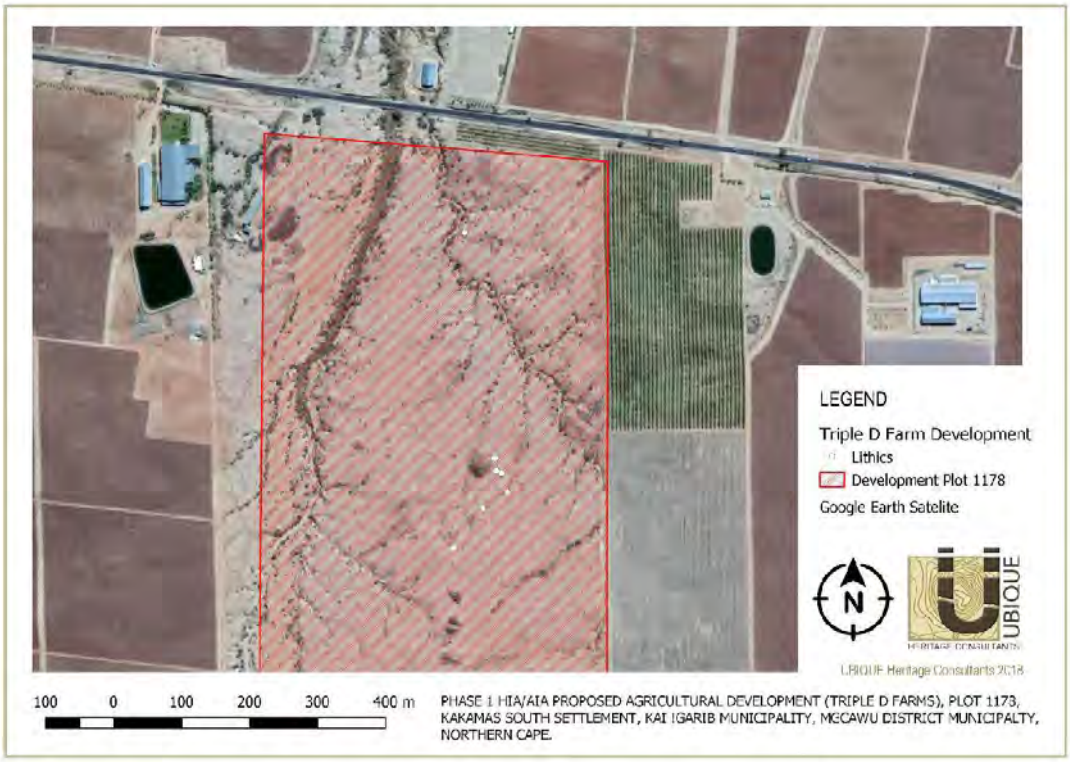

Figure 8 *Distribution of lithic occurrences across study area.*

6.3 Discussion

6.3.1 Archaeological features

A total of eight incidences of Stone Age material were recorded across the surveyed area (Figure 8). All eight locations are within the northern section of the surveyed area, with one isolated occurrence close to the northern boundary. The lithics are scattered ex situ in low densities along dry riverine and drainage lines, and amongst quartzite surface gravel. The cultural material shows various degrees of weathering and may either be representative of the Early Later Stone Age, or a mere mixture of LSA and MSA artefacts (Lombard 2011). The identified archaeological materials are of low significance, as the archaeological sample is small and without context, and therefor of little scientific value.

These Stone Age heritage finds are given a 'General' Protection C (Field Rating IV C). This means these sites have been sufficiently recorded (in the Phase 1). It requires no further action.

9(a)

9(b)

9(c)

9(d)

9(e)

9(f)

9(g)

9(h)

9(i)

Figure 9 *Lithic finds from study area.*

6.3.2 Historical features

No significant historical features were identified within the study area.

6.3.3 Graves

No formal or informal graves were identified in the study area.

6.3.4 Palaeontological resources

The proposed development is entirely underlain by the Riemvasmaak Gneiss of the Namaqua-Natal Province. The Riemvasmaak Gneiss is an igneous rock type and the potential for any fossil materials occurring within this rock unit is zero (Butler 2018; Almond & Pether 2008). Elize Butler from Banzai Environmental proposes exemption from doing a full paleontological study for this project (see Appendix 1).

7. RECOMMENDATIONS

Based on the assessment of the potential impact of the development on the identified heritage, the following recommendations are made, taking into consideration any existing or potential sustainable social and economic benefits:

4. The lithic traces on the landscape of the study area are of low significance and the impact of the development on these resources are inconsequential. No further mitigation is required. Therefore, from a heritage point of view we recommend that the proposed development can continue.

5. Due to the low palaeontological significance of the area, no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required pending the discovery of newly discovered fossils. It is considered that the development of the proposed development is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area. If fossil remains are discovered during any phase of construction, either on the surface or unearthed by fresh excavations, the ECO in charge of these developments ought to be alerted immediately. These discoveries ought to be protected (preferably in situ) and the ECO must report to SAHRA so that appropriate mitigation (e.g. recording, collection) can be carry out by a professional palaeontologist (Butler 2018).

6. Although all possible care has been taken to identify sites of cultural importance during the investigation of study areas, it is always possible that hidden or sub-surface sites could be overlooked during the assessment. If during construction, any possible discovery of finds such as stone tool scatters, artefacts, human remains, or fossils are made, the operations must be stopped, and a qualified archaeologist must be contacted for an assessment of the find. UBIQUE Heritage Consultants and its personnel will not be held liable for such oversights or for costs incurred as a result of such oversights.

8. CONCLUSION

This HIA has identified and recorded various heritage resources on plot 1178, Kakamas South Settlement, Kai !Garib Municipality, Mgcawu District Municipality, Northern Cape as set out in the report. In the development footprint are no archaeological, historical or cultural sites that will be impacted on negatively by the proposed development.

9. BIBLIOGRAPHY

ACRM. 2016. Archaeological Impact Assessment, proposed agricultural development on Farm 1726, Farm 1290 and Farm 1537 Augrabies, Northern Cape. Unpublished report: Rondebosch.

Beaumont, P.B. & Morris, D. 1990. *Guide to archaeological sites in the Northern Cape*. McGregor Museum: Kimberley.

Beaumont, P. 2004. Kathu Pan and Kathu Townlands/ Uitkoms. In Morris, D. and Beaumont, P. *Archaeology in the Northern Cape: some key sites*: 50-53. McGregor Museum: Kimberley.

Beaumont, P.B. 2008. Phase 1 Archaeological Impact Assessment Reprt on Kakamas South Farm 2092 Near Augrabies, Siyanda District Municipality, Northern Cape Province. Unpublished report. McGregor Museum: Kimberley.

Beaumont, P.B. 2013. *Phase 2 Archaeological Permit Mitigation Report on a 0.7ha Portion of the farm Bestwood 549, situated on the eastern outskirts of Kathu, John Taolo Gaetsewe District Municipality, Northern Cape Province*. Unpublished report. Dennesig.

Beaumont, P.B. & Vogel, J.C. 2006. On a timescale for the past million years of human history in central South Africa. *South African Journal of Science* 102: 217-228.

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

Breutz, P.L. 1953. The tribes of the Rustenburg and Pilanesberg districts. Department of Native Affairs, *Ethnological Publications* No.28. Government Printer: Pretoria.

Breutz, P.L. 1954. The tribes of Marico District. Department of Native Affairs, *Ethnological Publications* No. 30. Government Printer: Pretoria.

Breutz, P.L. 1963. The tribes of the districts of Kuruman and Postmasburg. Department of Native Affairs, *Ethnological Publications* No. 49. Government Printer: Pretoria.

Butler, E. 2018. *Palaeontological Desktop Assessment* Unpublished report. Banzai Environmental: Bloemfontein.

Coertze, P.J. & Coertze, R.D. 1996. *Verklarende vak woordeboek vir Antropologie en Argeologie*. R.D. Coertze: *Pretoria*.

Deacon, H.J. & Deacon, J. 1999. *Human Beginnings in South Africa: Uncovering the secrets of the Stone Age*. David *Phillips* Publishers: Cape Town.

De Jong, R.C. 2010. *Final Heritage Impact Assessment report: Proposed land use change to provide for irrigated agricultural activities on Erf 327 of the farm Kakamas North Settlement, Kai !Garib Municipality, Northern Cape Province.* Unpublished report. Cultmatrix: Pretoria.

Dreyer, J. 2006. *First phase archaeological and cultural heritage assessment of the proposed Concentrated Solar Thermal Plant (CSP) at the farms Olyvenhouts Drift, Upington, Bokpoort 390 and Tampansrus 294/295, Groblershoop, Northern Cape*. Unpublished EIA report. Bohlweki Consultants: Johannesburg.

Dreyer, J. 2012. *First phase archaeological and cultural heritage assessment of the proposed water pipeline from Sanddraai 391 to Bokpoort 390, Groblershoop, Northern Cape*. Unpublished EIA Report. SSI Engineers & Environmental 14 Consultants: Sandhurst.

Dreyer, J. 2014. *First phase archaeological & heritage investigation of the proposed mine prospecting at the remaining extent of the farm Inglesby 580 near Olifantshoek, Northern Cape Province*. Unpublished EIA report. Re A Kgona General Services: Kimberley.

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

Korsman, S.A. & Meyer, A. 1999. Die Steentydperk en rotskuns. In: Bergh, J.S. (red.). *Geskiedenisatlas van Suid-Afrika. Die vier noordelike provinsies*. J.L. van Schaik: Pretoria.

Lombard, M. 2011. Howieson's *Poort. McGraw Hill Year Book of Science & Technology*. Article ID: YB120253: Sequence Number 14.

Lombard, M. & Parsons, I. 2008. Blade and bladelet function and variability in risk management during the last 2000 Years in the Northern Cape. *South African Archaeological Bulletin* 63: 18-27.

Lombard, M., Wadley, L., Deacon, J., Wurz, S., Parsons, I., Mohapi, M. Swart, J. & Mitchell, P. 2012. South African and Lesotho Stone Age sequence updated. *South African Archaeological Bulletin* 67: 123-144.

Kaplan, J. 2012. Archaeological Impact Assessment: The Proposed Keren Energy Kakamas Solar Farm on ERF 1654 Kakamas Northern Cape Province. Unpublished report. Agency for Cultural Resource Management: Rondebosch.

Kaplan, J. 2013. Archaeological Impact Assessment Proposed Low Cost Housing Project in Kakamas, Northern Cape Province. Unpublished report. Agency for Cultural Resource Management: Rondebosch.

Kaplan, J. 2016. Archaeological Impact Assessment Proposed housing development on Erf 1612, Kakamas, Northern Cape Unpublished report. Agency for Cultural Resource Management: Rondebosch.

Kaplan, J. 2017. Archaeological Impact Assessment Proposed Packing Shed, Portion of Erf 1731 Kakamas South, Northern Cape. Agency for Cultural Resource Management: Rondebosch.

Mitchell, P. 2002. *The archaeology of Southern Africa*. Cambridge: Cambridge University Press.

Morris, A. 1995. The Einiqua: an analysis of the Kakamas skeletons. In: Smith A.B. (ed.) *Einiqualand: studies of the Orange River frontier*: 110-164.

Morris, D. & Beaumont, P. 2004. *Archaeology in the Northern Cape: Some key sites*. SAS Post-Conference Excursion, 8-10 April 2004. McGregor Museum: Kimberley.

Morris, D. 2005. Report on a Phase 1 Archaeological Impact Assessment of proposed mining areas on the farms Ploegfontein, Klipbankfontein, Welgevonden, Leeuwfontein, Wolhaarkop and Kapstevel, west of Postmasburg, Northern Cape. Unpublished report. McGregor Museum: Kimberley.

Morris, D. 2010. Heritage Impact Assessment of the proposed Hydropower station on the Orange River at Neus Island on the farm Zwartbooisberg, east of Kakamas, Northern Cape Unpublished Report. McGregor Museum: Kimberley.

Morris, D. 2011. Heritage Impact Assessment of the proposed new power-line route south of the river to Kakamas, Northern Cape Unpublished Report. McGregor Museum: Kimberley.

Morris, D. 2017. Heritage Impact Assessment of proposed sand mining in the bed of the Hartebees River on Lot 1768 Kakamas South, near Kakamas, Northern Cape. Unpublished Report. McGregor Museum: Kimberley.

Morris, D. 2017b. Heritage Impact Assessment of Agricultural Lot 2371 Kakamas South Settlement, near Kakamas, Northern Cape. Unpublished Report. McGregor Museum: Kimberley.

Mucina, L. & Rutherford, M.C. (eds) 2006. *The vegetation of South Africa*, Lesotho *and Swaziland*. Strelitzia 19. SANBI: Pretoria.

Orton, J. & Webley, L. 2013. *Heritage Impact Assessment for a proposed Hydro-Electric facility near Riemvasmaak, Northern Cape*. Unpublished report. ACO Associates cc: St James.

Pelser, A.J. & Lombard, M. 2013. *A report on the archaeological investigation of Stone Age finds on the Paling 434, Hay Magisterial District, near Postmasburg in the Northern Cape Province*. Unpublished EIA Report. Kia Batla Holdings: Craighall.

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

PGS Heritage. 2009. *Heritage Impact Assessment for Ntsimbintle Mining (Pty) Ltd on Portions 1, 2, 3 and 8 of the farm Mamatwan 331 and the farm Moab 700 in the Kgalagadi District Municipality of the Northern Cape Province*. Pretoria.

PGS Heritage. 2010a. *Heritage Impact Assessment for the Amari Kongoni Manganese Mine on Portion 1 and a section of the Remainder of the farm Kongoni 311 in the Kgalagadi District Municipality of the Northern Cape Province*. Pretoria.

PGS Heritage. 2010b. *Heritage Impact Assessment for the Proposed Lehating Mining (Pty) Ltd underground manganese mine on Portions of the Farm Lehating 714, approximately 20km northwest of Hotazel, Northern Cape Province*. Pretoria.

Porat, N., Chazan, M., Grun, Aubert, R., Eisenmann, V. & Horwitz, L. 2010. New radiometric ages for the Fauresmith industry from Kathu Pan, southern Africa: Implications for the Earlier to Middle Stone Age transition. *Journal of Archaeological Science* 37: 269-283.

Ross, R. 1975. The!Kora Wars on the Orange River, 1830-1880. *The Journal of African History*, 16 (4): 561-576.

Snyman, P.H.R. 2000. *Changing tides. The story of ASSMANG*. The Associated Manganese Mines of South Africa Limited: Johannesburg.

Thackeray, A.I., Thackeray, J.F. & Beaumont, P.B. 1983. Excavations at the Blinkklipkop specularite mine near Postmasburg, Northern Cape, *South African Archaeological Bulletin* 38:17-25.

Van der Walt, J. & Lombard, M. 2018. Kite-like structures in the Nama Karoo of South Africa. *Antiquity* (92) 363,e3: 1–6

Van Schalkwyk, J.A. 2010a. Archaeological impact survey report for the land use change on sections of the farm Vaalkoppies 40, Gordonia district, Northern Cape Province. Unpublished report 2010/JvS/069.

Van Schalkwyk, J.A. 2010b. Heritage impact assessment for the proposed agricultural development on a section of the property Kakamas South, Gordonia magisterial district, Northern Cape Province. Unpublished report 2010/JvS/093. Pretoria.

Van Schalkwyk, J.A. 2010c. Archaeological impact survey report for the Land Use Change on a Section of the Farm Kakamas North, Gordonia District. Northern Cape Province. Unpublished report. CULTMATRIX Consultants: Pretoria.

Van Schalkwyk, J.A. 2011. Heritage impact assessment report for the proposed establishment of the Inca Solar PV Power Plant, Kakamas region, Northern Cape Province. Unpublished report 2011/JvS/030.

Van Schalkwyk, J.A. 2011b. Heritage impact assessment for the proposed citrus orchard development on Portions of the farm Kakamas South, Augrabies, Gordonia magisterial district, Northern Cape Province. Unpublished report 2011/JvS/061.

Van Schalkwyk, J.A. 2013a. Cultural Heritage Impact Assessment for the Proposed Township Development on a Section of the Farm Kakamas Suid 28, Marchand, Kai !Garib Municipality, Northern Cape Province. Unpublished report. Pretoria.

Van Schalkwyk, J.A 2013b. Cultural Heritage Impact Assessment for the Proposed Township Development on a Section of the Farm Kakamas Suid 28, Augrabies, Kai !Garib Municipality, Northern Cape Province. Unpublished report. Pretoria.

Van Schalkwyk, J.A. 2013c. Cultural Heritage Impact Assessment for the Proposed Township Development on a Section of the Kakamas Suid 28, Alheit, Kai !Garib Municipality, Northern Cape Province. Unpublished report. Pretoria.

Van Schalkwyk, J.A. 2013d. Cultural Heritage Impact Assessment for the Proposed Township Development on a Section of the Farm Kakamas Noord 481, Cillie, Kai !Garib Municipalty, Northern Cape Province. Unpublished report. Pretoria.

Van Schalkwyk, J.A. 2013e. Cultural Heritage Impact Assessment for the Proposed Township Development on a Section of the Farm Kakamas North 481, Lutzburg, Kai !Garib Municipalty, Northern Cape Province. Unpublished report. Pretoria.

Van Ryneveld, K. 2007. *Archaeological Impact Assessment Phase 1: Portion of the farm Boksputs 118, Groblershoop district, Northern Cape South Africa*. Unpublished report.

Van Vollenhoven 2012a. *A report on a cultural heritage baseline study for the proposed exploration activities at the Jacomynspan Project, Northern Cape Province*. Unpublished report. Archaetnos: Groenkloof.

Van Vollenhoven, A.C. 2012b. *A report on a heritage impact assessment for the proposed SASOL CSP and CPV Project near Upington in the Northern Cape Province*. Unpublished report. Archaetnos: Groenkloof.

Van Vollenhoven, A.C. 2014a. *A report on a cultural heritage impact assessment for the proposed exploration activities at the Jacomynspan Project, Northern Cape Province*. Unpublished report. Archaetnos: Groenkloof.

Van Vollenhoven, A.C. 2014b. *A report on a basic heritage assessment for the proposed Eskom Fibre-Groblershoop 132 Kv power line, Northern Cape Province*. Unpublished report. Archaetnos: Groenkloof.

Van Vuuren, L. 2011. Kakamas– Oasis in the desert. *The Water Wheel*, March/April: 26-29.

Van Warmelo, N.J. 1935. A Preliminary Survey of the Bantu Tribes of South Africa. Department of Native Affairs, *Ethnological Publications* Vol. V. Government Printer: Pretoria.

Van Zyl, L. 2010 (revised edition). *Boegoeberg se mense. 'n Flukse draai van die wiel*. Boegoeberg Watergebruikersvereniging: Groblershoop.

Walker, S.J.H., Chazan, M. & Morris, D. 2013. *Kathu Pan: Location and Significance* – A report requested by SAHRA, Cape Town.

Wilkins, J. 2010. Style, symbolling, and interaction in Middle Stone Age societies. *Explorations in Anthropology* 10(1):102–125.

ACTS

National Environmental Management Act, 1998 (Act 107 of 1998).

National Heritage Resources Act, 1999 (Act 25 of 1999).

SAHRA. 1999. *Government Gazette 1999*. National Heritage Resources Act No. 25 of 1999.

SAHRA. 2007. *SG 2.2 SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports.*

SAHRA. 2008. *Site Management Plans: Guidelines for the Development of Plans for the Management of Heritage Sites or Places*. (see specifically Section 7). (www.sahra.org.za).

WEB

http://www.sahra.org.za/sahris

APPENDIX A

PALAEONTOLOGICAL EXEMPTION FOR THE PROPOSED AGRICULTURAL DEVELOPMENT (TRIPLE D FARMS), PLOT 1178, KAKAMAS SOUTH SETTLEMENT, KAI !GARIB MUNICIPALITY, MGCAWU DISTRICT MUNICIPALTY, NORTHERN CAPE.

RECOMMENDED EXEMPTION FROM FURTHER PALAEONTOLOGICAL STUDIES: OF PROPOSED AGRICULTURAL DEVELOPMENT, PLOT 1178, KAKAMAS SOUTH SETTLEMENT, KAI! GARIB MUNICIPALITY

Prepared by

BANZAI ENVIRONMENTAL (PTY) LTD

27 September 2018

1. BACKGROUND

Triple D Farms, Plot 1178, Kakamas South plans to develop approximately 60 ha of vineyards for table grape and raisin production. The development will comprise of the following: 1) a new pump station on the bank of the Orange River, 2) pipelines, 3) off-stream storage dam or reservoir, 4) filtering system, 5) fuel-depot and generator, and 6) packing shed and labour housing. The planned pipelines and pump station will be situated within registered servitudes.

This report is a **recommended exemption** from further Palaeontological studies as the proposed development site is underlain by the Riemvasmaak Gneiss of the Namaqua-Natal Province. These rocks are from igneous nature and thus **unfossiliferous**.

2. OUTLINE OF PROPOSED DEVELOPMENT

The proposed 60 ha development will be divided in two 30 ha irrigation systems each with their own pump, filtration system and mainline to the irrigation blocks, while irrigation will occur from the storage dam. Each 30 ha system will in turn be divided into 4 irrigation shifts of 7.5 ha each. The volume of the storage dam will be adequate to supply the 60 ha with a 12mm/day. The water requirement of the development will be 7200m^3 per day and water will be extracted from the river for 19 hrs per day.

