PROPOSED SURFACE WATER DEVELOPMENTS FOR AUGMENTATION OF THE WESTERN CAPE WATER SUPPLY SYSTEM

Terrestrial Ecology Specialist Study

Authority Reference No: 14/12/16/3/3/2/973

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Prepared for: Department of Water & Sanitation

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Title and Approval Page

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Executive Summary

Nemai Consulting has been appointed by Department of Water and Sanitation to undertake the environmental process for the for the proposed surface water developments for augmentation of the Western Cape Water Supply System.

The Western Cape Water Supply System serves the City of Cape Town, surrounding urban centres and irrigators. It consists of infrastructure components owned and operated by both the City of Cape Town and the Department of Water and Sanitation. In 2007, the Western Cape Reconciliation Strategy Study was commissioned by the Department of Water and Sanitation to determine future water requirements for a 25 year planning horizon. The Study investigated a number of options and found that whilst 556 million m^3 per annum would be available from 2007, the estimated water requirement in 2011 would be 560 million m^3/a, with the implication that the system supply will then be fully utilised and thus additional interventions will thus be required.

Based on the above, Department of Water and Sanitation identified the need for augmentation of the Western Cape Water Supply System by 2019 and proceeded with pre-feasibility and feasibility studies into potential surface water development options. Initially six options were assessed at a pre-feasibility level of detail. These options were then prioritized to identify the two most viable options. These were:

- Berg River-Voëlvlei Augmentation Scheme (also known as the First Phase Augmentation of Voëlvlei Dam); and
- Breede-Berg Transfer Scheme (also known as the Michell's Pass Diversion Scheme).

Ultimately, the Feasibility Study found that the Berg River-Voëlvlei Augmentation Scheme option was the most favourable surface water intervention and as such the Department of Water and Sanitation proposes to implement this scheme which involves the transfer of approximately 23 million m^3 per annum from the Berg River to the existing Voëlvlei Dam *i.e.* the yield of the dam would be 23 million m^3 per annum more than it is currently.

The proposed project is situated in Western Cape in the Drakenstein Local Municipality of the Cape Winelands District as well as the Swartland Local Municipality of the West Coast District.

The proposed developments fall within the Berg River Catchment of the Berg–Olifants Water Management Area. Both Voëlvlei Dam and the Lorelei abstraction site are located in quaternary catchment G10F of the Berg River Catchment.

The project components include the following:

- A low level weir, abstraction works and 4 m^3/s raw water pump station on the Berg River;
- A rising main pipeline from the Berg River to Voëlvlei Dam;
- A potential new summer release connection at the existing Swartland Water Treatment Works to facilitate summer releases into the Berg River for environmental requirements thus eliminating the need to utilize the existing canal from which water losses occur.

The following associated infrastructures were identified and assessed in details:

- Abstraction works;
- Rising main pipeline and pump station;
- Diversion weir;
- Access roads during construction;
- Access roads during operation; and
- Construction camp (footprint).

A Terrestrial Ecology Specialist Study was undertaken as part of the Environmental Impact Assessment process in order to assess the impacts that the proposed development will have on the flora and fauna on site. The current ecological status and conservation priority of vegetation on the site were assessed. Potential faunal habitats were investigated in the study area and all mammals, birds, reptiles and amphibians known to occur on site or seen on site were recorded. Red data species (both fauna and flora) that are known to occur on site were investigated.