3. GEOGRAPHICAL LOCATION OF THE SITE

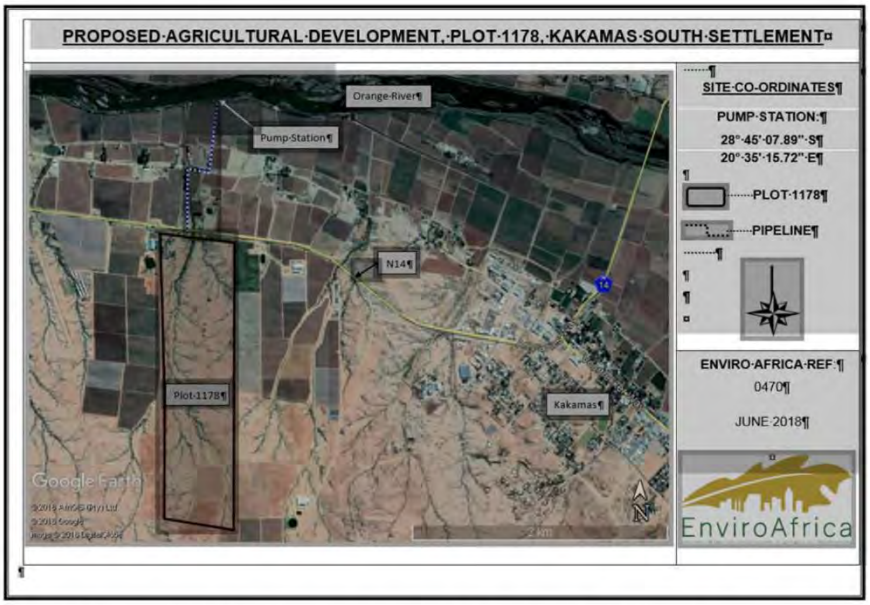

Figure 1: The location of the proposed 60 ha irrigation development: Triple D Farms, Plot 1178, Kakamas South. Map provided by EnviroAfrica.

GEOLOGICAL AND PALAEONTOLOGICAL HERITAGE

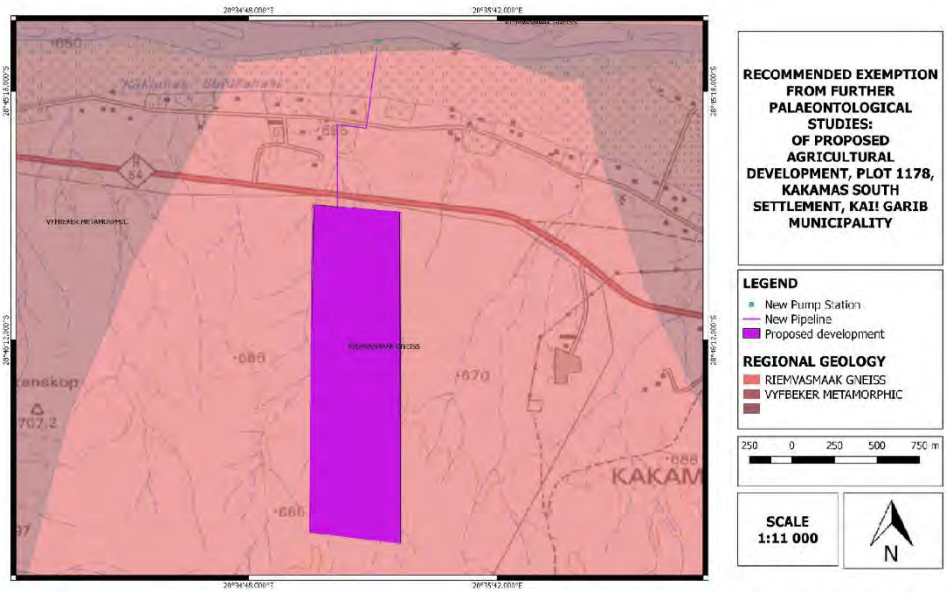

Figure 2: The surface geology of the proposed irrigation development: Triple D Farms, Plot 1178, Kakamas South. The proposed development is entirely underlain by the Riemvasmaak Gneiss of the Namaqua-Natal Province. Map drawn QGIS Desktop 2.18.14. The Orange River is represented by the brown in the map).

The proposed development is entirely underlain by the Riemvasmaak Gneiss of the Namaqua-Natal Province. These rocks are commonly found in KwaZulu-Natal and the Northern Cape and consists of igneous and metamorphic rocks formed during the Namaqua Orogeny approximately 1200 to 1000 million years ago. The proposed development probably falls in the Kakamas Terrane of the Namaqua-Natal Province which is ~ 200 million years old. The Riemvasmaak Gneiss consists of pink-weathering granular or augen quartz-feldspar gneiss. A gneiss is formed by high-temperature and high –pressure metamorphic processes.

The Riemvasmaak Gneiss is an igneous rock type and the potential for any fossil materials occurring within this rock unit is thus zero.

4. CONCLUSIONS & RECOMMENDATIONS

The proposed irrigation development: Triple D Farms, Plot 1178, Kakamas South is of NO significance in terms of local palaeontological heritage since the igneous rocks underlying the site are unfossiliferous.

It is therefore recommended that exemption from further specialist palaeontological studies and mitigation be granted for this development.

5.REFERENCES

ALMOND, J.E. 2011. Proposed Rooipunt Solar Power Park on Farm Rooipunt 617, near Upington, Gordonia District, Northern Cape Province. Palaeontological specialist study: desktop assessment, 12 pp

ALMOND, J.E. & PETHER, J. 2008. Palaeontological heritage of the Northern Cape. Interim SAHRA technical report, 124 pp. Natura Viva cc, Cape Town.

CORNELL, D.H. et al. 2006. The Namaqua-Natal Province. In: Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J. (Eds.) The geology of South Africa, pp 325-379. Geological Society of South Africa, Johannesburg & Council for Geoscience, Pretoria.

MCARTHY, T. and Rubidge, B. 2005. The Story of Earth Life: A southern African perspective on a 4.6-billion-year journey. Struik, Pp 333.

NORMAN, N. and WHITFIELD, G., 2006. Geological Journeys. De Beers, Struik, Pp 1-320. RUBIDGE, B. S. (Ed.), 1995. Biostratigraphy of the Beaufort Group (Karoo Supergroup). South African Committee for Biostratigraphy, Biostratigraphic Series No. 1, 46pp. Council for Geoscience, Pretoria.

SNYMAN, C.P. 1996. Geologie vir Suid-Afrika, Departement Geologie, Universiteit van Pretoria, Pretoria, Volume 1, Pp 513.

VISSER, D.J.L. 1984. Geological Map of South Africa 1:100 000. South African Committee for Stratigraphy.Council for Geoscience. WALRAVEN, F. 1978. Geological Map 2528 Pretoria, 1:250 000.Council for Geoscience, Pretoria.

APPENDIX H6: Agricultural Report

AGRIMOTION

SCIENTIFIC | INDEPENDENT | PRECISE

ONTWIKKELINGSVERSLAG

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SAMEVATTING

GRONDBESTUUR	
Grondvoorbereiding	• Maak land skoon, alle gelykmaak werk en opvul van duike asook verwydering van rotse. • Saai ameliorante en dis in boonste 10-20cm • 1ste losmaak aksie (enkeltand) in Noord-Suid rigting (parallel met die westelike grens) - 1 x 120cm (100cm effektief) • 2de losmaak aksie (enkeltand) 30° wes van Noord - 1 x 120cm (100cm effektief) • Vir die gedeeltes waar die rots vlakker voorkom moet daar moontlik 'n 3de losmaak aksie uitgevoer word saam met die plantry.
Beroking	Geen beroking indien daar sekerheid is dat Margarodes nie teenwoordig is nie.
DREINERING	
Interne dreinering	• Geen suboppervlak dreinering is aanbeveel nie • Slegs van die bestaande rivierlope is behou om voorsiening te maak vir vloed toestande
ANDER	
Besproeiingsbreek	Besproeiingsbreke sal slegs oorweeg word waar die klip% met meer as 30% verskil binne 'n blok.
Vogmonitering	Daar word 10 probes aanbeveel. Die posisies word op die blokuitlegkaart aangedui.

1. INLEIDING

'n Grondondersoek is behartig deur Danie Kritzinger te Triple D Farms (*Kakamas, Noord-Kaap*) om die geskiktheid van grond asook die prosedure vir die vestiging van tafeldruiwe in die area vas te stel. Die geklassifiseerde grondprofiele is op 'n kontoerkaart geplaas en kaarte wat die grondgrense en ameliorantblokke aandui is saamgestel. Die gekarteerde gronde is in meer besonderhede bespreek in die verslag en inligting aangaande die grondeienskappe en grondpotensiaal word hierin uitgelê. Die verslag bevat ook aanbevelings vir grondvoorbereiding, dreinering, blokuitleg en jongboom voeding. Die kaarte moet saam met die verslag gelees word. Die totale area wat karteer is beloop ongeveer 125ha.

2. GRONDVORM EN GRONDPOTENSIAAL

'n Totaal van 128 profielgate is tydens die opname volgens die Suid-Afrikaanse Grond Klassifikasie Sisteem (Grondklassifikasiewerkgroep, 1991) geklassifiseer.

Grondklassifikasie behels die identifikasie en onderskeiding van opeenvolgende **diagnostiese horisonte** in 'n profiel. Horisonte is horisontale lae wat volgens natuurlike grondvormingsprosesse ontwikkel uit onderliggende rots of vervoerde materiaal. In die Suid-Afrikaanse klassifikasiestelsel word 30 verskillende diagnostiese horisonte erken. Die verskillende diagnostiese horisonte wat in 'n gegewe landskap aangetref word is die gevolg van 'n kombinasie van grondvormingsfaktore wat, of gesamentlik of individueel, die eienskappe van 'n horison bepaal. Die belangrikste grondvormingsfaktore kan breedvoerig opgesom word as klimaat, topografie, moedermateriaal en lewende organismes. Die invloed van hierdie faktore veroorsaak verskille in grondstruktuur, grondchemie, grondnatheid en grade van verwering. Dit moet egter ook besef word dat dieselfde tipe diagnostiese horisonte heelwat kan varieer in terme van klei inhoud, sandgraad, natheid, klipfraksie, diepte, struktuur, kleur ens.

Die opeenvolging van die diagnostiese horisonte bepaal die **grondvorm**. Daar is 73 verskillende grondvorme in die Suid-Afrikaanse grondklassifikasie stelsel, almal met 'n unieke opeenvolging van diagnostiese horisonte. Met die variasie wat voorkom in elke grondvorm is dit nodig om alle veranderlikes in 'n kode-formaat te noteer. Die grondkode word in seksie 2.1 ontleed en al die grondvorms wat in die geklassifiseerde area voorkom is in seksie 2.2 beskryf.

Die grondbeskrywings van elke profielgat word in die kode-formaat op die grondkaart aangedui. Elke profielgat is per GPS genoteer en op die grondkaart geplaas. Gronde van dieselfde grondvorm is groepeer en volgens hul grondpotensiaal gekleurkodeer. Waar dieselfde grondvorm oor verskillende grondpotensiale beskik is die grondliggaam met 'n stippellyn verdeel.

2.1 VERDUIDELIKING VAN DIE GRONDKODE (ALGEMENE INLIGTING)

363 Oa 1210/Tu lo/lw(45)+f2g3 ne/yp(20)+f3 (80/30) (6)

f2 me 2(8) 2/3

Die inligting bo die lyn beskryf die grondvorm, familie en ondergrond horisonte.

363 : Horison diepte : Die eerste nommers in die kode dui aan op watter dieptes die oorgang tussen horisonte voorkom. Die A-horison is in die geval 0-30cm, die B-horison is 30-60cm en die laaste horison begin by 60cm. Die herhaalde 3 aan die einde dui daarop dat die growwe fragmente (+f3) op 30cm begin.

Oa :	Grondvorm :	Die grondvorm se afkorting. Elk van die 73 verskillende grondvorms het 'n twee-letter afkorting. Hierdie afkortings word saam met die grondvorm beskrywings in Afdeling 2.2 aangedui.
1210:	Grondfamilie:	Die volgende vier nommers dui die grondfamilie aan. Dit beskryf verdere diagnostiese eienskappe wat algemeen kan voorkom in die gegewe grondvorm. Die eienskappe sluit onder andere natheid, struktuur, basis status en kleur in.
/Tu:	Oorgangsvorm:	In baie gevalle beskik 'n individuele horison oor eienskappe van verskillende diagnostiese horisonte. Dit beteken dat meer as een grondvorm 'n moontlikheid kan wees. Die dominantste eienskappe word gebruik om die horison as 'n spesifieke diagnostiese horison te identifiseer en dus die grondvorm te klassifiseer. Die sekondêre of oorgangsgrondvorm moet egter ook aangeteken word en kan met 'n / na die geklassifiseerde vorm en familie aangedui word.
lo/lw:	Ondergrond horisonte:	Indien die diepste onderliggende horison nie afgelui kan word van die grondvorm nie, word dit aangedui na die familie kode. Elke diagnostiese horison word ook beskryf met 'n tweeletter afkorting wat in Afdeling 2.2 uitgelê word. As die horison 'n oorgang is tussen twee verskillende diagnostiese horisonte word 'n skuinsstreep (/) gebruik om dit aan te dui bv. lo/lw. Die horison opeenvolging strek van onder (diepste) na bo (net onder die A-horison).
( ) :	Ondergrond klei %:	Die klei inhoud van die waargenome ondergrond horisonte word aangedui in hakkies na die horison se benaming.
+f2g3 :	Growwe fragment:	Die growwe fragment inhoud is verdeel in vier grootte klasse en word as die persentasie van die totale profiel aangedui. Die fyn klas is as 'f' (0.2 – 2.5cm), die growwe klas as 'g' (2.5 - 7.5cm), klip as 'k' (7.5 – 25cm) en rots as 'r' (25cm +) aangedui. Die gegewe syfers voor elkeen van hierdie verteenwoordigende letters dui die persentasie van hierdie growwe fraksie in die horison aan. In die geval van die voorbeeld is daar 20% fyn growwe fragmente, 30% medium fragmente en geen klip of rots fraksies nie.
(yp) :	Addisionele ondergrond eienskappe:	
		Addisionele eienskappe van die B-horison kan ook aangedui word na die horison naam met die gebruik van 'n skuinsstreep (/). In die geval is daar 'n verharding van die B-horison wat aangedui word met die letters *yp*.
(80/30):	Rip en dol diepte:	Die stel nommers tussen hakkies dui eerstens die diepte van die grondlosmaak-aksie en dan die diepte van die grondvermengingsaksie in cm aan.
(6) :	Grondpotensiaal:	Die tweede stel nommers tussen hakkies dui die grondpotensiaal aan as 'n waarde uit 10. Die konsep word in meer diepte in Afdeling 2.4 bespreek.

<u>Die inligting onder die lyn in die grondkode beskryf die bogrond eienskappe en natheidsindeks.</u>

f2 :	Growwe fragment:	Daar is in die geval 20% fyn growwe fragmente in die A-horison.
me :	Sandgraad :	Die sandgraad dui op die korrelgrootte van die sandfraksie. Dit word in drie klasse verdeel: 'fi' vir fyn, 'me' vir medium en 'co' vir 'n growwe sandgraad.
2(8) :	Klei inhoud :	Die A-horison se klei persentasie van 8% val in die klei klas 2. Die klei klasse is verdeel as volg (1-5% as 1; 6-10% as 2; 11-15 as 3 ens.)
2/3 :	Natheidsindeks :	Die natheidsindeks beskryf die diepte waar natheid voorkom asook hoe lank die grond versadig is met water gedurende die jaar. 'n Natheidsklas van 1 dui op 'n droë grondprofiel deur die jaar, terwyl 'n natheidsklas van 9 dui op natheid so vlak as 30cm van die oppervlak vir 365 dae van die jaar.

2.2 GRONDVORMS GEKLASSIFISEER TE TRIPLE D FARMS

Die verskillende grondvorms in die geklassifiseerde area word in die onderstaande afdeling bespreek, tesame met die verskillende horisonte waaruit die spesifieke grondvorm saamgestel is. Om die grondkaart en die grondverspreiding beter te verstaan moet die afkorting van die grondvorm op die grondkaart geassosieer en gepaar word (bv. Gs in plaas van Glenrosa) met die beskrywings wat hieronder volg. Weens die feit dat gronde slegs eenmaal geklassifiseer word, is die gronde baie deeglik beskryf om aan enige verdere behoeftes wat in die toekoms nog mag voorkom, te voorsien.

Glenrosa (Gs)

Ortiese A-horison (ot):

Die ortiese A-horison is 'n bogrond horison wat nie kwalifiseer as 'n organiese O, humiese, vertiese of melaniese A-horison nie. Hierdie bogronde kom wydverspreid voor oor Suid-Afrika en beskik oor variërende eienskappe (diepte, klei en klipfraksie inhoud) wat in meeste gevalle soortgelyk is aan die van die ondergrond. Daar is niks spesifieks beperkend of kenmerkend van hierdie horisonte nie.

Litokutaniese B-horison (lo/lw/so/sw):

'n Litokutaniese B-horison is 'n jong grondhorison wat nog in 'n vroeë stadium van ontwikkeling is. Gevolglik beskik dit oor beide eienskappe van grond en oor die van die moedermateriaal van waaruit dit verweer. Hierdie horison gaan met diepte geleidelik oor na onverweerde rots. Litokutaniese B-horisonte besit ook kutaniese eienskappe (beweegbare klei en ander grondmateriale wat dun films of deklagies vorm rondom groter grondaggregate) wat tot kleur variasie lei en hierdie horisonte is ook nie altyd horisontaal aaneenlopend deur die profiel nie. Onderskeid word getref tussen verskillende litokutaniese B-horisonte op grond van die persentasie rots wat teenwoordig is (>70% rots = hard vs <70% rots = nie-hard) en of daar tekens van natheid teenwoordig is. Hierdie horisonte kan 'n fisiese beperking vir wortelgroei verteenwoordig.

Mispah (Ms)

Ortiese A-horison (ot):

Die ortiese A-horison is 'n bogrond horison wat nie kwalifiseer as 'n organiese O, humiese, vertiese of melaniese A-horison nie. Hierdie bogronde kom wydverspreid voor oor Suid-Afrika en beskik oor variërende eienskappe (diepte, klei en klipfraksie inhoud) wat in meeste gevalle soortgelyk is aan die van die ondergrond. Daar is niks spesifieks beperkend of kenmerkend van hierdie horisonte nie.

Harde rots (ro/rw):

Harde rots verteenwoordig, soos die naam impliseer, 'n aaneenlopende laag gedeeltelik verweerde of onverweerde rots wat dikwels naby die grondoppervlakte voorkom. Hierdie horisonte is 'n kenmerk van vlak en jong gronde en is 'n ernstige beperking vir wortelgroei en waterinfiltrasie. Dit kwalifiseer nie as 'n diagnostiese litokutaniese of harde plintiese B-horison, of as 'n hardebank karbonaat horison, of as diagnostiese dorbank nie.

Augrabies (Ag)

Ortiese A-horison (ot):

Die ortiese A-horison is 'n bogrond horison wat nie kwalifiseer as 'n organiese O, humiese, vertiese of melaniese A-horison nie. Hierdie bogronde kom wydverspreid voor oor Suid-Afrika en beskik oor variërende eienskappe (diepte, klei en klipfraksie inhoud) wat in meeste gevalle soortgelyk is aan die van die ondergrond. Daar is niks spesifieks beperkend of kenmerkend van hierdie horisonte nie.

Neokarbonaat B-horison (nc):

'n Neokarbonaat B is in beginsel soortgelyk aan 'n neokutaniese B (swak struktuur, nie uniforme kleur, kutaniese eienskappe) behalwe dat hierdie horisonte gekenmerk word deur 'n akkumulasie van kalsium-en/of magnesiumkarbonate. Hierdie karbonate oorheers egter nie die morfologie van die horison nie, maar sal sigbaar bruis indien dit met koue 10% soutsuur behandel word. Neokarbonaat horisonte ontwikkel in droër klimate (ariede sowel as semi-ariede streke) of in laerliggende landskap posisies. Die vry karbonate kan 'n chemiese beperking vir wortels inhou deurdat dit verhoogde pH's veroorsaak en die beskikbaarheid van nutriënte verlaag.

Brandvlei (Br)

Ortiese A-horison (ot):

Die ortiese A-horison is 'n bogrond horison wat nie kwalifiseer as 'n organiese O, humiese, vertiese of melaniese A-horison nie. Hierdie bogronde kom wydverspreid voor oor Suid-Afrika en beskik oor variërende eienskappe (diepte, klei en klipfraksie inhoud) wat in meeste gevalle soortgelyk is aan die van die ondergrond. Daar is niks spesifieks beperkend of kenmerkend van hierdie horisonte nie.

Sagte karbonaat horison (sk):

Die sagte karbonaat horison word gekenmerk deur 'n akkumulasie van vrye karbonate tot so 'n mate dat die karbonate die morfologie van die horison oorheers en maklik sigbaar is (witgrys kleure, poeieragtig). Dit is op grond van hierdie eienskap wat 'n sagte karbonaat van 'n neokarbonaat B-horison onderskei word. Die vry karbonate kan soortgelyk ook 'n chemiese beperking vir wortels inhou deurdat dit verhoogde pH's veroorsaak en die beskikbaarheid van nutriënte verlaag.

Coega (Cg)

Ortiese A-horison (ot):

Die ortiese A-horison is 'n bogrond horison wat nie kwalifiseer as 'n organiese O, humiese, vertiese of melaniese A-horison nie. Hierdie bogronde kom wydverspreid voor oor Suid-Afrika en beskik oor variërende eienskappe (diepte, klei en klipfraksie inhoud) wat in meeste gevalle soortgelyk is aan die van die ondergrond. Daar is niks spesifieks beperkend of kenmerkend van hierdie horisonte nie.

Hardebank karbonaat horison (hk):

Hardebank karbonaat horisonte word gekenmerk deur 'n akkumulasie van vrye karbonate (kalsium en/of magnesium van aard) tot so 'n mate dat dit die horison sementeer en 'n baie harde massiewe laag vorm. Die horison is aaneenlopend deur die pedon en weens die hardheid daarvan is dit 'n beperking vir wortelgroei en waterinfiltrasie. Hardebank karbonaat horisonte vorm in droër areas waar karbonate kan aansamel sonder dat dit uit die grond geloog word deur gereelde reënbuie.

Gamoep (Gm)

Ortiese A-horison (ot):

Die ortiese A-horison is 'n bogrond horison wat nie kwalifiseer as 'n organiese O, humiese, vertiese of melaniese A-horison nie. Hierdie bogronde kom wydverspreid voor oor Suid-Afrika en beskik oor variërende eienskappe (diepte, klei en klipfraksie inhoud) wat in meeste gevalle soortgelyk is aan die van die ondergrond. Daar is niks spesifieks beperkend of kenmerkend van hierdie horisonte nie.

Neokutaniese B-horisonte (ne):

'n Neokutaniese B-horison is 'n swak gestruktureerde ondergrond horison met kutaniese eienskappe. Kutaniese eienskappe verwys na 'n morfologiese verskynsel waar beweegbare klei en ander grondmateriale dun films of deklagies (kutane) vorm rondom groter grondaggregate. Die teenwoordigheid van kutane word beskou as 'n teken van 'n meer onstabiele klei fase. Neokutaniese B-horisonte kan verskil in kleur (rooi, geel, bruin), maar die teenwoordigheid van kutane impliseer dat kleuruitdrukking nooit uniform sal wees soos die geval met rooi- en geelbruin apedale B-horisonte nie. Per definisie is neokutaniese horisonte jonk en ontwikkel dit op vervoerde materiaal. Fisies verteenwoordig hierdie horisonte die ideale struktuur vir wortelgroei, maar chemiese eienskappe kan varieër.

Hardebank karbonaat horison (hk):

Hardebank karbonaat horisonte word gekenmerk deur 'n akkumulasie van vrye karbonate (kalsium en/of magnesium van aard) tot so 'n mate dat dit die horison sementeer en 'n baie harde massiewe laag vorm. Die horison is aaneenlopend deur die pedon en weens die hardheid daarvan is dit 'n beperking vir wortelgroei en waterinfiltrasie. Hardebank karbonaat horisonte vorm in droër areas waar karbonate kan aansamel sonder dat dit uit die grond geloog word deur gereelde reënbuie.

Dundee (Du)

Ortiese A-horison (ot):

Die ortiese A-horison is 'n bogrond horison wat nie kwalifiseer as 'n organiese O, humiese, vertiese of melaniese A-horison nie. Hierdie bogronde kom wydverspreid voor oor Suid-Afrika en beskik oor variërende eienskappe (diepte, klei en klipfraksie inhoud) wat in meeste gevalle soortgelyk is aan die van die ondergrond. Daar is niks spesifieks beperkend of kenmerkend van hierdie horisonte nie.

Gestratifiseerde alluvium (al & U1-7):

Gestratifiseerde alluvium is 'n onkonsolideerde horison bestaande uit gelaagdhede wat vorm weens verskillende alluviale (rivier) afsettingsprosesse. Die lae kan verskil in samestelling wat gewoonlik die mees opvallendste is in terme van hulle tekstuur en growwe fragment inhoud. Die pedogenetiese veranderinge in hierdie horisonte is minimaal en daarom verteenwoordig dit jong gronde. Met tyd sal pedogenese egter die gelaagdheid verwyder en meer uniforme horisonte ontwikkel.

2.3 GRONDPOTENSIAAL

'n Grondpotensiaal word in die veld aan elke grondprofiel toegeken. Die grondpotensiaal varieer tussen 1 (baie swak) en 10 (uitstekend), met 'n waarde van 5 wat as medium potensiaal beskou word. Die potensiaal-waarde dien as 'n relatiewe aanduiding van die grond se natuurlike vermoë om vrugte produksie te handhaaf. Dit is sonder die inagneming dat verskillende verbouingspraktyke toegepas kan word om die grond se geskiktheid te verbeter. Verder sal verskillende gronde ook minder of meer geskik wees vir sekere gewasse of kultivars afhangende van die gewas se natuurlike vermoë om verskillende grondkondisies te hanteer.

Die volgende faktore word in ag geneem tydens die potensiaal bepaling:

- Effektiewe diepte
- Grondstruktuur
- Grond-kleur van bogrond en ondergrond
- Tekens van natheid
- Growwe fragment inhoud
- Klei inhoud
- Vry kalk toestande

Interpretasie:

Die grondpotensiaal kan gebruik word om die grondkondisies beter te verstaan. As 'n grond met 'n swak potensiaal toegeken is, kan verbouingspraktyke soos dreinering, grondvoorbereiding, operdwalle, bemesting en bekalking gebruik word om die grond se geskiktheid vir vrugte verbouing merkwaardig te verbeter. Die praktyke word in die volgende afdelings behandel. 'n Gewas en/of onderstam kan ook geselekteer word wat die natuurlike grondtoestande beter kan hanteer.

Tabel 1. Beskrywing van grondpotensiaal klasse soos op die grondkaart aangedui.

Kleurkode van grondpotensiaal	Algemene grond beskrywing	Grondtipe
Medium Hoog 6.5	Die dominante grondtipe in die area is Dundee gronde. Die bogrond (0-30cm), bevat 6% klei en 70% growwe fragmente. Die ondergrond bevat gelaagdheid weens alluviale nedersetting en word algemeen langs rivierlope aangetref. Dit bevat 6% klei en 70% growwe fragmente. Die gronde bevat geen tekens van natheid nie en geen vrykalk nie. Die gronde kan diep losgemaak word (120cm). Dit is belangrik dat klippe van die ondergrond nie na die oppervlak verplaas word tydens grondbewerking nie.	**Dundee**
Medium 5.5	Die dominante grondtipe in die area is Augrabies gronde (voorkoms: 7%). Die bogrond (0-30cm), bevat 8-10% klei en 40-50% growwe fragmente. Die ondergrond bestaan uit 'n neokarbonaat horison (vrykalk is teenwoordig) en dit bevat 8% klei en 50-60% growwe fragmente. Die gronde kan diep losgemaak word (120cm). Dit is belangrik dat klippe van die ondergrond nie na die oppervlak verplaas word tydens grondbewerking nie.	**Augrabies**
Medium Laag 4.5	Die dominante grondtipes in die area is Glenrosa en Brandvlei gronde (voorkoms: 58%). Die bogrond (0-30cm) bevat 8-10% klei en 20-60% growwe fragmente. Die Brandvlei gronde bevat 'n sagte karbonaat horison wat 'n chemiese beperking (lae weerstand en hoë pH) vir wortelontwikkeling kan inhou. Die ondergrond van die Glenrosa gronde bestaan uit uitermatige hoë klip (70%+) van gedeeltelik verweerde rots. Die gronde se grootste risiko is 'n beperkte benutbare diepte (30-50cm) in die natuurlike toestand. Dit noodsaak dat intensiewe grondvoorbereiding moet plaasvind om gronddiepte te skep asook die dreinering van besproeiingswater kan plaasvind. Hierdie gronde bevat 'n uiters lae waterhouvermoë en korrekte besproeiing skedulering sal baie belangrik wees.	**Glenrosa, Brandvlei**
Laag 3.5	Die dominante grondtipes in die area is Mispah, Glenrosa en Coega gronde (voorkoms: 33%). Die bogrond (0-20cm) bevat 6-10% klei en 50-70% growwe fragmente. Die Coega gronde bevat 'n harde karbonaat horison wat 'n chemiese beperking (lae weerstand en hoë pH) vir wortelontwikkeling kan inhou. Die ondergrond van die Mispah en Glenrosa gronde bestaan uit uitermatige hoë klip (80%+) van gedeeltelik verweerde rots en in sekere areas soliede rots. Die gronde se grootste risiko is 'n beperkte benutbare diepte (20-30cm) in die natuurlike toestand. Dit noodsaak dat intensiewe grondvoorbereiding moet plaasvind om gronddiepte te skep asook die dreinering van besproeiingswater kan plaasvind. Hierdie gronde bevat 'n uiters lae waterhouvermoë en korrekte besproeiing skedulering sal baie belangrik wees.	Mispah, Coega, Glenrosa

Nie Plantbaar **1.5**	Hierdie area word verteenwoordig deur rots (voorkoms: 2%) wat op die oppervlak voorkom en waar daar geen bogrond beskikbaar is nie.	Rots

2.4 ALGEMENE BESKRYWING VAN GEKLASSIFISEERDE GRONDE TE TRIPLE D FARMS

Die geklassifiseerde gronde te Triple D Farms beskik in die algemeen oor 'n medium-lae potensiaal in die natuurlike toestand vir die verbouing van meerjarige gewasse. Uitermatige hoë klip persentasie wat in groot gedeeltes oorgaan in onverweerde rots beperk die bewerkbare diepte van die grond en noodsaak intensiewe en duursame grondvoorbereiding. By areas waar die hoë klip persentasie en rots (Glenrosa en Mispah) nie teenwoordig is nie bevat die gronde wel 'n groter bewerkbare diepte, maar dan is die chemie 'n beperking (Brandvlei en Coega) d.m.v. die teenwoordigheid van vrykalk en/of brak toestande (lae weerstande) wat wortel ontwikkeling kan beperk. Loging van oortollige soute sal in hierdie geval noodsaaklik wees om optimale produksies te bereik.

Figuur 1. Die Brandvlei grondvorm met 'n sagte karbonaat B-horison. Hierdie gronde het geen beperkte diepte nie, maar kan wel 'n chemiese beperking wees vir wortelontwikkeling weens hoë pH en lae weerstand (brak).

Figuur 2. Die Glenrosa grondvorm met gedeeltelik verweerde moedermateriaal wat voorkom vanaf 30cm diepte. In die geval van die Mispah grondvorm is die moedermateriaal minder verweer en is meer rots teenwoordig.

Figuur 3a-c. Voorbeeld van die rotse wat in sekere areas op die oppervlak teenwoordig is.

Figuur 4. 'n Voorbeeld van 'n rivierloop wat oop gehou moet word om voorsiening te maak vir vloed toestande.

3. OMGEWINGSASPEKTE

Daar het in die afgelope 10 jaar geen grondbewerking in die gekarteerde area te Triple D Farms plaasgevind nie, en gevolglik is skriftelike toestemming nodig om die area te ontwikkel (volgens artikels 2 en 3 van die Wet op Bewaring van Landbouhulpbronne, Seksie 43 van 1983). Die twee wetgewings wat die misbruik of besoedeling van natuurlike grondhulpbronne voorkom is CARA (*Conservation of Agricultural Resources Act*) en NEMA (*National Environmental Management Act*).

Daar is 3 kokerbome teenwoordig in die area en daar sal seker gemaak moet word oor die regulasies rondom die verwydering al dan nie van kokerbome. Die posisies van die 3 bome word op die grondkaart en blokuitlegkaart aangebring.

Die grondkaart voldoen aan Global G.A.P vereistes. Die ameliorant behoefte word bereken vanaf grondmonsters wat analiseer is by Bemlab of ander geakkrediteerde laboratoriums. Die aanbevole grondvoorbereiding en na-voorbereidingsaksies is bewys om grondstruktuur te verbeter en te behou.

4. GRONDMONSTERS VIR AMELIORANTE

Gronde is groepeer in ameliorantblokke volgens soortgelyke fisiese en morfologiese kenmerke wat opmerkbaar is tydens die grondopname. 'n Ameliorantblok verteenwoordig dus 'n area waarin die grond relatief uniform is en wat soortgelyke chemiese en fisiese bestuurspraktyke gaan vereis. Belangrike oorwegings in hierdie onderverdeling van die gronde in 'n area sluit in die grondvorm tipes en growwe fragment inhoud. 'n Variasie in growwe fragmente is belangrik om in ag te neem aangesien growwe fragmente die werklike volume grond (dit wat chemies reggestel kan word en waarin die plant eintlik groei) "verdun" en sodoende die hoeveelheid ameliorante wat benodig word sal beïnvloed.

Grondmonsters is reeds deur Agrimotion geneem en na Bemlab gestuur vir 'n volledige grondontleding (makro en spoorelemente) asook KUK ontleding. Indien die ameliorante variërend toegedien word, sal die aanbeveling as 'n 'shapefile' aan die kliënt verskaf word om 'n akkurate toediening te verseker.

5. GRONDVOORBEREIDING

5.1 ALGEMENE INLIGTING

Die twee hoof doelwitte van grondvoorbereiding is om ameliorante met die grond te vermeng asook om 'n losser en meer geskikte medium te skep wat 'n groter wortelvolume kan onderhou. Grondvoorbereiding verbeter die grond se interne dreinering en verseker dat wortels gevestig word in ideale chemiese en fisiese grondkondisies. Verder is goeie grondvoorbereiding ook noodsaaklik indien beroking gaan plaasvind aangesien dit deurligting en gaswisseling verbeter. Weens die feit dat daar slegs een geleentheid is om 'n nuwe boord te vestig, is dit van uiterste belang om seker te maak dat 'n ideale wortelsone geskep word voordat die bome geplant word. Dit sal bydra tot die lewenskragtigheid en ekonomiese lewensvatbaarheid van die boord oor die langtermyn. Regstellings nadat die boord gevestig is, is ontwrigtend, duur en die effektiwiteit is wisselvallig. Die gevaar van grondvoorbereiding is dat indien dit nie korrek uitgevoer word nie, dit groot langtermyn skade kan aanrig. Weens die rede is dit baie belangrik dat grondvoorbereiding noukeurig gemonitor moet word.

Belangrike punte voordat grondvoorbereiding plaasvind:

- Die land moet skoongemaak word en alle ou bome, wortels, strukture, dreine, operdwalle ens. moet verwyder word.
- Enige ashope wat oorbly nadat plantmateriaal gebrand is, moet uitgesprei word om te verseker dat die as nie in spesifieke areas gekonsentreerd is nie.
- Enige ou paaie wat in die blok voorkom en nie gebruik gaan word nie moet opgerip word.
- 'n Sistemiese onkruiddoder moet gebruik word om alle kweek en ander onkruid dood te spuit.
- Die aanbevole ameliorant hoeveelhede moet oor die volle grondoppervlak gestrooi word in die spesifieke ameliorantblokke soos aanbeveel deur Agrimotion Consulting. Die hoeveelheid ameliorante word uitgewerk op grond van die ***meng aksie se diepte*** soos aanbeveel in die verslag.
- Die skaal op die ameliorantkaart kan gebruik word om die ameliorantblokke uit te meet. Gebruik dan penne of kalk om die ameliorantblokke op die land uit te pen. Die meeste van die ameliorantblokke se sye loop parallel en loodreg met die paaie van die blok. Alternatiewelik kan 'n Variërende strooier en GPS kan gebruik word om die ameliorante uit te strooi. Agrimotion sal die shapefiles en ameliorant hoeveelhede aan die kontrakteur verskaf om die diens effektief uit te voer.
- Spoorelemente kan met sand gemeng word om die uitstrooi daarvan te vergemaklik.
- Nadat die ameliorante uitgestrooi is, moet dit 20-30cm in die grond in geploeg word om te verseker dat voldoende vermenging tydens grondvoorbereiding plaasvind. Die plaas se eie implemente kan vir die aksie gebruik word.
- Daarna word die aanbevole grondvoorbereiding gedoen.
- Dit kan voordelig wees om 'n paar gate te grawe in areas waar die dol dieptes verskil om die kontrakteur te wys hoekom die aanbevelings gemaak is.

Om te verseker dat die bogenoemde twee doelwitte van grondvoorbereiding bereik word, is daar hoofsaaklik twee tipes aksies wat aanbeveel kan word vir diep bewerking. Die eerste aksie is gefokus op die losmaak van die grond, terwyl die tweede tipe aksie beoog om grond vermenging te bewerkstellig. Die tegnieke en/of implemente wat voorgestel word sowel as die diepte van bewerking, word bepaal deur die grondtoestande, die ameliorant hoeveelhede en die gewas wat gevestig gaan word. Die belangrikste inligting aangaande hierdie losmaak- en meng aksies kan as volg opgesom word:

- **Die losmaak aksie** word tradisioneel uitgevoer met 'n skeur- of rip implement wat oor een of meer vertikale tande beskik wat deur die grond sny om so deur enige kompaksie, harde lae, rotse en/of ander growwe fragmente wat in die grond voorkom op te breek. Alle fisiese beperkings vir wortelgroei word dus opgehef. Die losmaak aksie vergroot ook die effektiewe grondoppervlakte wat blootgestel word aan ameliorante en maak dus 'n klein bydrae tot vermenging. Indien 'n nouer aanvoorwydte geïmplementeer word en 'n kruis aksie met die implement uitgevoer word, sal die vermengingseffek selfs meer wees. 'n Vlerk aan die agterkant en/of 'n skaar aan die onderpunt

van die vertikale tande kan ook vermenging tot 'n meerdere mate aanhelp. Indien daar van sulke implement aanpassings gebruik gemaak word, is dit belangrik om seker te maak dat die implement se tande nie klei van die onderste lae na die grondoppervlak toe opbring nie, veral in die geval waar 'n skaar op die toon van 'n implement aangebring is. *Die belangrikste bydra van die losmaak aksie vir ameliorant vermenging lê egter daarin dat dit 'n losser medium skep wat makliker met daaropvolgende meng aksies vermeng kan word.* Met die losmaak aksie is dit belangrik dat die diepste aksie (gewoonlik die tweede aksie) helling af moet plaasvind om interne dreinering te verbeter. Verder moet daar by die aanbevole bewerkingsdieptes en aanvoorwydtes gehou word.

- **Die meng aksie** se doel is ten einde 'n grondvolume te skep waarin ameliorante eweredig versprei is tot op 'n gespesifiseerde diepte. Om ameliorante in die grond in te meng is daar tradisioneel van implemente gebruik gemaak wat grondlae omkeer, deurmeng en basies op mekaar neersit (bv. dolploeg). Hierdie tipe implemente soos die dolploeg is goed geskik waar geen ondergrond beperkinge voorkom nie en die bo- en ondergrond relatief homogeen is. In baie gevalle is daar egter tekstuur en struktuur verskille tussen die bo- en ondergrond en sodoende veroorsaak 'n meng aksie wat die ondergrond op die bogrond omkeer onherstelbare skade. Onder toestande waar klei of baie growwe fragmente in die ondergrond voorkom moet die meng aksie eerder van bo na onder plaasvind m.a.w. die bogrond en die ameliorante wat op die grondoppervlakte gestrooi is moet afwaarts in die profiel in gewerk en vermeng word. Die gevolg is dat klei en/of klip nie na die grondoppervlakte toe opgebring word nie. Implemente wat vir die doeleindes gebruik kan word is die skuifdolploeg of selfs net tandimplemente wat oor drie of meer tande beskik wat met nouer aanvoorwydtes op die raamwerk geset is. Die skuifdolploeg werk op die beginsel dat dit eerder grond horisontaal verplaas om sodoende 'n voor te skep agter die rysterbord waardeur bogrond kan val en vermenging bewerkstellig word. Om 'n aksie met hierdie implement prakties uitvoerbaar te maak is daar egter nog steeds ±40cm se grond nodig wat vry is van enige beperkinge. Waar beperkende lae vlakker in die profiel voorkom (≤30cm) kan die bogenoemde tandimplemente aangewend word om beide die grond los te maak en ameliorante te vermeng. Die effektiwiteit van die vermengingseffek van hierdie meervoudige tandimplemente berus op die nouheid van die aanvoorwydte sowel as die aantal aksies wat uitgevoer word ('n kruis aksie 30-40° op mekaar moet nagestreef word). Indien 'n area hervestig word en die ryrigting verander, is dit belangrik om 'n kruismeng aksie uit te voer om nutriënt verskille tussen die ou plantrye en huidige werksrye uit te skakel. As dit kom by implementkeuses is daar 'n verskeidenheid aanpassings en uitvindings wat grondvermenging kan bewerkstellig. Maak egter seker dat die gekose implement die verwagte effek het.

Neem asseblief kennis van die volgende punte tydens grondvoorbereiding:

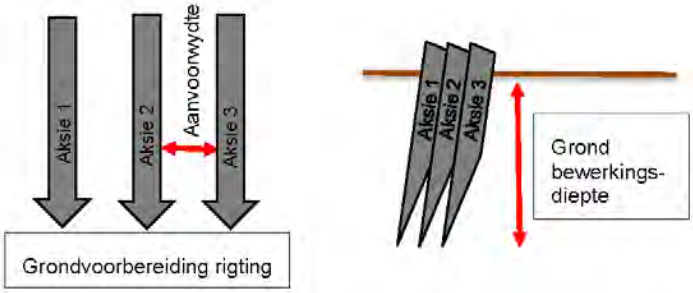
- **Grondvoorbereiding moet slegs geskied as grondvog korrek is**
  Dit is baie belangrik dat grondvoorbereiding by die korrekte grondvog toestande moet geskied. Dit is tussen veldwaterkapasiteit en die uitrolgrens. By die korrekte grondvog inhoud kan 'n balletjie grond in die hand gerol word wat sal verkrummel indien dit met jou duim gedruk word. *Sanderige gronde kan onder effens natter kondisies bewerk word om voldoende vermenging tussen die grond en ameliorante te verseker, maar daar moet nie vry water in u hand agter bly as die balletjie saamgepers word nie.* Dus moet die grond sigbaar nat wees, maar nie te nat nie.

  Die beste tyd van die jaar om grondvoorbereiding te behartig is na die reënseisoen as die gronde afgedroog het tot die korrekte grondvog inhoud. Indien grondvoorbereiding in die droë seisoen toegepas word, moet die land eers besproei word en daarna 'n paar dae laat staan word om die grond toe te laat om af te droog tot die ideale grondvog inhoud.