The proposed developments fall within the Fynbos Biome and this Biome extends across the southern corner of South Africa in a 100-200km wide coastal belt in the Western Cape Province. Fynbos is characterised as schlerophyllous shrub-land and this biome is comprised of two major vegetation types, the Fynbos and the Renosterveld. The Fynbos Biome forms the main part of the Cape Floristic Region, which is recognised globally as a biodiversity hotspot, due to the high numbers of endemic plant and invertebrate taxa. The project area falls within three Vegetation types, namely Atlantis Sand Fynbos, Swartland Alluvium Fynbos

and Swartland Shale Renosterveld. Although the proposed developments fall within two Critically Endangered vegetation units (Swartland Alluvium Fynbos and Swartland Shale Renosterveld), the area is quite disturbed and transformed as a result of farming activities such as vineyards and wheat faming. The riparian vegetation (along the Berg River), is now predominantly invaded by alien plant species such as *Eucalyptus camaldulensis*, *Ricinus communis, Sesbania punicea, Pinus* species*, Populous deltoids etc.* Some of the indigenous herb vegetation characteristics of the riparian vegetation found were *Zantedeschia aethiopica* and *Typha capensis.* The plant species of conservation importance listed on **Appendix A**, which are previously recorded in the region, were recorded on the proposed development areas, but could potentially be found in the Voëlvlei Nature Reserve. The preferred habitats of these species are limited along the proposed routes.

The Western Cape Biodiversity Framework is a type of conservation plan aimed at a broader range of sectors than just conservation authorities and institutions. It is a tool for supporting and streamlining land-use planning and environmental decision-making across all sectors and tiers of government, with an emphasis on the spatial implications for development and conservation. According to this Plan, both Pipeline Alternative 1 and 3 fall within the Critical Biodiversity Area and Ecological Support Area.

The Western Cape Biodiversity Sector Plan: Spatial Assessment consists of data layers depicting Critical Biodiversity Areas, Ecological Support Areas and other information to be used in land- and resource- use decision-making. This GIS dataset is a beta version, 'quick-reference' layer indicating the location of all known CBAs, ESAs and other spatial biodiversity planning categories, as per the Western Cape Biodiversity Sector Plan: Spatial Assessment (Pence and Pretorius, 2016). A Biodiversity Sector Plan serves as the primary spatial biodiversity informant guiding proactive conservation action and directing land-use planning and reactive decision-making in local, provincial and national spheres of government.

The following are the biodiversity priority categories:

- Critical Biodiversity Area;
- Critical Biodiversity Area: Degraded;
- Ecological Support Area;
- Ecological Support Area: Plantation on CR Veg;
- Ecological Support Area: Plantation supporting CBA;

- Ecological Support Area: Restore;
- Other Natural Area;
- Protected Area;

According to this Plan, both pipeline Alternatives 1 and 3 fall within the Critical Biodivery Area and Ecological Support Area: restore categories. Only the Discharge Point 2 falls within the CBA.

The proposed development areas consisted of suitable habitats for mammalian species such as rivers, riparian vegetation and grasslands. During the field assessments, some small rodent species were observed on the study area but the identity of these species could not be verified and only nine (9) species recorded on sites and none of the species recorded were of conservation concern. The traps set did not yield any positive results as no mammals were captured.

The Important Bird and biodiversity Areas Programme identifies and works to conserve a network of sites critical for the long-term survival of bird species that are globally threatened, have a restricted range and are restricted to specific biomes/vegetation types. Several Conservation and planning tools were consulted for relevancy for the project and these included IBAs. The proposed developments fall within the Boland Mountains IBA. The IBA encompasses a continuous chain of mountains and includes several State forests, mountain catchment areas and provincial nature reserves. The Boland Mountains IBA also includes the Voëlvlei Dam, which provides habitat for a range of waterbirds, which congregate in high numbers at this site. It is particularly important for the near-endemic South African Shelduck (*Tadorna cana)*, large flocks of which use the site as a safe refuge for their annual post-breeding moult. A total of 1 400 Shelduck has been recorded in a single count, which represents c. 3% of the species' global population. These birds probably move in from the Swartland farmland to the west and north and from the Karoo to the east to undergo their moult at the dam. Voelvlei also provides habitat for large numbers of non-threatened waterbirds such as Egyptian Goose (*Alopochen aegyptiaca)*, Spur-winged Goose (*Plectropterus gambensis)* and Red-knobbed Coot (*Fulica cristata)*.

One of the two Red Data bird species found on site was the Blue Crane (*Anthropoides paradiseus),* which is now listed as Near Threatened. This species is endemic to southern Africa. It is a national bird of South Africa and has declined mostly due to loss of habitat (human population growth), direct and indirect poisoning and also powerline collisions. It is a bird of

open grasslands and other upland habitats and is mostly found in natural vegetation in the eastern parts of their distribution (e.g. Mpumalanga and KwaZulu-Natal), but also utilises cultivated pastures and crop lands. One breeding pair was noted on Gouklip Farm, near the proposed Pump Station and Laydown Area 3.

Much of the fynbos in the Swartland has been transformed due to agriculture. Though this obviously resulted in considerable natural habitat being destroyed, numerous species have adapted well to this transformation. One such species, which is highly relevant to this study, is the Blue Crane. This species has thrived on the grain lands and pastures in the southern and western Cape. The Blue Crane has relatively recently expanded its range into the Swartland, where it feeds on *inter alia* fallen grain and recently germinated crops. They also feed on supplementary food put out for small stock, and can congregate in huge numbers around these feed lots.

It is important to note that during construction phase, any breeding pairs and/or nest sites located during this survey must be plotted and should be treated as focal sites for subsequent monitoring.

Another Red data bird species found on site was the Great White Pelican (*Pelecanus onocrotalus*). This species is generally known to be found on large inland waters, and on the coast and is listed as Vulnerable (D2). This species was recorded in the Voëlvlei Dam.

One endemic species recorded on site was the Jackal Buzzard (*Buteo rufofuscus*). Bird species endemic to southern Africa are important as they do not occur anywhere else in the world. A marginal of the World's bird species have small, restricted ranges, being confined to a particular area, and they are thus endemic to that area. Typically a bird is termed endemic if it is constricted to a range of 50,000 km^2 or smaller. Regionally endemic species pose special conservation responsibilities to the region’s conservation authorities, government and land owners. The constricted range makes these species vulnerable to population reduction. This species is known to be found in cliffs and ridges, and also on open grasslands. South Africa is known to boast a number of endemic restricted to fynbos biome. The proposed development is not likely to be associated with large-scale loss of habitat, thus it is highly unlikely that the proposed development would exert an impact of any significance on this endemic bird species.

The reptile assessments indicate that the grasslands and riparian vegetation are of high importance to reptiles. Some sections of the study areas have resulted in increased habitat modification and transformation mainly due to farming activities in the area. The increased

human presence and associated disturbances (illegal reptile collecting, indiscriminate killing of all snake species, frequent fires) are all causal factors in the alteration and disappearance of reptile diversity in many areas. Termite mounds were present on the study area and some large mounds had been damaged by previous foraging by Antbears. This resulted in the exposing of tunnels into the interior of the termite mound. Old termite mounds offer important refuges especially during veld fires as well as cold winter months for numerous frog, lizard, snake and smaller mammal species. Large number of species of mammal, birds, reptiles and amphibians feed on the emerging alates (winged termites). No termite mounds were destroyed during the brief field survey. All overturned rock material was carefully replaced in its original position.

According to the information gathered from the farm owners and workers, there are two protected reptile species occurring on the proposed Access roads routes (Gouklip farm), namely Angulate tortoise and Mole Snake. The Angulate tortoise is considered not threatened, as it is common and abundant in home ranges. It is, however, listed on the Convention on International Trade in Endangered Species of Wild Fauna and FloraAppendix II, together with other tortoise species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled. In South Africa, it is further classified as a protected species by the Nature Conservation Ordinance No. 19 of 1974 (as amended in 2000) and it may not be collected, transported, or possessed in, or imported into or exported from, the Western Cape Province without special permission in the form of a permit from the relevant conservation authorities

According to the South African Reptile Conservation Assessment, the two Red Data reptile species which were recorded in the grid cells 3319AC and 3318BD are Oelofsen's Girdled Lizard (*Cordylus oelofseni*) and Geometric Tortoise (*Psammobates geometricus*), listed as Near Threatened and Critically Endangered respectively. Even though the Geometric Tortoise was not found during the field surveys, this species is known to occur in the Voëlvlei Nature Reserve. A walk down survey and monitoring plan will need to be development before the construction commences in order to protect this species together with its habitat.