  Indien grondvoorbereiding plaasvind as die gronde te nat is, sal die implemente die grond smeer en kompakteer. Dit sal lei tot swak wortelontwikkeling, water- en suurstof penetrasie asook moontlike *Phytophthora* probleme. As die gronde onder te droë toestande bewerk word, sal swak ameliorant vermenging plaasvind. In hierdie geval vloei die grond om die rysterbord en val in die gat agter die rysterbord voordat die verrykte bogrond tot onder kan tuimel. In klei-ryke ondergronde is dit ook die geval dat groter kluite gebreek word waarvan die kern van die kluit nooit aan ameliorante blootgestel word nie. Die gevolg is dus dat daar eilande van grond in die wortelvolume voorkom wat nie chemies reggestel is nie.

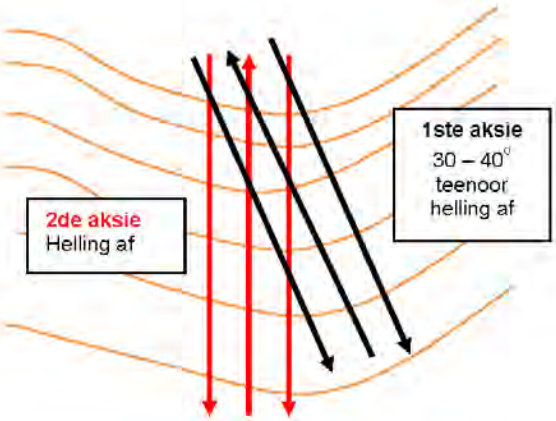
Figuur 5. Voorbeeld van die korrekte grondvog waarby grondvoorbereiding moet geskied.

- **Maak seker dat die aanvoorwydte 2/3 van die bewerkingsdiepte is**
  Deur die beginsel toe te pas sal verseker word dat die hele grondoppervlak bewerk word. Indien nie, sal daar sekere dele wees wat nie bewerk is nie en geen ameliorant vermenging plaasgevind het nie. Let wel: Aanvoorwydte verwys beide na die afstand tussen aksies en die afstand tussen individuele tande op 'n implement.



Figuur 6. Aanvoorwydte moet 2/3 van die bewerkingsdiepte wees.

- **Die tweede aksie moet 30-40° teenoor mekaar wees**
  Indien grondvoorbereiding in twee rigtings geskied (kruis aksie), moet die aksies 30-40° teenoor mekaar wees. Die *diepste losmaak aksie* moet helling af wees om dreinering te verbeter. Die *laaste meng aksie* moet in die aanbevole ryrigting wees om tonge van onvermengde grond in die plantry te vermy.



Figuur 7. Voorbeeld van 'n kruis aksie.

- **Moet nooit dieper as die aanbevole diepte bewerk nie**
  Die aanbevole diepte vir grondvoorbereiding is aanbeveel na gelang van die grondkondisies en spesifieke grondbeperkings wat waargeneem is tydens die grondopname. Wees versigtig om nie dieper as die aanbevole diepte te bewerk nie aangesien klei-, klip- en/of kalkhoudende horisonte na die oppervlak gebring kan word. Indien klei na die oppervlak gebring word, sal dit lei tot verseeling wat water- en suurstof penetrasie kan benadeel. Weens die *plaaslike variasie in gronddiepte*, kan horisonte wat oor 'n hoë klei inhoud beskik in sommige dele nader aan die grondoppervlak voorkom. Indien daar tydens grondvoorbereiding waargeneem word dat klei na die oppervlak gebring word, moet die bewerkingsdiepte dadelik verminder word. Sodra waargeneem word dat die kleilaag weer dieper voorkom, kan die bewerkingsdiepte diensooreenkomstig aangepas word.
  Let ook wel dat die effektiewe diepte van bewerking is gewoonlik tot en met 70% van die implement se lengte. Meer tande verhoog die weerstand op die implement en veroorsaak vlakker bewerking. So ook sal die gebruik van 'n trekker wat nie sterk genoeg is nie, nog vlakker bewerkingsdieptes tot gevolg hê.

- **Maak seker dat grondvoorbereiding tot op die blokgrense plaasvind.**
  Indien dit nie toegepas word nie sal die gewas nie na wense presteer naby aan die blokgrense nie.

- **Maak seker dat daar 'n tand agter die trekker wiele loop.**
  Die skeur- of rippertand moet in die trekker se wielspore loop om te verseker dat kompaksie opgehef word.

- **Na grondvoorbereiding moet geen wielverkeer oor die land plaasvind nie.**
  Indien suboppervlak dreinering installeer word na grondvoorbereiding, moet alle wielspore gerip word.

Nadat grondvoorbereiding plaasgevind het, kan die blokke en rye uitgepen word. Daarna kan operdwalle gemaak word en beroking kan uitgevoer word indien benodig.

5.2 AANBEVOLE GRONDVOORBEREIDING TE TRIPLE D FARMS

Lees die belangrike punte hierbo voordat enige grondvoorbereiding uitgevoer word.

Let wel: Die effektiewe diepte van bewerking is gewoonlik tot en met 70% van die implement se lengte. As die trekker nie sterk genoeg is nie of die implement beskik oor 'n groter aantal tande, kan die dieptes nog minder wees. Om uniformiteit oor die blok te verseker, is die dieptes en tipes aksies so vêr as moontlik dieselfde in 'n blok. Die uitvoer van die aanbeveling moet so prakties as moontlik wees sonder om in te boet op wetenskaplike korrektheid.

Die waargenome gronde te Triple D Farms bevat oor die algemeen 'n hoë klip% met gedeeltelik verweerde rots. Gevolglik gaan grondvoorbereiding daarop gemik moet wees om a) te verseker dat daar genoeg grondvolume geskep word waar die rots vlak voorkom, b) 'n los en fisies meer gunstige grondvolume vir tafeldruif verbouing geskep word en c) om te verseker dat effektiewe interne dreinering kan plaasvind.

'n Enkel aksie teen die helling af (noord-suid rigting parallel aan westelike grens) met 'n enkeltand skeurploeg (ripper) geset tot op 'n diepte van 120cm (100cm effektief) word aanbeveel om die gronde aanvanklik los te maak. Hiermee saam sal hierdie aksie ook help vir dreinering van besproeiingswater wat deur die seisoen toegedien gaan word sodat dit nie iewers vassteek en versuip toestande veroorsaak nie. Areas waar harde rotsbanke nie gebreek kan word nie moet gemerk word sodat die grootte van die area vasgestel kan word om te besluit of dit ekonomies sin sal maak om hierdie areas reg te stel al dan nie.

Om die gronde verder los te maak asook om die vermenging van ameliorante afwaarts in die profiel te bewerkstellig, moet 'n 2de kruis aksie 30-40° op die 1ste losmaak aksie uitgevoer word. Maak seker dat daar nie met die aksie klip en kalk na die oppervlakte toe opgebring word nie.

Tabel 2. Lys van bewerkingsaksies te Triple D Farms volgens die ameliorantkaart.

Ameliorantblok nommer	Bewerkingsaksie	Kommentaar
Alle blokke	1. 1ste losmaak aksie. Gebruik rip implement (enkeltand skeurploeg) en bewerk tot op 'n diepte van 120cm (effektief 100cm) in noord-suid rigting (parallel met die westelike grens) 2. 2de losmaak aksie. Gebruik rip implement (enkeltand skeurploeg) en bewerk tot op 'n diepte van 120cm (effektief 100cm) 30-40° W v N teen die helling af.	Maak seker dat daar nie klippe en vrykalk na die oppervlakte toe opgebring word tydens die grondbewerking nie.

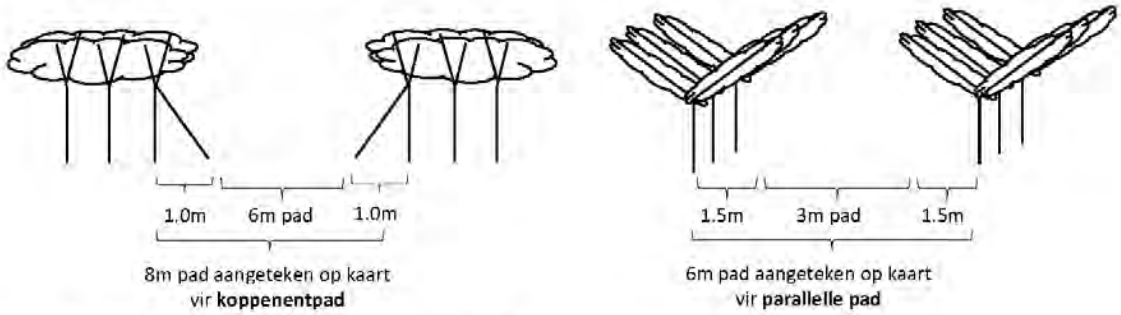
6. BLOKUITLEG

Die blokuitleg word op die blokuitlegkaart aangedui en blokke word geselekteer volgens die grondvorms, grondnatheid, ligonderskepping en kontoere van die betrokke blok. Na grondvoorbereiding kan die rye en die paaie uitgepen word soos aangedui op die blokuitlegkaart.

6.1 PAAIE

Op die blokuitlegkaart word die grense van die paaie aangedui waar die eerste ry stokke geplant moet word. Op die kaart is die koppenent paaie 8m wyd (*stokstam tot stokstam*) en parallelle paaie is 6m wyd (*stokstam tot stokstam*). Die paaie rondom die blok is ook 8m. 'n Trekker benodig ten minste 6m om te draai, alhoewel 7m meer ideaal is. Met wingerde wat opgelei is, is daar gewoonlik 'n ankerdraad wat 1.0-1.5m weg van die laaste stok af is. Dus is die koppenent paaie 1.0m + 6m + 1.0m = 8m. Met die parallelle paaie is die prieel omtrent 1.0-1.5m vanaf die stok (Figuur 8). Dus sal 'n 3m pad (effektief), 6m wyd wees op die blokuitlegkaart (1.5m + 3m + 1.5m).

Aanbevole paaie vir die nuwe ontwikkeling:



Figuur 8. Illustrasie van die aanbevole padwydtes

6.2 RYRIGTING

'n Ryrigting van tussen 30° oos en 30° wes van noord is ideaal vir sonlig onderskepping. Wes van noord is egter beter weens die verminderde risiko vir sonbrand temperatuur van die lower. Met tafeldruiwe is 'n oos-westelike ryrigting voordelig aangesien die son in die rigting beweeg en meer son penetreer tot die vloer van die blok tussen die gapings in die lower. Die helling van die spesifieke areas word ook in ag geneem sodat oppervlakwater maklik uit die blok kan vloei. Dit verseker dat water nie in die rye opdam nie. Verder word die huidige/voorgestelde paaie ook in ag geneem om te verhoed dat rye nie te lank of te kort is nie. Verder moet seker gemaak word dat die mikro-terrein egalig is en daar nie mikro-depressies of koppies voorkom wat waterbeweging kan beïnvloed nie.

Die aanbevole ryrigting vir die nuwe aanplantings sal dieselfde wees as die bestaande blokke, nl. oos-wes ryrigting.

6.3 BLOKUITLEG ONTWERP

Let wel dat daar 'n verskil is tussen stok-hektare en blok-hektare aangesien daar 'n ry stokke is aan die sy van die blok wat nie ingesluit is in die blok-hektare nie. Dus sal daar altyd meer stokke per hektaar wees as wat bereken is vanaf die blok-hektare. Die blok grootte word beplan vanaf die aantal rye.

7. DREINERING

7.1 ALGEMENE INLIGTING EN BEGINSELS VAN DREINERING

Inleiding:

Oormatige grondnatheid in die wortelsone is baie nadelig vir vrugte verbouing. Onder versuipde grondtoestande word suurstof uit die grond porieë verplaas wat die diffusie tempo van suurstof na die wortels vertraag. Wortels benodig suurstof vir sel respirasie, 'n sentrale proses wat nutriënt opname, energie produksie en groei reguleer. Prosesse soos nutriënt loging en element reduksie is ook prominent onder natter grondtoestande. Oor die algemeen is die grondtemperature onder natter toestande ook laer wat bydrae tot swak element opname en vertraagde fisiologiese stadia gedurende die seisoen. Die optimale grondtemperatuur vir element opname is tussen 18-23 °C. Nat gronde verteenwoordig ook gunstige kondisies vir die ontstaan en verspreiding van patogene wat lei tot wortelskade en wortelvrot.

Die nadelige effek van uitermatige natheid in die wortelsone kan tot 'n sekere mate verlig word deur die korrekte ryrigting en grondvoorbereidingsaksies in 'n plantblok toe te pas. Die beste en mees effektiewe metode om oortollige water uit 'n boord uit te verwyder, is egter deur oppervlakwater uit die boord uit te kanaliseer asook om ondergrondse dreinering te installeer.

Verskeie dreineringsopsies is beskikbaar vir hierdie doeleindes. 'n **Afsnydrein** bestaan uit 'n geperforeerde pyp wat onder die grondoppervlak gelê word en sub-oppervlakwater uit die boord uit verwyder. 'n **French drein** beskik oor 'n soortgelyke ontwerp, behalwe dat die sloot gevul word met klip tot op die oppervlak en nie met grond soos in die geval van 'n afsnydrein nie. Gevolglik is 'n French drein in staat om beide oppervlak- en sub-oppervlakwater op te vang (Figuur 9).

'n Alternatiewe dreineringsopsie is die gebruik van oopslote. 'n **Oopsloot** is tipies 1.2m diep en word gebruik met die doel om oppervlak water op te vang voordat die water in 'n spesifieke boord invloei van hoërliggende areas. Vanuit 'n bestuur oogpunt is dit belangrik om die oopslote in stand te hou deur grond en onbeheerde plantegroei te verwyder wat dreinering kan verhinder. Die wande van die sloot moet nie loodreg af gemaak word nie, maar eerder meer teen 'n hoek sodat 'n dekgewas op die oppervlak gevestig kan word. Dit sal erosie voorkom.

Belangrike punte om van kennis te neem tydens die <u>ontwerp van 'n dreineringstelsel</u>:

- Sub-oppervlak dreineringspype moet deur die blok loop, ongeag die ryrigting.
- Die pyp moet 'n konstante val van tussen 1-3% hê.
- Indien die drein ontwerp is om in 'n duik te sit, moet oordeel in die veld geneem word om die drein in die regte posisie te installeer.
- Dit is belangrik dat daar 'n konstante val teenwoordig is van die begin punt van die drein tot by die eindpunt. Indien daar variasie is in die gronddiepte, moet die sloot waarin die dreineringspyp gelê word dieper gemaak word, sodat die water steeds in die pyp kan vloei. In natter areas of areas waar duike in die landskap voorkom, is dit belangrik om van 'n "visgraad" ontwerp gebruik te maak.

Figuur 9. Voorbeeld van 'n afsny- en French drein.

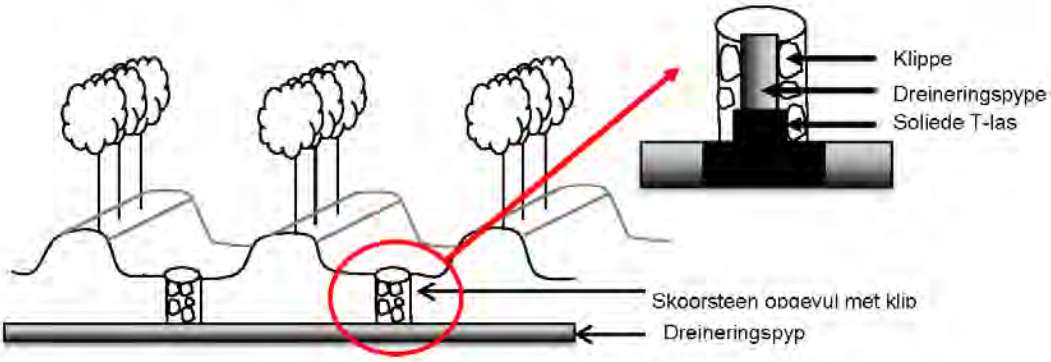
Konstruksie van 'n drein:

Die onderkant van die sloot waarin die dreineringspyp gelê word, moet 20-30cm onder die diepste grondvoorbereiding diepte wees (ten minste 1m diep om pype te beskerm gedurende toekomstige ontwikkelings). Hierdie diepte sal gewoonlik binne die klei of saprolitiese laag geskied. Onder normale omstandighede sal water bo-op die beperkende laag versamel, maar deur die sloot waarin die dreinering gelê word binne die beperkende laag te maak, gee dit die water die geleentheid om 'n kapilêre druk op te bou wat die water in die dreineringspyp in forseer. Indien die gronde nie oor 'n beperkende laag/horison beskik nie, moet die dreinering op 'n diepte van 1.2-1.5m geïnstalleer word. Die sloot waarin die dreineringpyp gelê word, moet so smal as moontlik wees om die hoeveelheid klei wat verwyder word te minimaliseer. Hierdie klei moet dan uit die blok verwyder word en nie terug geplaas word in die sloot bo die dreineringspyp nie. Grawe altyd die sloot van onder af na boontoe. 'n Gruis laag waarvan die gruis 1cm in deursnee is, moet om die pyp geplaas word. Moet nooit bidem rondom die pyp plaas nie, want oor tyd sal ysteroksides in die bidem vas sit en toe seël. Onder die pyp moet die gruis 10cm dik wees terwyl die gruis rondom die pyp dieselfde dikte as die pyp moet wees. PVC

pype word aanbeveel met 'n wanddikte van 1.5mm tot 4.3mm. Die pyp deursnee sal bepaal word deur 'n dreinerings spesialis, maar is gewoonlik 75-110mm. Die gaatjies in die pyp waardeur die water in die pyp inbeweeg moet 8mm in deursnee wees en 80mm uitmekaar. Pype met twee rye gaatjies kan gebruik word vir optimale dreinering. Dit is belangrik dat die gaatjies afwaarts teen 'n helling van 120 ° is om effektiewe vervoer van water te verseker. Tydens die installering van 'n afsnydrein moet 'n plastieklaag bo die gruis geplaas word om te verhoed dat grond in die gruislaag in beweeg wat kan veroorsaak dat die drein verstop. Die sloot word dan opgevul met grond indien dit 'n afsnydrein is, anders met klip as dit 'n French drein is.

Dit is belangrik dat dreine aan die bokant van paaie geinstalleer word en dat alle wielverkeer aan die helling af kant van die drein plaasvind. Deur die bestuurspraktyk toe te pas sal verseker word dat geen grondkompaksie wat dreinering kan beinvloed plaasvind nie. Na die installasie van die dreinering moet alle wielspore en kompaksie opgehef word deur 'n ripaksie uit te voer. Vir verdere tegniese advies, raadpleeg asb 'n dreinerings spesialis.

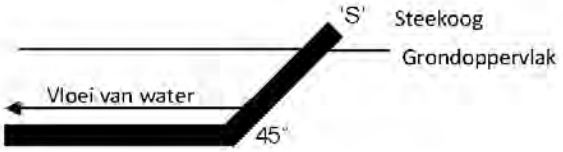
Die konstruksie van 'n French drein benodig 'n groot hoeveelheid klip om alle dreineringslote op te vul. Indien daar nie genoeg klip beskikbaar is nie, kan gebruik gemaak word van die "skoorsteen" ontwerp. Die beginsel is 'n kombinasie van die afsnydrein en French drein konsep, soos geillustreer in Figuur 10. Die dreineringspyp word op 'n soortgelyke manier geinstalleer as 'n afsnydrein, behalwe dat 'n metaal drom in die werkrye bo die dreineringspyp geplaas word. 'n Vertikale dreineringspyp moet met 'n T-aansluit by die horisontale dreineringspyp. Die drom word met klip opgevul rondom die vertikale pyp, terwyl die res van die sloot met grond opgevul word. As die drom klaar met klip opgevul is, word die drom verwyder en die "skoorsteen" bly agter. Die ontwerp verminder die hoeveelheid klip wat benodig word en verminder dus die kostes betrokke aan dreinering. Strooi of snoeisels moet bo-op die skoorsteen geplaas word om te verhoed dat grond en slik die skoorsteen verstop.



Figuur 10. Voorbeeld van sub-oppervlak dreinering deur gebruik te maak van die skoorsteen metode.

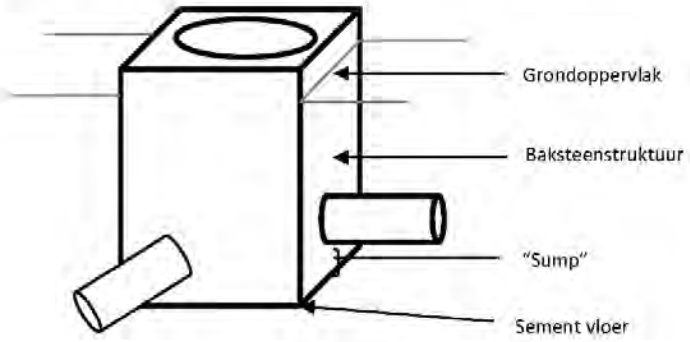
Belangrike punte om van kennis te neem tydens die <u>installasie van dreins</u>:

- Installeer dreinering gedurende die droë seisoen nadat grondvoorbereiding plaasgevind het.
- Versterk dreine wat onder paaie deurloop.
- Dreine wat naby windbreke geinstalleer is, moet nie gaatjies bevat nie om te verhoed dat wortels in die pyp ingroei en tot verstoppings lei. Onder ideale toestande moet dreinering nie binne 20m van 'n Beefwoord windbreek geinstalleer word nie.
- Dreineringswater moet in sentrale kanale deponeer word wat in nabye riviere, strome of damme invloei.
- Monitor die uitvloei van dreineringspype en indien daar 'n afname in die vloeitempo is, moet die dreineringspype skoongemaak word.
- Sub-oppervlak dreine moet 'n steekoog by die drein se oorsprong hê soos in Figuur 11 aangedui word. Die dreineringpyp buig met 'n 45° hoek na die oppervlak en bevat 'n klep.