The Berg River, Voëlvlei Dam and Canal hold water on a permanent basis and are probably important breeding habitat for most of the frog species which occur at the sites. Only two frog species were recorded on site (Cape River Frog and Clicking Stream Frog) and none of these species recorded were of conservation importance. Two Red Data frog species are known to occur in the region of the proposed development sites-namely Cape Rain Frog (*Breviceps*

gibbosus) and Cape Caco (*Cacosternum capense*), both listed as Vulnerable, and the probability of occurrence of these species on the study area is high.

Exotic vegetation is encountered in the project area and is mostly associated with over-grazing and disturbances linked to farming activities. Areas will be cleared during the construction phase of the project and all disturbed areas will need to be appropriately rehabilitated to ensure that a cumulative impact is not caused in this regard. Through the Search, Rescue and Relocation Plans, a concerted effort will be made to prevent the loss of red data, protected and endangered fauna and flora species that will be affected by the project. In terms of the alternatives provided for this project, Access Road 1 is more preferred as it runs along the gravel road on the farms. A breeding pair of Red data bird species Blue Crane were observed near the Pump station and during construction, this species should not be unnecessarily disturbed. With regards to proposed pipelines, both pipeline Alternatives 1 and 3 fall within the Critical Biodivery Area and Ecological Support Area: restore categories and only the Discharge Point 2 falls within the Critical Biodivery Area and therefore Alternative 2 is the preferred option. The proposed Alternative 3 is situated adjacent to the Voëlvlei Nature Reserve and there is higher probability of encountering and destroying the habitat of Geometric Tortoise and therefore this route is recommended as the least preferred one.

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1 INTRODUCTION AND BACKGROUND

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A Terrestrial Ecology Specialist Study was undertaken as part of the Environmental Impact Assessment (EIA) process in order to assess the impacts that the proposed development will have on the flora and fauna on site. The current ecological status and conservation priority of vegetation on the site were assessed. Potential faunal habitats were investigated in the study area and all mammals, birds, reptiles and amphibians known to occur on site or seen on site were recorded. Red data species (both fauna and flora) that are known to occur on site were investigated.

1.1 Objectives of the survey

In order to achieve the aim stated above, the following objectives are to be achieved:

- To apply relevant literature to determine the diversity and eco-status of the plants, mammals, birds, reptiles and amphibians on the proposed development areas;
- To carry out a field surveys to gain an understanding of the diversity and eco-status of taxa which inhabit the proposed study area, as well as the presence of unique habitats that might require further investigation or protection;

- To assess the current habitat and conservation status of plant and animal species on the study sites;
- To comment on ecological sensitive species/areas;
- To assess the possible impact of the proposed project on these taxa and/or habitats;
- To list the species on sites and to recommend necessary actions in case of occurrence of endangered, vulnerable or rare species or any species of conservation importance;
- To provide management recommendations to mitigate negative and enhance positive impacts of the proposed development areas; and
- To recommended the preferred alternative from a terrestrial ecological perspective.

2 DECLARATION OF INDEPENDENCE

The specialist investigator declares that I:

- Act as independent specialist for this project.
- Consider myself bound by the rules and ethics of the South African Council for Natural Scientific Professions.
- Do not have any personal or financial interest in the project except for financial compensation for specialist investigations completed in a professional capacity as specified by the Environmental Impact Assessment Regulations, 2006.
- Will not be affected by the outcome of the environmental process, of which this report forms part of.
- Do not have any influence over the decisions made by the governing authorities.
- Do not object to or endorse the proposed developments, but aim to present facts and my best scientific and professional opinion with regards to the impacts of the development.

3 TERMS OF REFERENCE

The terms of reference are as follows:

- Undertake a Terrestrial Ecology Specialist Study.
- A complete potential biodiversity list must be provided.
- The conservation status of each species listed must be determined.
- The potential species list in accordance to the habitat unit availability must also be compiled.
- An assessment of the impact of development on flora and fauna species especially Red Data List species to be undertaken.
- Suggest suitable mitigation measures to address the identified impacts.

- Provide recommendations regarding the alternatives provided from an ecological perspective.
- Compile a report that reflects the above and includes appropriate mapping. Ensure that the report complies with Appendix 6 of GN No. R982 (2014), as part of the EIA Report.
- Prepare a sensitivity map (GIS-based), based on the findings of the study.
- Present findings at the public meeting.

4 RELEVANT LEGISLATION AND GUIDELINES

The following pieces of legislation are relevant to this project.

- Constitution of the Republic of South Africa (Act No. 108 of 1996);
- National Environmental Management Act (Act No. 107 of 1998);
- National Water Act (Act No. 36 of 1998);
- National Environmental Management: Protected Areas Act (Act No. 57 of 2003);
- National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004);
- Conservation of Agricultural Resources Act (Act No. 43 of 1983);
- National Forestry Act (Act No. 84 of 1998);
- Conservation of Agricultural Resources Act (Act No. 43 of 1983);
- Guideline for involving biodiversity specialists in EIA processes (2005): Edition 1. CSIR Report No ENV-S-C 2005 053 C;
- Fynbos Forum Ecosystem Guidelines for Environmental Assessment in the Western Cape (2005);
- National Biodiversity Assessment (2011);
- Western Cape Biodiversity Framework (2014) Status Update: Critical Biodiversity Areas of the Western Cape (2014);
- The Western Cape Provincial Spatial Development Framework (2014) (Department of Environmental Affairs & Development Planning) and
- Environmental Management Framework for the Drakenstein Municipality (2015).

5 STUDY AREA

The project area is situated in Western Cape in the Drakenstein Local Municipality of the Cape Winelands District Municipality as well as the Swartland Local Municipality of the West Coast District Municipality (**Figures 1** and **2).**

The proposed development falls within the Berg River Catchment of the Berg–Olifants Water Management Area (WMA). The Berg River Catchment receives most precipitation during the winter rainfall season, with the east of the catchment receiving relatively high volumes of rain (ca. 5 000 mm per annum) in contrast to the lower-lying foothills and floodplains to the west receiving only 400 – 500 mm per annum, decreasing towards the sea. A collage of images illustrating the proposed development areas are indicated in **Figure 3** below.