Figuur 11. Voorbeeld van 'n steekoog.

- Waar dreineringspype van rigting verander, by mekaar invoer, of waar 'n dreineringspyp langer as 200m is, moet 'n mangat geïnstalleer word. Alle mangate (Figuur 12) moet 'n deksel hê wat bo die grond uitsteek, groot genoeg wees vir 'n persoon om in te klim en 'n filter (sump) aan die onderkant hê om slik op te vang.



Figuur 12. Voorbeeld van 'n mangat.

- Dreineringspype moet op 'n jaarlikse basis skoongemaak word om enige ysteroksied en wortels te verwyder voordat dit tot watervloei probleme lei. Dit word gedoen deur skoonmaak gereedskap vanaf die steekoë en mangate deur die sisteem te trek.
- Maak gebruik van 'n klep by dreinpype se uitlaatpunte wat toeval indien die water ophou vloei om te verhoed dat diere soos muise en rotte in die dreineringspype inklim.

Alternatiewelik vir meer tegniese advies oor dreinering installasies, kontak die dreinering spesialiste by die Departement Landbou.

7.2 DREINERINGSAANBEVELING TE TRIPLE D FARMS

Oop slote (**blou lyn** soos aangedui op die blokuitlegkaart) moet behou word om storm water uit die hoërliggende areas, tydens 'n groot reënbui, te kanaliseer sodat dit nie deur die blokke vloei en skade aanrig nie.

Daar word geen suboppervlak dreinering aanbeveel vir die nuwe ontwikkeling nie. Die aanbevole grondvoorbereiding behoort voldoende te wees om besproeiingswater wat toegedien word te dreineer. Waar grondbewerking nie harde rots wat vlakker voorkom kan breek nie, kan dreinering 'n probleem wees omdat die water by hierdie areas sal vassteek. Dit is belangrik om die grootte van hierdie areas te bepaal en daarvolgens kan besluit word om dreinering te installeer.

8. HERVESTIGINGSAKSIES

Voor plant

Aangesien daar nie voorheen tafeldruiwe op die grond verbou is nie sal dit nie nodig wees om die grond te berook nie. Neem egter die gepaste na oes stappe om te verseker dat aalwurms onder beheer gehou word. Die besproeiingswater moet ook gemonitor word om seker te maak dat dit nie die grond met aalwurm besmet nie.

Na plant:

Behandel vir aalwurms in die eerste seisoen met 2.5ml/m² Nemacure 3 weke na bot, 20ml Rugby per stok 3 maande later en monitor die wingerd die volgende Desember vir aalwurms. Daarna moet elke 3 jaar gemonitor word vir die leeftyd van die wingerd. Grondmonsters kan aan Nemlab (021 875 8160) gestuur word vir ontledings.

Dien 'n enkel Phytex 200SL bespuiting (1lit /100lit) teen *Phytophthora* in November na plant toe en weer in April (5 maande later). Dieselfde bespuiting kan weer in die tweede seisoen herhaal word indien *Phytophthora* probleme waargeneem word op die jongste aanplantings. Phytex moet nie toegedien word terwyl dag temperature hoër as 30°C is nie. Stokke moet transpireer, maar nie onder droogte of stres verkeer nie.

9. WINDLANINGS

Geen windlanings word aanbeveel vir die nuwe ontwikkeling te Triple D Farms nie.

10. PLANTMATERIAAL EN PLANT PROSEDURES

Gebruik slegs die beste plantmateriaal en gesertifiseerde materiaal wat siektevry is om wingerde te vestig. Die regte tyd van die jaar om wingerde te plant is in die winter, maar gronde moet nie te nat wees nie. Gronde moet afdroog voordat stokke aangeplant word. Indien gronde smeer as gate gemaak word, is die grond nog te nat. Vroeë kultivars moet vroeg geplant word.

Plant met 'n waterkar en wees versigtig vir uitdroging tydens opberging en plant. Met die maak van die plantgate, wees versigtig om nie die wande met die graaf te smeer nie. Breek die wande van die gate tydens plant met 'n spitvurk om te verhoed dat 'n poteffek vorm waardeur wortels nie kan groei nie. Vul die plantholtes goed op met grond na plant om te verseker dat daar nie 'n holte vorm rondom die stam wanneer die grond sak nie. Dit sal die aansameling van water en gepaardgaande *Phytophthora* infeksie verhoed. Stokke moet so vinnig as moontlik gestut word deur van 'n opleistelsel gebruik te maak. Hoe vinniger die stokke gestut word, hoe beter sal die stokke groei.

11. BESPROEIINGSTELSEL, BESPROEIINGSBREKE EN VOGMETER POSISIES

Dit is belangrik dat die besproeiingsisteem vir die nuwe blokke inpas by die algehele bestuur van die plaas asook die bestaande stelsels. Dit is egter net so belangrik om grondeienskappe in ag te neem om te verseker dat die gekose besproeiingstelsel nie net maklik bestuurbaar is nie, maar ook gepas is vir die spesifieke grondkondisies. Die gronde van die nuwe ontwikkeling te Triple D Farms bevat 'n hoë klip% wat beteken dat die grond oor 'n lae waterhouvermoë beskik. Huidiglik word drip besproeiing

(enkellyn) oor die grootste gedeelte van die plaas aangewend en gevolglik word dit aanbeveel dat 'n dripstelsel ook geïnstalleer word vir die nuwe blokke te Triple D Farms. 'n Dubbel dripperlyn met spasiëring van 0.6m tussen die drippers en 'n lewering van 1.6L/h elk word aanbeveel. 'n Dubbel driplyn sal sorg vir 'n groter benattingswydte en dus 'n groter wortelvolume. Vir verdere navrae en beplanning rakende die besproeiingstelsel en ontwerp, kontak asseblief u huidige besproeiingskonsultant.

Besproeiing	Spasiëring	Lewering	Jaar 1: enkellyn	Jaar 2+: dubbellyn
Drip	3m x 0.6m	1.6L/uur	8.89m³/ha/uur	17.78 m³/ha/uur

Besproeiingsbreke word normaalweg aanbeveel waar 'n noemenswaardige verskil in die gronde se waterhouvermoë (verskil in klei persentasie en / of growwe fragmente) voorkom. So ook sal dit slegs aanbeveel word indien die area prakties groot genoeg is om as individuele besproeiingsafdelings hanteer te word. In die geval van Triple D Farms sal besproeiingsbreke slegs aanbeveel word as die klip% in 'n blok met meer as 30% verskil. Weens die uniformiteit van die bogrond is geen besproeiingsbreke aanbeveel vir die nuwe ontwikkeling nie.

Potensiële vogmeterposisies word op die blokuitlegkaart aangedui in pienk. Indien die plaas van die instrumente gebruik maak vir besproeiingskedulering doeleindes, word dit aanbeveel dat vogmeters in die spesifieke posisies geplaas word. Die vogmeters moet in 'n verteenwoordigende grondliggaam geïnstalleer word wat die helling sowel as die natuurlike watervloei in ag neem. As daar tussen twee gronde met effens verskillende waterhouvermoëns gekies moet word vir die plasing van vogmeters, sal die grond met die laer waterhouvermoë gebruik word. Die grond sal meer gereeld deur middel van kleiner pulse besproei word. Vanuit 'n bestuursposisie moet die vogmeters maklik bereikbaar wees vir diens doeleindes asook naby 'n geklassifiseerde grondprofiel vir kalibrasie doeleindes. Die vogmeter moet beskerm word deur 'n staal hok, of soortgelyk, bo-oor die meter te plaas. Die hok moet nie die vloei van water op die oppervlak of onder die grond affekteer nie.

Dit is belangrik om te onthou dat die probe slegs effektief is oor 'n paar sentimeter se grond en die paar sentimeter moet verteenwoordigend wees vir die hele blok.

Wanneer die probe geïnstalleer word, maak seker van die volgende:

- Dit is belangrik dat die probe naby aan 'n verteenwoordigende boom geplaas word om te verseker dat die water wat gebruik word, die hele blok verteenwoordig en nie 'n siek of inboet boom nie.
- Dit is van kardinale belang dat die probe *in die aktiewe wortelsone geplaas moet word* om water onttrekking vanuit die grond te monitor.
- Die probe moet in die benatte sone geïnstalleer wees. Met **drip besproeiing**, moet die lyne vasgepen word om te verhoed dat die lyne nie per ongeluk weg van die probe geskuif word nie. Aangesien sande vinniger dreineer as klei gronde, moet die probe nader aan die dripper geplaas word. Die probe moet 10-15cm weg van die dripper gepen word. 15cm weg van die dripper is te vêr op sanderige gronde. Dieselfde geld vir meer klipperige gronde.

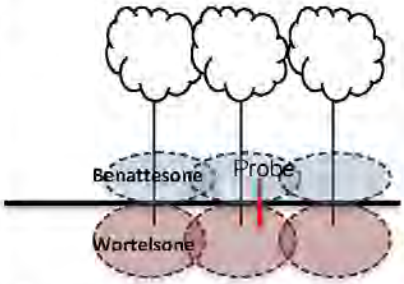


Figure 13. Uitbeelding van probe plasing.

- Daar moet geen obstruksie wees tussen die waterbron en die probe nie (Bv. 'n paal, rots, onkruid ens).
- Wees bewus van die vorm van die grondoppervlak rondom die probe veral op operdwalle. As die grond konveks is, sal die meeste van die water vloei van die probe af. Dus sal die probe droë grondtoestande aandui wat nie verteenwoordigend is nie. As die oppervlak konkaaf is, sal water rondom die probe akkumuleer en die probe sal natter toestande aandui.
- Die wydte van die gat vir installasie moet net dunner as die deursnee van die probe wees om effektiewe kontak met die grond te verseker. Enige lugborrels sal die lesings affekteer. As die

gat te nou is, sal die grond gekompakteer word en dit sal ook die lesings affekteer. Met die dunner probes, kan 'n staal pen gebruik word om die gate te maak of 'n grondboor vir die dikker probes. Die gate moet gemaak word wanneer die grondvog optimaal is (dieselfde as by grondvoorbereiding). As klei grond te nat is tydens installasie, sal die wande van die gat smeer en die probe lesings nie akkuraat wees nie. Nadat die gat gemaak is, word 'n 'slurry' van die grond vanuit die gat gemaak. *Moenie klei grond of nie-verteenwoordigende grond gebruik om die 'slurry' te maak nie.* Vul die gat twee derdes vol met die 'slurry' en druk die probe in. Die probe moet goeie kontak maak met die grond.

12. VOEDING VIR JONG, NIE-DRAENDE BOORDE

Bemestingsprogram vir jong, nie-draende tafeldruiwe

Kontak vir Agrimotion vir die opstel van 'n fertigasie program vir die jongstokke

Blaarvoeding vir jong, nie-draende tafeldruiwe

Dien mengsel A drie weke na bot toe en volg 7-10 dae later op met mengsel B. Herhaal hierdie prosedure tot 'n maksimum van drie toedienings elk tot einde Desember. Die mees effektiewe opname vind plaas deur die nuwe blare. Dit is belangrik dat blare effektief benat word aan albei kante van die blaar, veral met mengsel B. Indien Ystertekorte voorkom, moet dit reggestel word deur gebruik te maak van Ysterchelaat. Urea en Progibb (4%) kan uitgelaat word indien die bome te geil raak. 'n Insek- of plaagdoder kan by gevoeg word indien nodig, maar nie olie of Phytex nie.

JONGBOOM BLAARVOEDING AANBEVELING

	Hoeveelhede (g of mℓ/100ℓ)	
Fase	A	B
Spuitureum (LB)	250g	400g
MAP	250g	-
Goëmar BM86E	200ml	200ml
*Progibb (4%)	20ml	-
Mangaansulfaat	25g	-
Sinkoksied	50g	-
Koper-oksi-chloried	-	20g
Solubor	-	25g
Biodew	6mℓ	6mℓ

*Gebruik 2g Progibb as dit die 40% formulasie is.

Spuit Magnisal (800g/100lit) in November en herhaal teen middel Desember in die weke tussen een stel A/B en 'n volgende. Die produkte moet apart gespuit word met minstens 7 dae tussen die produk en die blaarvoeding mengsel om enige brand te verhoed. Moenie op 'n baie warm dag spuit nie.

Ekwivalente produkte soos Tsama Mag (250ml/100lit), Quatro Mag (260ml/100lit) of Foliamag (250ml/100lit) kan ook gebruik word. Voeg 'n insek of swam middel by die B mengsel indien nodig. Voeg 'n swam middel by mengsel A indien nodig. Indien Dithane gebruik word kan die Mangaan Sulfaat uitgelaat word.

13. DEKLAAG

Aalwurmbehandeling, waar nodig, moet eers plaasvind asook opvolg toetse om die effektiwiteit daarvan te bepaal voordat 'n deklaag (of mulch) toegedien word. Deklae verminder kompaksie, lei tot meer geskikte grondtemperature, verbeter waterinfiltrasie en bewaar grondvog. Dit verhoed ook dat grond met afloopwater vanaf 'n bankie verwyder word. By gronde wat oor 'n hoë growwe fragment inhoud beskik, is 'n deklaag voordelig om grondvog te bewaar en verdamping te verminder. Voor bot kan die deklaag van die operdwalle afgeskuif word, sodat gronde vinniger warmer word. Later in die seisoen kan die deklae weer terug geskuif word, sodat die gronde nie te warm word gedurende piek temperature nie.

Deklae dra verder ook by tot plaagbeheer, verbeterde biologiese aktiwiteit in die grond en grondstruktuur. In boorde waar jongbome is, kan vrot strooi of denne chips gebruik word om die bankie te bedek nadat die eerste vol besproeiingsiklus toegedien is. Dit is belangrik om 'n handbreedte spasie om die stam oop te hou en nie te bedek met denne chips of strooi nie. Dit is belangrik om te verhoed dat *Phytophthora* infeksie voorkom.

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APPENDIX H7: Fresh Water Assessment

Fresh Water Report

Proposed Agricultural Development on

Portion of Farm Kakamas

A requirement in terms of the National Water Act (36 of 1998).

August 2018

WATSAN *Africa*

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Abbreviations

Average Score Per Taxon	ASPT
Critical Biodiversity Area	CBA
Department of Environmental Affairs and Development Planning	DEA&DP
Department of Water and Sanitation	DWA
Ecological Importance	EI
Ecological Sensitivity	ES
Ecological Support Area	ESA
Environmental Impact Assessment	EIA
Electronic Water Use License Application (on-line)	eWULAA
Government Notice	GN
Metres Above Sea Level	masl
National Environmental Management Act (107 of 1998)	NEMA
National Freshwater Environment Priority Area	NFEPA
National Water Act (36 of 1998)	NWA
Northern Cape Department of Environment and Nature Conservation	DENC
Present Ecological State	PES
South Africa National Biodiversity Institute	SANBI
South African Scoring System Version 5	SASS5
Wastewater Treatment Works	WWTW
Water Use License Application	WULA

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1 Introduction

Triple D Farms (www.ddd-farms.com) is a well-established grape farming operation near Kakamas on the Northern Cape. This is an extremely well-run and modern business that is managed according to sound management principles by a team of qualified and experienced professional people.

Triple D Farms is planning to expand its current operation with another 100 hectares.

The new development is intersected by a drainage line that triggers the need for a Water Use Licence Application (WULA) in terms of section 21 of the National Water Act (NWA, 36 of 1998). This is a legal requirement, apart from the Environmental Impact Assessment (EIA) in terms of the National Environmental Management Act (107 of 1998). The WULA should be regarded as an integral part and parallel process to the EIA.

A Fresh Water Report (recently re-named Technical Report), apart from a completed set of official application forms, is a WULA requirement.

Triple D Farms appointed Enviro Africa to launch the EIA on its behalf. Enviro-Africa, in turn, appointed Dr Dirk van Driel of WATSAN Africa to deal with the WULA.

Two water courses are impacted by the proposed development, the drainage line as well as the Orange River. For the purpose of the WULA, these two will have to be assessed according to the prescribed methodologies.

2 Triple D Farm Fact Sheet

Farm Name:	Perseel 2435 Kakamas Suid Nedersetting Kenhardt RD
Deeds Office:	Kimberley
Municipality:	Kai !Garib
Size:	309.1548 ha
Title Deed:	T4689/2018
Date of Title Deed:	2018/12/05
Cadastral Code:	None given on SANBI BGIS
Company Registration:	1999/00125/07
Registration Date:	1999/01/20
Quaternary Catchment:	D53J
Postal Address:	PO Box 537, Kakamas 8870
Street Address:	Perseel 2435, N14, Kakamas
Contact Person:	Mr PT Dykman
Telephone:	054 431 1568
Contact email:	piet@dddfarms.net
VAT No.:	12345

The reach of the drainage line that will be developed stretches over a distance of 2.3km along the following coordinates:

28°45'43.01" S; 20°35'09.43E and
28°46'55.45" S; 20°35'11.67E

3 The New Agricultural Development

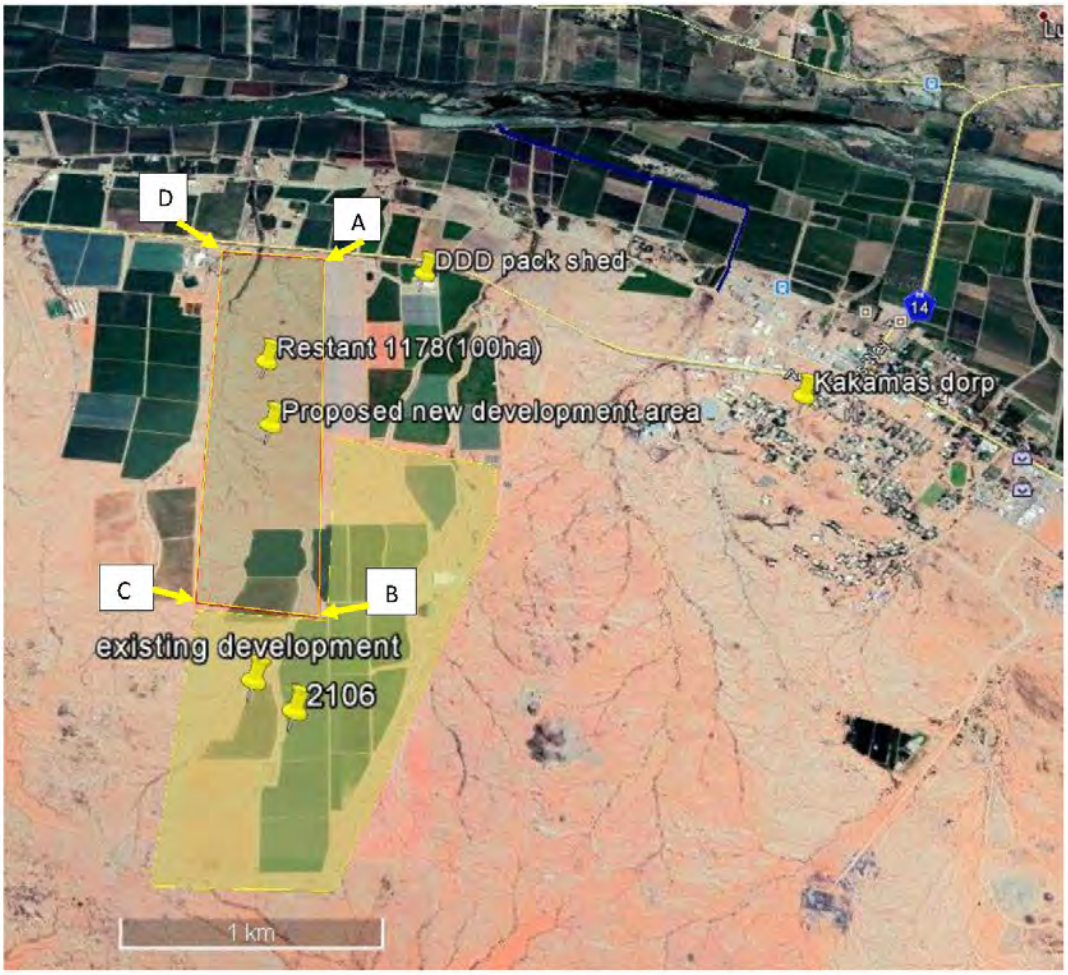


Figure 1 New Development

Table 1 Coordinates

Point	Coordinates
A	28°45'44.37"S; 20°35'21.06"E
B	28°46'56.39"S; 20°35'21.43"E
C	28°46'53.33"S; 20°35'01.21"E
D	28°45'42.89"S; 20°35'02.42"E

The new development is depicted in Figure 1. It is 1.1km long and 0.5km wide. It covers an area of 100 hectares. A small part along the southern boundary has previously been developed.

The highest point on the southern boundary is 692masl and the lowest on the N14 trunk road is 662masl. This represents slope of 2.7 (a drop of 2.7m in every 100 vertical metres).

For the most part this is virgin land that has not been tilled before. There are signs of heavy earth moving machinery that has moved over the land before, so it van hardly be described as pristine.

The drainage lines in the upper sub-catchment are faint. Closer to the N14 it is deeper, incised.

4 Legal Framework

The proposed development "triggers" sections of the National Water Act. These are the following:

S21 (c) *Impeding or diverting the flow of a water course*

The proposed development is spanning the banks of a drainage line. The drainage line would be altered, should the development go ahead.

S21 (i) *Altering the bed, bank, course of characteristics of a water course.*

Some part of the proposed development will alter the characteristics of the banks of the drainage line.