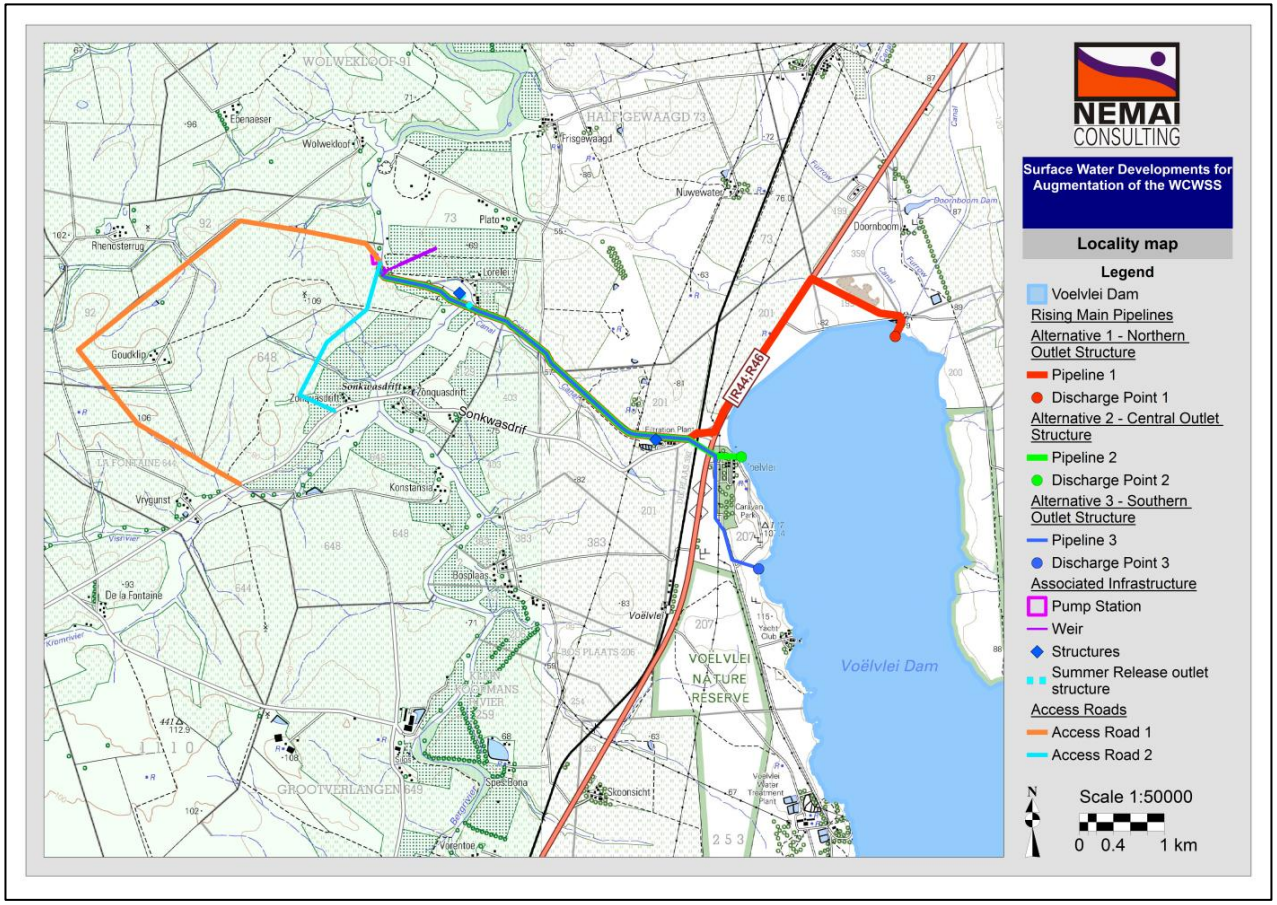

Figure 1: Map showing the project components

Figure 2: Map indicating Google earth image of the study area.

Figure 3: A collage of images illustrating the proposed development areas

5.1 **Alternatives**

5.1.1 Pipelines

Three alternative pipeline routes are considered as part of the Berg River-Voëlvlei Augmentation Scheme (BRVAS) (also known as the First Phase Augmentation of Voëlvlei Dam). These routes are related to three potential discharge options into the dam from the diversion weir site. These alternative routes are as follows:

- Option 1 (**Figure 4**): Pipeline route to Northern Discharge Point = 8 115 m;
- Option 2 (**Figure 5**): Pipeline route to Central Discharge Point = 5 000 m; and
- Option 3 (**Figure 6**): Pipeline route to Southern Discharge Point = 6 300 m.