Government Notice 267 of 24 March 2017

Government Notice 1180 of 2002. *Risk Matrix.*

The Risk Matrix as published on the DWS official webpage must be completed and submitted along with the Water Use Licence Application (WULA). The outcome of this risk assessment determines if a letter of consent, a General Authorization or a License is required.

Government Notice 509 of 26 August 2016

An extensive set of regulations that apply to any development in a water course is listed in this government notice in terms of Section 24 of the NWA. No development take place within the 1:100 year-flood line without the consent of the DWS. If the 1:100-year flood line flood line is not known, no development may take place within a 100m from a water course without the consent of the DWS.

Likewise, the development triggers a part of the National Environmental Management Act, NEMA, 107 of 1998).

The EIA Regulations of 2014 No.1 Activity 12 states that no development may take place within 32 m of a water course without the consent of the Department of Environmental Affairs and its provincial representatives. A part of the development is in the river and the river bed. Consequently, this regulation is relevant to this application.

5 Climate Kakamas

Kakamas normally receives about 62mm of rain per year, with most rainfall occurring mainly during autumn. The chart below (lower left) shows the average rainfall values for Kakamas per month. It receives the lowest rainfall (0mm) in June and the highest (19mm) in March. The monthly distribution of average daily maximum temperatures (centre chart below) shows that the average midday temperatures for Kakamas range from 20°C in July to 33°C in January. The region is the coldest during July when the mercury drops to 3.1°C on average during the night.

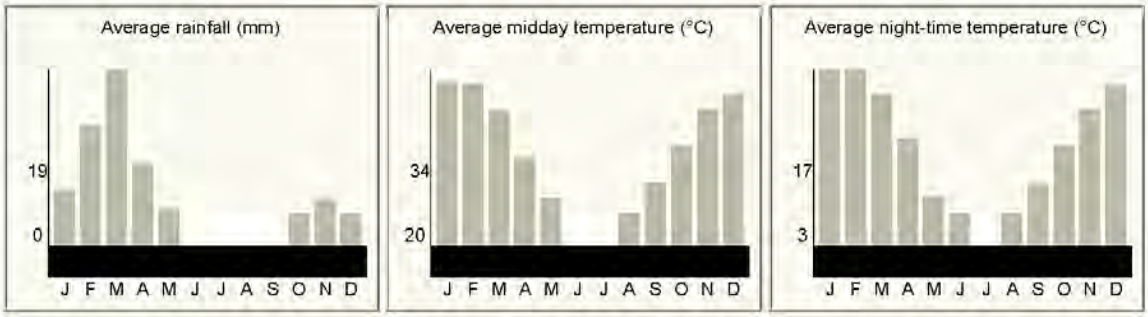


Figure 2 Kakamas Climate

Kakamas is arid. During 4 months of the year it does not rain at all.

The economy entirely dependent on water abstraction from the Orange River.

It is evident from Figure 2 that this is an arid region. The drainage lines exist because of sudden and intense downpours that occur only once in several years. These must have been formed over millennia since historical times.

The contribution to the flow in the Orange River is negligible.

6 The Sub-Catchment

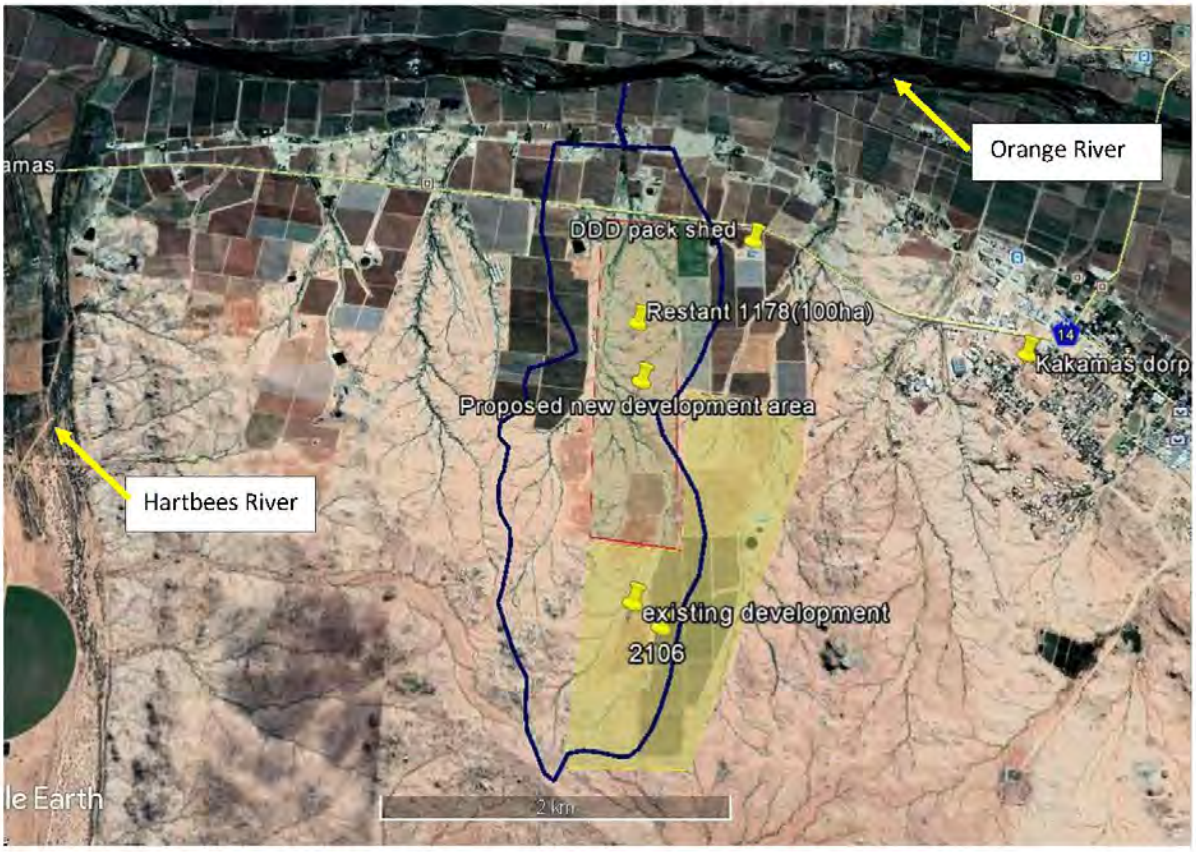


Figure 3 Sub-Catchment

The Lower Orange River is flanked by numerous drainage lines, which are mostly dry and only contain water during the occasional thunder storm. These drainage lines are a part of the arid landscape. These are nevertheless drainage lines with water flows strong enough to maintain its morphological integrity. These sudden and intense storms occur only occasionally, perhaps once in several years.

The drainage lines are poorly demarcated by vegetation. The scrub and small trees are the same as those further afield away from the drainage lines. Only the stand of higher vegetation is denser around drainage lines.

One such drainage line runs through the Triple D property that is now earmarked for development into vineyards (Figure 3). It is this drainage line that triggered the legal requirement for a Water Use License Application.

Benches and terraces, as described in DWAF wetlands and riparian zone field guide, are generally ill defined or absent, with only a wide floodplain in which transported material has been deposited as is the Triple D drainage line higher up the sub-catchments. It is pronounced and incised lower down closer to the trunk road.

There are two smaller drainage lines towards the west between the Triple D property and the Hartbees River.

The Hartbees River rises as the Sak River on the highlands to the south of Sutherland more than 300km to the south. A series of pans separate the Sak River from the Hartbees River. The Hartbees River only flows when these pans overflow. This happened in 1999 and in 2010. It is expected that these overflows will occur less often in future as water abstraction from the Sak River for agriculture increases.

It is however important to note that the Sak River as well as all of the drainage lines along the Orange River does not contribute towards the Mean Annual Runoff (MAR) of the Orange River. This is an arid region and its contribution is negligible.

The sub-catchment (Figure 3) covers 415 hectares. It is 10.4 km in circumference, 4.7km long and 114 m at its widest. The N14 trunk road cuts the sub-catchment off from its natural confluence with the Orange River.

From the N14 trunk road the drainage line has been partially formalised and where it flows through the vineyards along the Orange River, it has been channelled into a straight furrow (Figure 4).

Figure 4 Furrow downstream of the N14 Road Bridge

The drainage line passes underneath the N14 road through a bridge (Figure 5).

Figure 5 N14 Road Bridge

A dense stand of *Phragmitis* reeds covers the bottom of the drainage line upstream and adjacent to the road bridge (Figure 6). These reeds are maintained by the scant agricultural return flow and not natural flow down the drainage line.

Figure 6 *Phragmitis* reeds adjacent to the N14 Road Bridge

Further up the drainage line conditions are more natural. There are not any signs of riparian vegetation or hydromorphic soils. The drainage line was bone dry (Figure 7).

Figure 7 Drainage line further upstream of the N14 Road Bridge

Part of the sub-catchment has been transformed into manicured vineyards. Here it is hard to establish the natural boundaries, as the pattern of the drainage lines are no longer visible on Google Earth. This leaves room for guesswork, as far as an accurate estimation of the surface area is concerned.

The South African National Biodiversity Institute (SANBI) indicated the vegetation type at the proposed agriculture development as Bushmanland Arid Grassland. This is not listed as endangered in any way. The Orange River is indicated as a National Freshwater Ecosystem Priority Area (NFEPA). The islands and riparian area are indicated as Nama Karoo Bushmanland Floodplain Wetland, despite it being developed into manicured agriculture.

In the drainage lines, on the riparian zones, the dominant tree is swarthaak *Senegalia mellifera*. The vegetation here can be higher than that of the surrounding land, which provides habitat to a variety of organisms that would not have been present, were it not for these drainage lines. The drainage line on the proposed new development does not bear testimony of this taller vegetation and therefore does not contribute to this form of varied habitat.

7 Impact

A realistic and most probable impact of the proposed vineyard development is illustrated by the existing vineyards of the Triple D property. The drainage lines have been formalised, as is evident on Figure 8.

Figure 8 Formalised drainage line

Again, in these formalised furrows there was no sign of any aquatic habitat or riparian zone during the site visits. The only wetness was of a little agricultural return flow that emanated from the filling of a tanker from a valve in a water line.

It is fully expected that the drainage line on the proposed development would very much resemble the ones on the already developed property.

8 Biomonitoring Orange River

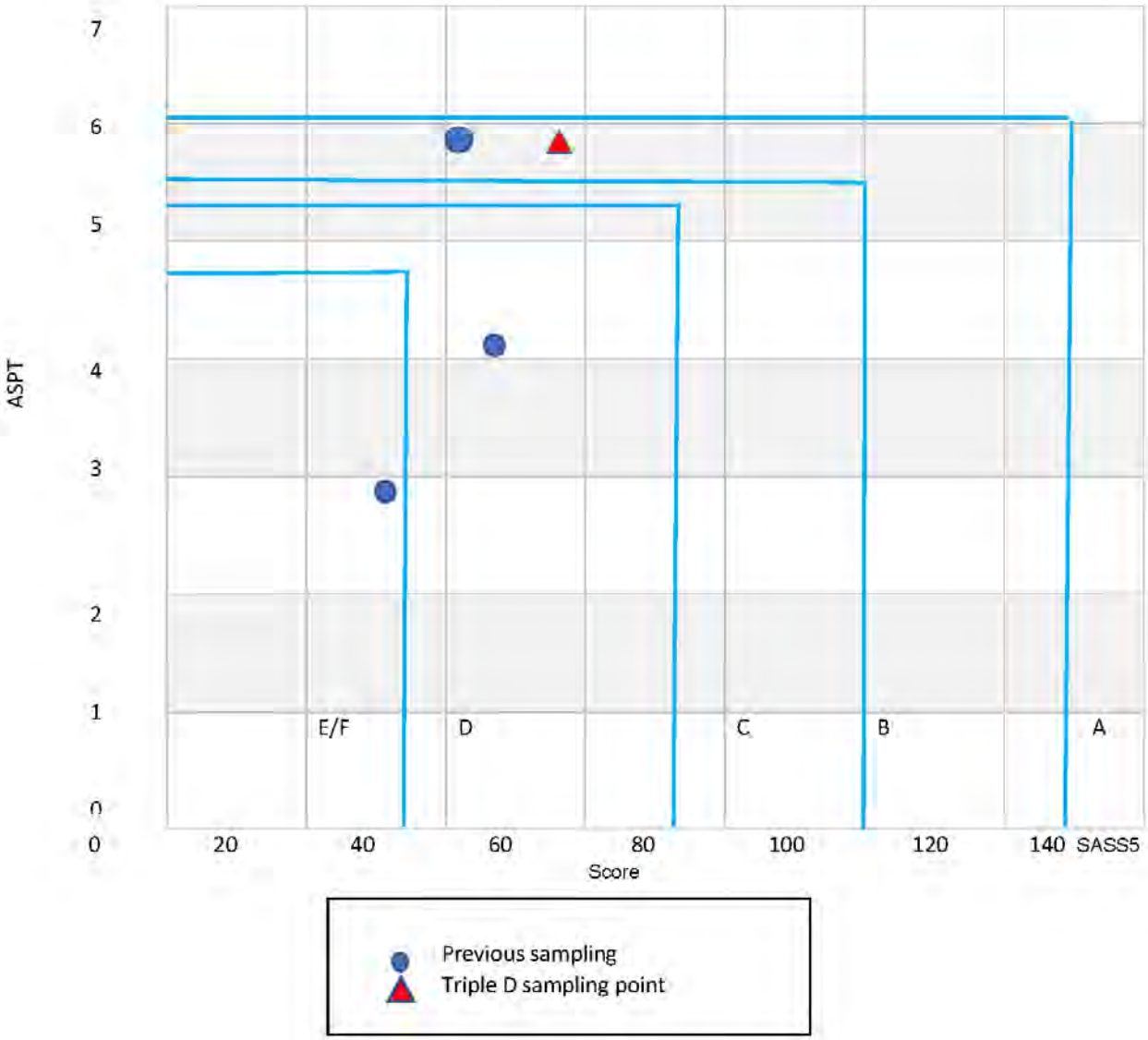
The sampling point was chosen directly below the Triple D farm on the southern bank of the Orange River. The site was marked by the water pump installation (Figure 9). This site was 520m to the north of the N14 road bridge on the boundary of the Triple D property.

The biomonitoring was carried out according to the description of Dickens & Graham (2002).

Figure 9 Sampling Point

The river here was broad and pool-like, perhaps 250m wide, with little current along the bank. In the middle of the river the current was stronger. The bank was very steep, because of the berms that were constructed for flood management.

Phragmites reeds made up most of the emerging vegetation and recently submerged grasses in the shallows along the bank provided more habitat. Solid substrate was provided by the steel floats of the pumping installation. There were clumps of pondweed *Potamogeton* drifting down the current, which was sampled as well. The bottom was sandy and muddy, with no other substrate types.



Integrity Class	Description
A	Pristine; not impacted
B	Very Good; slightly impacted
C	Good; measurably impacted with most ecological functioning intact
D	Fair; impacted with some loss of ecological functioning
E	Poor; loss of most ecological function
F	Very Poor; loss of all ecological function

Figure 10 Lower Orange River Biomonitoring Results

The SASS5 score was at 50 high for this type of mature river habitat, with an average score per taxon (ASPT) of 5.6. This score left the Triple D result in the good, slightly impacted, category (Figure 10) and clearly in a better category than some of the other, previously monitored sampling rounds that were done by WATSAN Africa during similar projects in the Lower Orange River from Groblershoop to Augrabies.

This positive result is not all that easy to explain. Perhaps it was because of the slightly better availability of habitat, with the pond weed, sandy bottom, submerged and emerging vegetation. Perhaps it was because of the river that was recently in flood, with an improvement in water quality. Perhaps it was because the drainage line was dry, with no agricultural return flow. This was in contrast with other drainage lines with large volumes of poor-quality return flow.

9 Water Quality Orange River

A water sample was taken at the sampling point in the Orange River from a sampling point at the pumping installation. The sample was frozen soon after and subsequently delivered at Quantum Laboratories in Malmesbury.

Table 2 Water Quality Orange River at Triple D

Constituent		Value
Temperature	°C	12.6
pH		8.6
Electrical Conductivity	mSm^{-1}	37.7
Turbudity	NTU	6.4
Dissolved Oxygen	mgl^{-1}	10.3
Ammonia	mgl^{-1}	0.12
Total Nitrogen	mgl^{-1}	7
Total Phosphorus	mgl^{-1}	0.06

There was enough oxygen in the water to sustain healthy aquatic life (Table 2). The water was rather fresh, not salty. The water was not as turbid as it usually is, despite the strong flow. The water is rather alkaline, as is often measured in the lower Orange River.

The ammonia concentration is low, which indicates that the river here is not subject to faecal pollution, be it from farm animals or human settlement. Phosphorus binds to the ground and is not easily washed out, despite a hefty application on agricultural lands, hence the low concentration in the Orange River as well. However, the nitrogen concentration is high, indicating a release from agriculture, but not as high is as elsewhere in the region. It is surmised that upstream of the sampling point, from a drainage line now transformed into a canal, a volume of irrigation return flow is flowing into the Orange River.

10 Present Ecological State (PES)

The PES and EIS are protocols that have been produced by Dr Neels Kleynhans (Table 3, 4 and 5) in 1999 of the then DWAF to assess river reaches. The scores given are solely that of the practitioner and are based on expert opinion.

10.1 Present Ecological State Orange River

Table 3 Present Ecological State Orange River at Triple D

Instream	Score	Weight	Product	Maximum score
Water abstraction	12	14	168	350
Flow modification	12	13	156	325
Bed modification	20	13	260	325
Channel modification	22	13	286	325
Water quality	15	14	210	350
Inundation	15	10	150	250
Exotic macrophytes	10	9	90	225
Exotic fauna	15	8	120	200
Solid waste disposal	18	6	108	150
Total		100	1428	2500
% of total			57.1	
Class			C	
Riparian				
Water abstraction	12	13	156	325
Inundation	12	11	132	275
Flow modification	20	12	240	300
Water quality	22	13	286	325
Indigenous vegetation removal	15	13	195	325
Exotic vegetation encroachment	5	12	60	300
Bank erosion	18	14	252	350
Channel modification	8	12	96	300
Total			1417	2500
% of total			56.7	
Class			D	

Much has been published on the ecological state of South African rivers and the Orange River is no exception. In fact, it seems somewhat arrogant to assess the Lower Orange River, even at the sampling point, with a team of one and with the financial backing of a single WULA. This is a large undertaking that is to be contemplated by a team of experts. Nevertheless, this is what the WULA requires.

The river at Kakamas, as elsewhere, has been impacted by major dams, large-scale water abstractions, an influx of agricultural chemicals, encroachment of reeds and exotic macrophytes, translocated and exotic fish, levees, bridges and many other infarctions. Hence the river was scored a C, which signifies that it has been impacted, but despite these impacts still exhibits appreciable ecological functioning. The riparian zone scores a D, which signifies that ecological functioning has been lost.

There is a good chance that other practitioners would score the river very much the same.

10.2 Present Ecological State of the Drainage Line

The question now arises if a dry drainage line without a discernible riparian zone carries adequate weight or is worthy of such an assessment. The answer is yes, indeed, as this is the way nature intended it to be, a dry drainage line.

Table 4 Present Ecological State Triple D Drainage Line

Table 4 **Triple D Drainage Line Habitat Integrity**

Instream	**score**	**weight**	**Product**	**Maximum Score**
Water Abstraction	24	14	336	350
Flow modification	19	13	247	325
Bed modification	17	13	221	325
Channel modification	16	13	208	325
Water quality	24	14	336	350
Inundation	20	10	200	250
Exotic macrophytes	24	9	216	225
Exotic fauna	25	8	200	200
Solid waste disposal	15	6	90	150
max score		100	2054	2500
% of total			82.2	
Class			B	
Riperian Zone				
Water abstraction	24	13	312	325
Inundation	19	11	209	275
Flow modification	17	12	204	300
Water quality	24	13	312	325
Indigenous vegetation removal	12	13	156	325
Exotic vegetation encroachment	20	12	240	300
Bank erosion	16	14	224	350
Channel modification	14	12	168	300
		100	1825	2500
% of total			73.0	
Class			C	

Table 5 Habitat Integrity according to Kleynhans, 1999

Category	Description	% of maximum score
A	Unmodified, natural	90 – 100
B	Largely natural with few modifications. A small change in natural habitats and biota, but the ecosystem function is unchanged	80 – 89
C	Moderately modified. A loss and change of the natural habitat and biota, but the ecosystem function is predominantly unchanged	60 – 79
D	Largely modified. A significant loss of natural habitat, biota and ecosystem function.	40 – 59
E	Extensive modified with loss of habitat, biota and ecosystem function	20 – 39
F	Critically modified with almost complete loss of habitat, biota and ecosystem function. In worse cases ecosystem function has been destroyed and changes are irreversible	0 - 19

The Triple D drainage line was assigned a class B (Table 4) for the instream assessment. Only a part of the sub-catchment has been lost to agriculture, while a large part still remains intact. This would obviously change when the site is developed, probably to class D or E, with the original morphology significantly altered.

The riparian zone was placed into a category C, not only because of the loss of habitat due to agriculture, but because of clear signs that earth moving machinery has been active in some parts of the area. There was not much of a riparian zone to begin with, with no typical riverine riparian vegetation or hydromorphic soils.

11 Ecological Importance

The Ecological Importance (EI) is based on the presence of especially fish species that are endangered on a local, regional or national level (Table 5).

There are no fish in the drainage line, as there is no permanent water. According to this assessment, which is prescribed for WULA's, the drainage line is not important.

No other endangered species, either plant or animal, were detected in or near the drainage line.

Table 6. Ecological Importance according to endangered organisms (Kleynhans,1999).

Category	Description
1	One species or taxon are endangered on a local scale
2	More than one species or taxon are rare or endangered on a local scale
3	More than one species or taxon are rare or endangered on a provincial or regional scale
4	One or more species or taxa are rare or endangered on a national scale (Red Data)

The Orange River is most important, according to this assessment.

According to Skelton (1993) 11 species of fish occur in the Lower Orange River. Since 2011 another one was added, as well as 3 exotic species. These are the following:

Barbus trimaculatus
B paludinosus
B. hospus
Labeobarbus kimberleyensis (Near threatened)
L aenus
Labeo umbratus
L capensis
Austroglanis sclateri (Widespread elsewhere)
Clarias gariepinus
Pseudocrenilabrus philander (Threatened locally but abundant elsewhere)

Pseudobarbus quathlabae
Mesobola brevianalis (critically endangered)
Cyprinus carpio
Tilapia sparrmanii
Oreochromus mossambicus

Those in blue are endangered to some extent. Those indicated in red are exotic or translocated fish.

The only one that causes real concern in the largemouth yellow fish *Labeobarbus kimberleyensis*. It is endemic to the Orange River system and hence is threatened not only on a local scale, but on a national scale as well. This puts the Lower Orange in category 4. This renders the Orange River as important.

According to the owners of the Kalahari River and Safari Co. along the northern bank of the Orange River on the Riemvasmaak Road, mature blue kurper *Oreochromus mossambicus* are regularly captured in increasing numbers. It now takes at least 4 man-days to capture a single yellow fish. Yellow fish are generally infected with cestode bladder worms, while darters (*Anhinga rufa*) that predate on these fish are heavily infected with tape worms. It seems as if the translocated Tilapia are not affected by these parasites.

12 Ecological Sensitivity

Ecological Sensitivity (ES) is often described as the ability of aquatic habitat to assimilate impacts. It is not sensitive if it remains the same despite of the onslaught of impacts. Put differently, sensitive habitat changes substantially, even under the pressure of slight impacts.

The Ecological Sensitivity also refers to the potential of aquatic habitat to bounce back to an ecological condition closer to the situation prior to human impact. If it recovers, it is not regarded as sensitive.

12.1 Ecological Sensitivity Orange River

The Orange River at Kakamas has absorbed numerous and deep-cutting human impacts. Yet is still functions as an aquatic ecosystem. In the highly improbable event of ceased human impact, the river here would probably bounce back to its previous glory. In this respect the river cannot be categorised as sensitive. It is dreaded among conservation minded people that the Lower Orange River might have some more capacity to absorb further impact.

12.2 Ecological Sensitivity Drainage Line

If left to its own devices, the drainage line would remain as it is now, without the need for protection measures. However, if the agricultural development is allowed to proceed, the drainage line would probably never recover to any resemblance of its current state. In this regard it can be considered to be ecologically sensitive.

13 Impact Assessment

Some of the decision-making authorities prescribe an impact assessment according to a premeditated methodology, as described in the Appendix.

The main benefit of this exercise is that it allows for the evaluation of mitigation measures. Later follows a Risk Assessment. This is different from the Impact Assessment as it does not attempt to weigh the success of mitigation measures.

It is fully accepted that the current drainage line will be fundamentally changed if the development should go ahead and that no mitigation measure can be employed to stop this. However, the final outcome could be a landscaped channel without signs of erosion.

The following pertains to Table 6:

- Local means the drainage line below and adjacent to the drainage line.
- Regional means downstream of the drainage line into the Orange River.
- Short term means the time during the construction phase.
- Long term means the operational period, that is the time during which grapes are produced on the envisaged vineyards. Once changed into agricultural land, it is not foreseen that this status would ever change.
- Probability is expressed with a 5-point scale: Improbable, Low, Medium, High, Probable.
- The Confidence Level can either be low, medium or high. The same applies to Intensity and Significance.
- Significance is the combined effects of Extent, Duration and Intensity.

Table 7 Summary of possible impacts

Possible Impact		Extent	Duration	Intensity	Significance	Probability	Confidence
Clearing of vegetation, levelling of land	Without mitigation	Regional	Medium term	High	Medium	Probable	High
	With mitigation	Local	Short term	Low	Low	Low	High
Drainage Line reconstruction	Without mitigation	Regional	Medium term	Medium	Medium	Probable	High
	With mitigation	Local	Short term	Low	Low	Low	High
Installation of infrastructure, irrigation	Without mitigation	Regional	Medium term	Medium	Medium	Probable	High
	With mitigation	Local	Short term	Low	Low	Low	High
Operation of vineyards	Without mitigation	Regional	Long term	Medium	High	Probable	High
	With mitigation	Local	Long term	Low	Low	Low	High

13.1 Mitigation Measures pertaining to the Drainage Line

No activities should be allowed outside of the demarcated agricultural development area. Machinery, waste and rubble should not be allowed to accumulate anywhere in the natural vegetation.

The main threat because of the establishment of the agricultural development is the movement of sediments down the drainage line and into the Orange River. The land would be entirely transformed by heavy earth moving machinery, as is required for the establishment of vineyards in virgin land. This transformation should be affected during the dry season, when the likelihood of sudden thunder storms is at its least.

Any signs of erosion in the altered drainage line should be addressed immediately after downpours. Eroded areas should be filled in and the compacted. It should be planted with

suitable vegetation. Irrigation may be required to establish this vegetation. If necessary, berm and contours should be constructed to direct storm water away to less susceptible areas.

The flow path of the drainage line should remain the same as far as possible, despite of the agricultural development.

Agricultural waste and other waste and litter should not be allowed to pass down the channel.

Vehicles and other disturbances should be kept out of the altered drainage lines as to prevent any disturbance that could result in erosion.

13.2 Mitigation Measures pertaining to the Orange River

The single most threat to the Orange River during the subsequent end use is the agricultural return flow because of over-irrigation. This is overly evident in so many of these originally dry natural drainage lines turned into agricultural drainage channels. The impact on river's water quality is negative and deleterious. It is therefore expected that the ground moisture levels will be scientifically monitored and that irrigation will be adjusted accordingly, with return flow limited, if not eliminated altogether.

According to what has been witnessed during site visits in the Lower Orange River catchment it was evident that farming practices and in particular the level of management differ widely. The volume of agricultural return flow is perhaps the most telling criterium.

It is also evident that best practice and in particular control can be most effective to limit the impact of the downstream aquatic environment. From current practice on the property it is evident that best practice is entirely within Triple D's ability and that this company can be trusted to continue to implement such practices. The probability of mitigating measures to be successful is evident.

14 Risk Matrix

The assessment was carried out according to the interactive Excel table that is available on the DWS webpage. The methodology is explained in the Appendix. Table 7 is a replica of the Excel spreadsheet that has been adapted to fit the format of this report. The numbers in Table 7 (continued) represent the same activities as in Table 6, with sub-activities added.

This assessment has been designed to assist in the decision if a General Authorisation or a License is required, should the development be allowed.

The risk rating according to this assessment is generally low. This suggests that a General Authorisation should be in order.

This only applies if all of the mitigation measures are in place.

However, then environmental risk because of the re-alignment of the drainage line can never be low. It is rated as medium. This represents the decision the authorities will have to make; the trade-off between the alteration of the drainage line against the economic benefit and job opportunities.

If the drainage line offered viable aquatic habitat, apart from perhaps sub-surface water, the risk rating would have been much higher. The importance and extent of aquatic habitat was taken into consideration.

The low risk rating attached to the ongoing operation of the vineyards was rated as low, as the control of the volume of irrigation return flow can be effective and as rainfall is few and far between in this arid area.

Table 8 Risk Matrix

No.	Activity	Aspect	Impact	Significance	Risk Rating
1	Clearing of vegetation, preparation of land	Mobilisation of sediments	Sediments in Orange River	26	Low
2.1	Drainage line reconstruction	Mobilisation of sediments	Sediments in Orange River	26	Low
2.2		Destruction of drainage line habitat	Habitat destruction in drainage line	129	Medium
3	Installation of infrastructure, irrigation	Mobilisation of sediments	Sediments in Orange River	39	Low
4	Operation of vineyards	Agricultural return flow	Water quality impairment in Orange River	38.5	Low

Table 8 Continued Risk Rating

No	Flow	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Conse-quence
1	1	1	2	1	1.25	1	1	3.25
2.1	1	1	2	1	1.25	1	1	3.25
2.2	4	2	4	1	2.25	4	4	10.75
3	1	1	2	1	1.25	1	1	3.25
4	1	1	2	2	1.5	1	1	3.5

No	Frequency of activity	Frequency of impact	Legal issues	Detection	Likelihood	Significan-ce	Risk Rating
1	1	1	5	1	8	26	Low
2.1	1	1	5	1	8	26	Low
2.2	1	1	5	1	8	129	Medium
3	1	1	5	1	12	39	Low
4	1	1	5	1	11	38.5	Low

15 Resource Economics

The goods and services delivered by the environment, in this case the Triple D drainage line is a Resource Economics concept as adapted by Kotze *et al* (2009). The methodology was designed for the assessments of wetlands, but in the case of the drainage line the goods and services delivered are particularly applicable and important, hence it was decided to include it in the report.

The diagram (Figure 11) is an accepted manner to visually illustrate the resource economic footprint the drainage line, from the data in Table 8.

Table 9. Goods and Services

Goods & Services	Score
Flood attenuation	5
Stream flow regulation	5
Sediment trapping	5
Phosphate trapping	2
Nitrate removal	2
Toxicant removal	2
Erosion control	4
Carbon storage	2
Biodiversity maintenance	2
Water supply for human use	0
Natural resources	1
Cultivated food	1
Cultural significance	1
Tourism and recreation	0
Education and research	1

0	Low
5	High

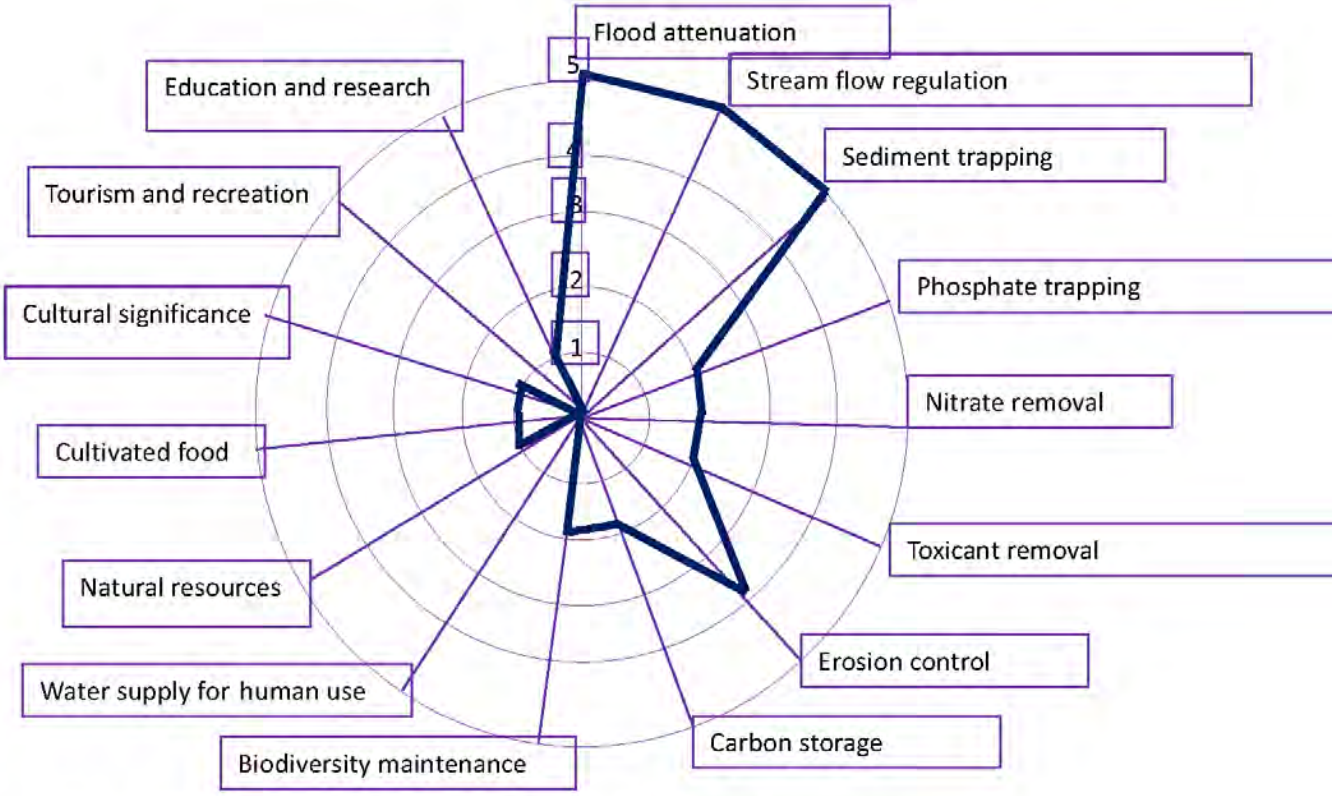


Figure 11. Resource Economics Footprint of the Triple D drainage line

The size of the star shape of Figure 11 attracts the eyes of the decision-makers. This shape is small, indicating that the water course has a small economic foot print. Apart from flood attenuation, stream flow regulation and sediment trapping, the drainage line is not important.

16 Conclusions

Figure 12 has been adapted from one of the most recent DWS policy documents.

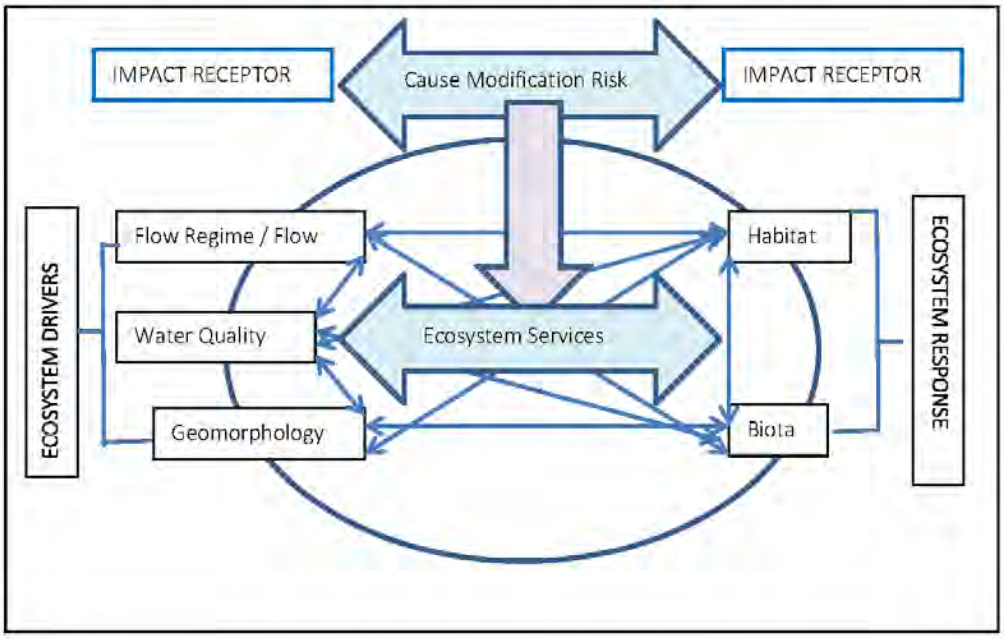


Figure 12 Minimum Requirements for a S21(c) and (i) Application

An anthropogenic activity can impact on any of the ecosystem drivers or responses and this can have a knock-on effect on all of the other drivers and responses. This, in turn, will predictably impact on the ecosystem services (Figure 12). The WULA and the EAI must provide mitigation measured for these impacts.

The driver of the drainage line is the occasional flood that follows sudden and intense rainfall events. This is followed by prolonged droughts and intense summer heat that prevents the development of any viable aquatic habitat. This is apart from shallow ground water that explains the growth of a somewhat more prolific vegetation along the drainage lines. These plants are by no means an indication of aquatic or riparian habitat. The Triple D drainage line's riparian vegetation is not taller than that of the surrounding landscape and therefore does not add much to habitat variation.

The planned agricultural expansion would obviously and greatly alter the drainage line. However, the Triple D drainage line is not important in terms of aquatic habitat, aquatic biodiversity and economic footprint. The envisaged alteration would therefore not be a

significant loss. Apart from this, the banks of the Orange River are already heavily exploited, with little habitat that has not been impacted upon in a varying degree.

A note from the DWS dated 18 July 2018 (Appendix) stated that drainage lines are "extremely sensitive to development". The DWS did not, by any means, ruled out development over drainage lines.

The DENC, on the other hand, in their note dated 9 March 2019 (Appendix), stated that disturbance of ephemeral rivers is "strongly prohibited". This effectively rules out any further development in the Lower Orange River, as drainage lines are densely distributed over the landscape. Numerous developments are in various stages of completion, representing literally billions of Rands worth of investment.

The question arises if this ruling has been promulgated as a provincial ordinance or regulation in terms of an ordinance, or only stands as departmental policy.

The conservation of drainage lines along the Lower Orange River deserves and demands attention by decision-making authorities, environmental practitioners, the conservation and farming community alike. As more of these drainage lines are impacted upon, and because impacts are radical by nature, because sections of drainage lines are replaced by vineyards or other forms of agriculture, or transformed into return flow infrastructure, the necessity for a widely accepted conservation policy becomes urgent as development escalates.

A percentage of still unimpacted drainage lines should be identified, prioritised and set aside for conservation. Only specified practices with no or limited impacts should be allowed in these sub-catchments and their drainage lines.

It remains for the decision-making authorities to decide if the proposed agricultural developments in the Lower Orange River are acceptable and if they should go ahead. Since impacts are already evident and since a vast amount of money has already been invested in this venture, with many job opportunities at stake, the proposed development should go ahead, but the eminent approval would increase the urgency and pressure for a known and accepted Lower Orange River Drainage Lines conservation policy.

It is therefore recommended that the agricultural development should go ahead, subject to a General Authorisation, or even an official letter of consent. A Licence is should not be necessary.

17 References

Annonymous. Date unknown. *A practical field procedure for identification and delineation of wetlands and riparian areas.* Department of Water Affairs and Forestry, Pretoria.

Dickens, CWS & PM Graham. 2002. *The South African Scoring System (SASS) Version 5 Rapid Bioassessment Method for Rivers.* African Journal of Aquatic Science 27: 1–10

Kleynhans, C.J. 1999. *Assessment of Ecological Importance and Sensitivity.* Department of Water Affairs and Forestry. Pretoria.

Kotze, G., G. Marneweck, A. Batchelor, D. Lindley & Nacelle Collins. 2009. *A technique for rapidly assessing ecosystem services supplied by wetlands.* Water Research Commission, Pretoria.

Skelton, P. 1993. *A Complete Guide to the Fresh Water Fishes of Southern Africa.* Tutorial Press, Harare.

18 Declaration of Independence

I, Dirk van Driel, as the appointed independent specialist hereby declare that I:

- Act/ed as the independent specialist in this application
- Regard the information contained in this report as it relates to my specialist input/study to be true and correct and;
- Do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2010 and any specific environmental management act;
- Have and will not have vested interest in the proposed activity;
- Have disclosed to the applicant, EAP and competent authority any material information have or may have to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the environmental Impact Assessment Regulations, 2010 and any specific environmental management act.
- Am fully aware and meet the responsibilities in terms of the NEMA, the Environmental Impacts Assessment Regulations, 2010 (specifically in terms of regulation 17 of GN No. R543) and any specific environmental management act and that failure to comply with these requirements may constitute and result in disqualification;
- Have ensured that information containing all relevant facts on respect of the specialist input / study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties facilitated in such a manner that all interested and affected parties were provided with reasonable opportunity to participate and to provide comments on the specialist input / study;
- Have ensured that all the comments of all the interested and affected parties on the specialist input were considered, recorded and submitted to the competent authority in respect of the application;
- Have ensured that the names of all the interested and affected parties that participated in terms of the specialist input / study were recorded in the register of interested and affected parties who participated in the public participation process;
- Have provided the competent authority with access to all information at my disposal regarding the application, weather such information is favourable or not and;
- Am aware that a false declaration is an offence in terms of regulation 71 of GN No. R543.

Signature of the specialist:
Name of the company: WATSAN Africa Date: 19 August 2018

19 Résumé

Dr Dirk van Driel
PhD, MBA, PrSciNat, MWISA
Water Scientist

PO Box 681
Melkbosstrand 7437
saligna2030@gmail.com
079 333 5800 / 022 492 2102

Experience

WATSAN Africa, Cape Town. Scientist **2011 - present**

USAID/RTI, ICMA & Chemonics. Iraq & Afghanistan **2007 -2011**
Program manager.

City of Cape Town **1999-2007**
Acting Head: Scientific Services, Manager: Hydrobiology.

Department of Water & Sanitation, South Africa **1989 – 1999**
Senior Scientist

Tshwane University of Technology, Pretoria **1979 – 1998**
Head of Department

University of Western Cape and Stellenbosch University 1994- 1998 part-time
- Lectured post-graduate courses in Water Management and Environmental Management to under-graduate civil engineering students
- Served as external dissertation and thesis examiner

Service Positions
- Project Leader, initiator, member and participator: Water Research Commission (WRC), Pretoria.
- Director: UNESCO West Coast Biosphere, South Africa
- Director (Deputy Chairperson): Grotto Bay Home Owner's Association
- Member Dassen Island Protected Area Association (PAAC)

Membership of Professional Societies
- South African Council for Scientific Professions. Registered Scientist No. 400041/96
- Water Institute of South Africa. Member

Recent Reports &
Water Use License Applications

- Process Review Kathu Wastewater Treatment Works
- Effluent Irrigation Report Tydstroom Abattoir Durbanville
- River Rehabilitation Report Slangkop Farm, Yzerfontein
- Fresh Water and Estuary Report Erf 77 Elands Bay
- Ground Water Revision, Moorreesburg Cemetery
- Fresh Water Report Delaire Graff Estate, Stellenbosch
- Fresh Water Report Quantum Foods (Pty) Ltd. Moredou Poultry Farm, Tulbagh
- Fresh Water Report Revision, De Hoop Development, Malmesbury
- Fresh Water Report, Idas Valley Development Erf 10866, Stellenbosch
- Wetland Delineation Idas Valley Development Erf 10866, Stellenbosch
- Fresh Water Report, Idas Valley Development Erf 11330, Stellenbosch
- Fresh Water Report, La Motte Development, Franschhoek
- Ground Water Peer Review, Elandsfontein Exploration & Mining
- Fresh Water Report Woodlands Sand Mine Malmesbury
- Fresh Water Report Brakke Kuyl Sand Mine, Cape Town
- Wetland Delineation, Ingwe Housing Development, Somerset West
- Fresh Water Report, Suurbraak Wastewater Treatment Works, Swellendam
- Wetland Delineation, Zandbergfontein Sand Mine, Robertson
- Storm Water Management Plan, Smalblaar Quarry, Rawsonville
- Storm Water Management Plan, Riverside Quarry
- Water Quality Irrigation Dams Report, Langebaan Country Estate
- Wetland Delineation Farm Eenzaamheid, Langebaan
- Wetland Delineation Erf 599, Betty's Bay
- Technical Report Bloodhound Land Speed Record, Hakskeenpan
- Technical Report Harkerville Sand Mine, Plettenberg Bay
- Technical Report Doring Rivier Sand Mine, Vanrhynsdorp
- Rehabilitation Plan Roodefontein Dam, Plettenberg Bay
- Technical Report Groenvlei Crusher, Worcester
- Technical Report Wiedouw Sand Mine, Vanrhynsdorp
- Technical Report Lair Trust Farm, Augrabies
- Technical Report Schouwtoneel Sand Mine, Vredenburg
- Technical Report Waboomsrivier Weir Wolseley
- Technical Report Doornkraal Sand Mine Malmesbury
- Technical Report Berg-en-Dal Sand Mine Malmesbury
- Wetland Demarcation, Osdrif Farm, Worcester
- Technical Report Driefontein Dam, Farm Agterfontein, Ceres
- Technical Report Oewerzicht Farm Dam, Greyton
- Technical Report Glen Lossie Sand Mine, Malmesbury
- Preliminary Report Stellenbosch Cemeteries
- Technical Report Toeka & Harmony Dams, Houdenbek Farm, Koue Bokkeveld
- Technical Report Kluitjieskraal Sand & Gravel Mine, Swellendam

20 Appendix

20.1 SASS5 score sheet

SASS5 Score Sheet										
Date	15 Aug 18	Taxon	Weight	Score	Taxon	Weight	Score	Taxon	Weight	Score
Locality	Orange River	Porifera	5		**Hemiptera**			**Diptera**		
		Coelenterata	1		Belostomatidae	3		Athericidae	10	
		Turbellaria	3		Corixidae	3	3	Blepharoceridae	15	
		Oligochaeta	1		Gerridae	5		Ceratopogonidae	5	
Coordinates	28°45'08.37"	Hirudinea	3		Hydrometridae	6		Chironomidae	2	
	20°35'06.16"	**Crustacea**			Naucoridae	7	7	Culicidae	1	
		Amphipodae	13		Nepidae	3		Dixidae	10	
DO mg/l	10.3	Potamonautidae	3		Notonectidae	3	3	Empididae	6	
Temperature °C	12.6	Atyidae	8	8	Pleidae	4		Ephydridae	3	
pH	8.64	Palaemonidae	10		Veliidae	5		Muscidae	1	
EC mS/m	37.7	Hydracarina	8		**Megaloptera**			Psychodidae	1	
		Plecoptera			Corydalidae	10		Simuliidae	5	
SASS5 Score	50	Notonemouridae	14		Sialidae	8		Syrphidae	1	
Number of Taxa	9	Perlidae	12		**Trichoptera**			Tabanidae	5	
ASPT	5,6	**Ephemeroptera**			Dipseudopsidae	10		Tipulidae	5	5
		Baetidae 1 sp	4		Ecnomidae	8		**Gastropoda**		
Other Biota		Baetidae 2 sp	6	6	Hydropsychidae 1 sp	4		Ancylidae	6	
		Baetidae >3 sp	12		Hydropsychidae 2 sp	6		Bulinidae	3	
		Caenidae	6		Hydropsychidae <2 sp	12		Hydrobiidae	3	
		Ephemeridae	15		Phylopotamidae	10		Lymnaeidae	3	
		Heptageniidae	13		Polycentropodidae	12		Physidae	3	
		Leptophlebiidae	9		Psychomyidae	8		Planorbidae	3	
		Oligoneuridae	15		Cased Caddis			Thiaridae	3	
Comments		Polymitarcyidae	10		Barbarochthonidae	13		Viviparidae	5	
		Prosopistomatida	15		Calamoceratidae	11		**Pelecipoda**		
		Teloganodidae	12		Glossostomatidae	11		Corbiculidae	5	
		Trichorythidae	9		Hydroptilidae	6		Sphariidae	3	
		Odonata			Hydrosalpingidae	15		Unionidae	6	
		Calopterygidae	10		Leptostomatidae	10				
		Clorocyphidae	10		Leptoceridae	6				
		Chorolestidae	8		Petrothrincidae	11				
		Coenagrionidae	4		Pisulidae	10				
		Lestidae	8		Sericostomatidae	13				
		Platycnemidae	10		**Coleoptera**					
		Protoneuridae	8		Dyticidae	5	5			
		Aesthnidae	8		Elmidae Dryopidae	8				
		Corduliidae	8	8	Gyrinidae	5				
		Gomphidae	6		Haliplidae	5				
		Libellulidae	4		Helodidae	12				
		Lepidoptera			Hydraenidae	8				
		Pyralidae	12		Hydrophilidae	5	5			
					Limnichidae	10				
					Psephenidae	10				
Score				22			23			5

20.2 Methodology used in determining significance of impacts

The methodology to be used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks associated with the alternatives is provided in the following tables:

Table 20.2.1 Nature and type of impact

Nature and type of impact	Description
Positive	An impact that is considered to represent an improvement to the baseline conditions or represents a positive change
Negative	An impact that is considered to represent an adverse change from the baseline or introduces a new negative factor
Direct	Impacts that result from the direct interaction between a planned project activity and the receiving environment / receptors
Indirect	Impacts that result from other activities that could take place as a consequence of the project (e.g. an influx of work seekers)
Cumulative	Impacts that act together with other impacts (including those from concurrent or planned future activities) to affect the same resources and / or receptors as the project

Table 20.2.2 Criteria for the assessment of impacts

Criteria	Rating	Description
Spatial extent of impact	National	Impacts that affect nationally important environmental resources or affect an area that is nationally important or have macro-economic consequences
	Regional	Impacts that affect regionally important environmental resources or are experienced on a regional scale as determined by administrative boundaries or habitat type / ecosystems
	Local	Within 2 km of the site
	Site specific	On site or within 100m of the site boundary
Consequence of impact/ Magnitude/ Severity	High	Natural and / or social functions and / or processes are severely altered
	Medium	Natural and / or social functions and / or processes are notably altered
	Low	Natural and / or social functions and / or processes are slightly altered
	Very Low	Natural and / or social functions and / or processes are negligibly altered
	Zero	Natural and / or social functions and / or processes remain unaltered
Duration of impact	Temporary	Impacts of short duration and /or occasional
	Short term	During the construction period
	Medium term	During part or all of the operational phase
	Long term	Beyond the operational phase, but not permanently
	Permanent	Mitigation will not occur in such a way or in such a time span that the impact can be considered transient (irreversible)

Table 20.2.3 Significance Rating

Significance Rating	Description
High	High consequence with a regional extent and long-term duration High consequence with either a regional extent and medium-term duration or a local extent and long-term duration Medium consequence with a regional extent and a long-term duration
Medium	High with a local extent and medium-term duration High consequence with a regional extent and short-term duration or a site-specific extent and long-term duration High consequence with either local extent and short-term duration or a site-specific extent with a medium-term duration Medium consequence with any combination of extent and duration except site-specific and short-term or regional and long term Low consequence with a regional extent and long-term duration
Low	High consequence with a site-specific extent and short-term duration Medium consequence with a site-specific extent and short-term duration Low consequence with any combination of extent and duration except site-specific and short-term Very low consequence with a regional extent and long-term duration
Very low	Low consequence with a site-specific extent and short-term duration Very low consequence with any combination of extent and duration except regional and long term
Neutral	Zero consequence with any combination of extent and duration

Table 20.2.4 Probability, confidence, reversibility and irreplaceability

Criteria	Rating	Description
Probability	Definite	>90% likelihood of the impact occurring
	Probable	70 – 90% likelihood of the impact occurring
	Possible	40 – 70% likelihood of the impact occurring
	Unlikely	<40% likelihood of the impact occurring
Confidence	Certain	Wealth of information on and sound understanding of the environmental factors potentially affecting the impact
	Sure	Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact
	Unsure	Limited useful information on and understanding of the environmental factors potentially influencing this impact
Reversibility	Reversible	The impact is reversible within 2 years after the cause or stress is removed
	Irreversible	The activity will lead to an impact that is in all practical terms permanent
Irreplaceability	Replaceable	The resources lost can be replaced to a certain degree
	Irreplaceable	The activity will lead to a permanent loss of resources

20.3 Risk Matrix Methodology

RISK ASSESSMENT KEY (Referenced from DWA RISK-BASED WATER USE AUTHORISATION APPROACH AND DELEGATION GUIDELINES)

Negative Rating

TABLE 1- SEVERITY

How severe does the aspects impact on the environment and resource quality characterisitics (flow regime, water quality, geomorfology, biota, habitat)

Insignificant / non-harmful	1
Small / potentially harmful	2
Significant / slightly harmful	3
Great / harmful	4
Disastrous / extremely harmful and/or wetland(s) involved	5
Where "or wetland(s) are involved" it means	

TABLE 2 – SPATIAL SCALE

How big is the area that the aspect is impacting on?

Area specific (at impact site)	1
Whole site (entire surface right)	2
Regional / neighbouring areas (downstream within quaternary catcl	3
National (impacting beyond seconday catchment or provinces)	4
Global (impacting beyond SA boundary)	5

TABLE 3 – DURATION

How long does the aspect impact on the environment and resource quality?

One day to one month, PES, EIS and/or REC not impacted
One month to one year, PES, EIS and/or REC impacted but no change in status
One year to 10 years, PES, EIS and/or REC impacted to a lower status but can be improved over this period through mitigation
Life of the activity, PES, EIS and/or REC permanently lowered
More than life of the organisation/facility, PES and EIS scores, a E or F

TABLE 4 – FREQUENCY OF THE ACTIVITY

How often do you do the specific activity?

Annually or less	1
6 monthly	2
Monthly	3
Weekly	4
Daily	5

TABLE 5 – FREQUENCY OF THE INCIDENT/IMPACT

How often does the activity impact on the environment?

Almost never / almost impossible / >20%	1
Very seldom / highly unlikely / >40%	2
Infrequent / unlikely / seldom / >60%	3
Often / regularly / likely / possible / >80%	4
Daily / highly likely / definitely / >100%	5

TABLE 6 – LEGAL ISSUES

How is the activity governed by legislation?

No legislation	1
Fully covered by legislation (wetlands are legally governed)	5
Located within the regulated areas	

TABLE 7 – DETECTION

How quickly can the impacts/risks of the activity be observed on the environment (water resourc

Immediately
Without much effort
Need some effort
Remote and difficult to observe
Covered

TABLE 8: RATING CLASSES

RATING	CLASS	MANAGEMENT DESCRIPTION
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated. Wetlands may be excluded.
56 – 169	M) Moderate Risk	Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and
170 – 300	(H) High Risk	Always involves wetlands. Watercourse(s) Impacts by the activity are such that they impose a long-term threat on a large scale

A low risk class must be obtained for all activities to be considered for a GA

TABLE 9: CALCULATIONS

Consequence = Severity + Spatial Scale + Duration
Likelihood=Frequency of Activity + Frequency of Incident +Legal Issues + Detection
Significance \Risk= Consequence X Likelihood

20.4 Note DWS

water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

Northern Cape Provincial Operations, Private Bag X 6101, Kimberley, 8301, 28 Central Road Beaconsfield Kimberley, Tel: 053 836 7600, Fax: 053 842 3258.

F	053 830 8825		Vhonani Ramugondo
E	ramugondov@dws.gov.za	☎	053 836 7648

Triple D (Pty) Ltd
P. O. BOX 5367
Helderburg
7135

Email:admin@enviroafrica.co.za

By Email/Registered Mail

Attention: EnviroAfrica CC

RE: CONSULTATION IN TERMS OF SECTION 4 OF THE NATIONAL WATER ACT, (ACT NO. 36 OF 1998): FOR PROPOSED AGRICULTURAL DEVELOPMENT (60HA OF VINEYARDS FOR TABLE GRAPE AND RAISIN PRODUCTION) ON PLOT 1178, SITUATED IN KAKAMAS SOUTH SETTLEMENT, NORTHERN CAPE PROVINCE.

Reference is hereby made for to your Invitation to register and comment on NEMA Public Participation Report drafted by EnviroAfrica on behalf of Triple D farms (Pty) as presented to the Department of Water and Sanitation dated 04 June 2018.

RECOMMENDATIONS AND DECISION

This Department has evaluated the nature of the activity and the following should be addressed by the applicant when proving the application to the Department:

a) It is apparent that the nature of activities the applicant is proposing to engage in has potential impacts on the environment and water resources, as the area to be irrigated has non-perennial

NATIONAL DEVELOPMENT PLAN
Our Future - make it work

streams around. The Department rates all perennial and non- perennial streams together with all dry river beds and natural drainage, wetlands, pans and associated riparian areas extremely sensitive to development

b) The water uses must be clearly identified and elaborated according to the National Water Act (Act 36 of 1998);

c) Clear colour topographical map showing the property, facilities in the property, land use, water courses and location of water abstraction point;

d) The relevant water uses according to the National Water Act (Act 36 of 1998) must be identified and clearly identified and defined;

e) A rehabilitation and monitoring plan must be included in the report;

f) A pre consultation meeting has to be arranged when the final draft is finalised to discuss the final water use authorisation requirements ;

g) The regulations on the use of water for agriculture and related activities aimed at the protection of the Water Resources as published in the Government Notice No.704 on 4 June (Government Gazette No. 20119) must be complied with.

This reply does not grant any exemption from the requirements of any applicable Act, Ordinance, Regulation or By-law.

This office reserves the right to revise its initial comments and request additional information that may arise from correspondence and upon inspection.

Yours sincerely

DIRECTOR: INSTITUTIONAL ESTABLISHMENT
DATE: 18/11/2008

20.5 Note DENC

the denc

Department:
Environment & Nature Conservation
NORTHEN CAPE PROVINCE
REPUBLIC OF SOUTH AFRICA

Private Bag X6102, Kimberley, 8300, SASKO Building, Tel: 053-807 7430, Fax: 053-831 3530

Enquiries / Dipatlisiso / Navrae / Imibuzo: Ordain Riba

Date / Letta / Datum / Umhla: 06 March 2019

Reference / Tshupelo / Verwysing / Isalathiso: NC/EIA/02/ZFM/DAW/KAK1/2019

Att: Clinton Geyser
EnviroAfrica
P.O. BOX 5367
Helderberg
7135
Email: admin@enviroafrica.co.za

Dear Clinton

RE: PROPOSED AGRICULTURAL DEVELOPMENT, PLOT 2435, KAKAMAS SOUTH SETTLEMENT, KAI GARIEB MUNICIPALITY, NORTHERN CAPE.

The final scoping report which was submitted by you in respect of the above mentioned application and received by the Department on 05 February 2019, has been reviewed and found acceptable by the Department. You may proceed with undertaking of the Environmental Impact Report in accordance with the tasks that are outlined in the Scoping plan of study. However please take into consideration the following approval conditions:

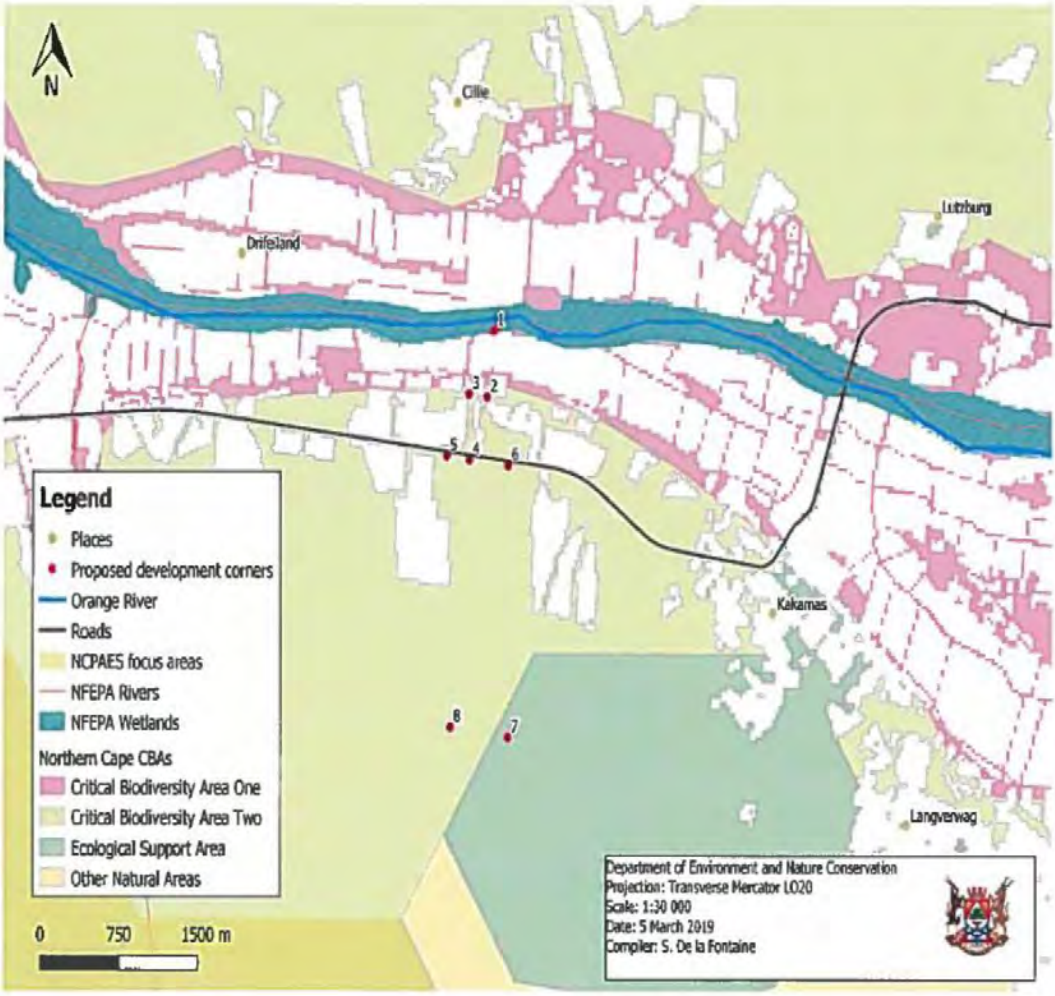
- The proposed development triggers activity 15 of LN 2 and thus cannot trigger activity 27 of LN 1, please amend the application form (Page only) and correct this in the final EIR report

With regards to planned botanical impact assessment please take into consideration the following;-

- The proponent should take the Northern Cape Nature Conservation Act 9 of 2009 as well as the National Forest Act 84 of 1998 in consideration as part of the legal frameworks when drafting the EIR. These acts list species that are protected in the province and nationally respectively. The specialist is advised to map listed species; their abundances should influence the sensitivity map.

1

- The sensitivity map should be up to standard. Sensitivity maps should include no-go areas, areas of high, medium and low sensitivity, ALL in relation to the layout of the proposed development. All of this information should be informed by the information drawn by the specialist's from the literature, background knowledge, virtual museums, site-visits, etc.
- Other man-made features should also be highlighted in relation to the sensitive features identified by the specialists.
- Reason for emphasis on the above-mentioned is because the proposed development area falls within CBA 1 (the pipeline), CBA 2 (majority of the proposed the development) and ESA areas (small south western corner of the proposed developmental area; see map attached), hence, a lot of detail should be given to sensitive features, protected species and their abundances, mitigation, conservation, etc. in order for the competent authority to make a sound and informed decision regarding the application for environmental authorization for the proposed development. Seeing that the proposed development falls within CBAs, the proponent should clearly illustrate if the proposed development triggers an off-set, or not, with supporting facts. The accumulation of impacts within the broader vicinity should also be given attention to.
- It is advised that a site-visit be taken prior to the drafting of the EIR. The site-visit should be undertaken in an appropriate season and for a considerate time.
- Any water features e.g. ephemeral rivers, seasonal pans, etc. Should be regarded in the dry Kalahari region as no-go areas. Disturbance of these features will have a direct negative impact on the local biodiversity of the area. Disturbance is thus strongly prohibited.
- It must be noted that at present there is a moratorium in place in the Northern Cape on the removal of *Aloidendron dichotomum* from the wild due to historic trade related pressures on populations (Proclamation No 968, 1 April 2005). All *A. dichotomum* individuals within close proximity to the planned development must be mapped in all documents going forward and regarded as no-go areas.



Please draw the applicant attention to the fact that the activity may not commence prior to an environmental authorization being granted by the Department.

Yours faithfully

Ordain Riba
ZFM Environmental Officer: IMPACT MANAGEMENT