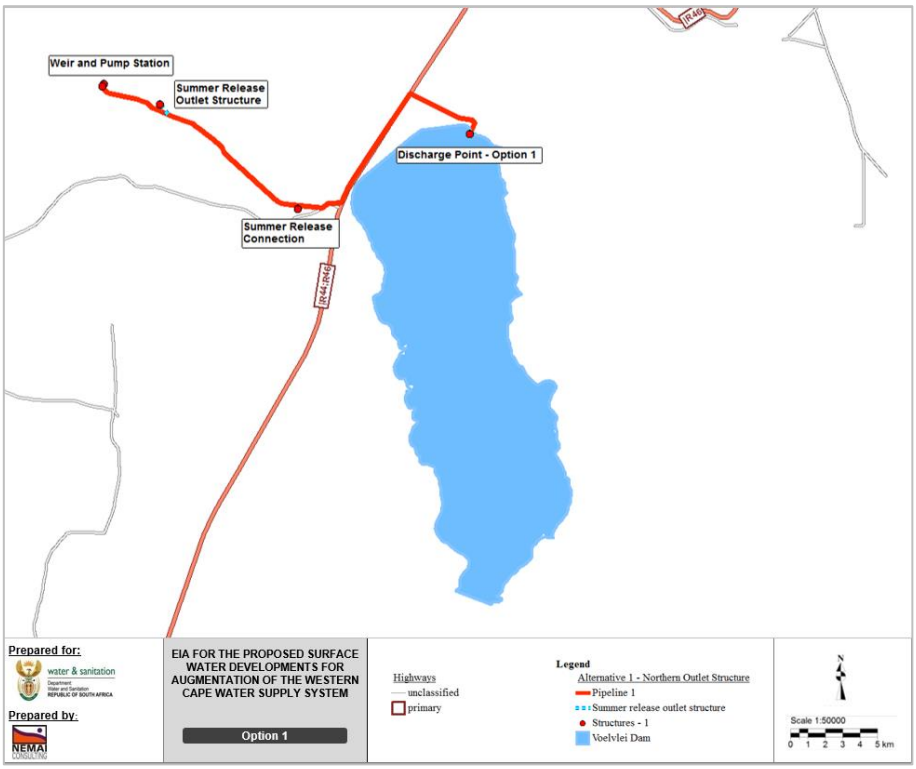

Figure 4: Pipeline alternative 1

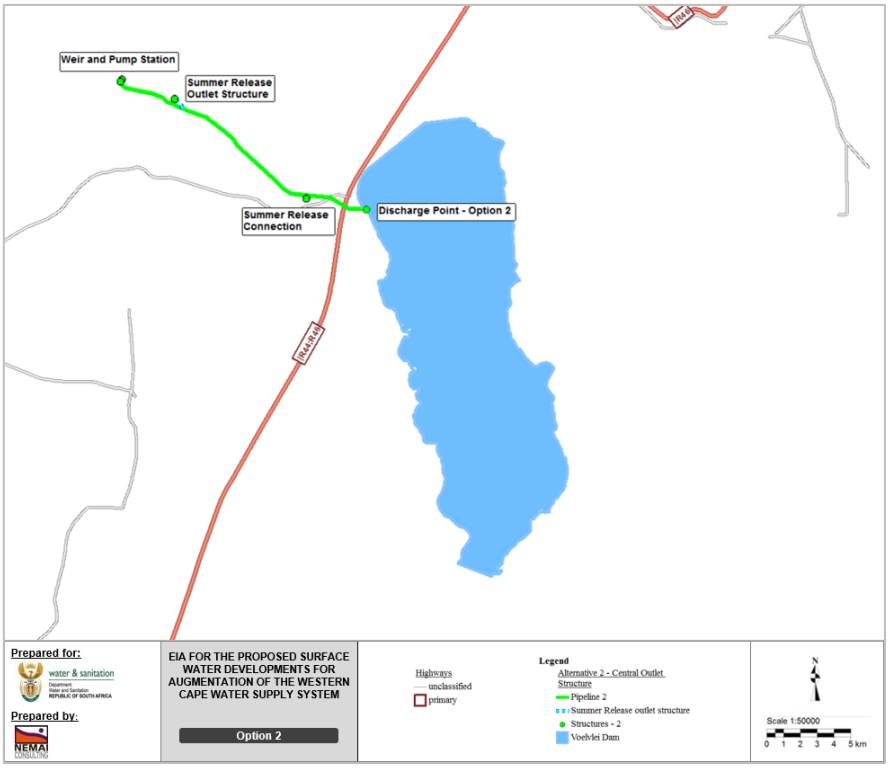

Figure 5: Pipeline alternative 2

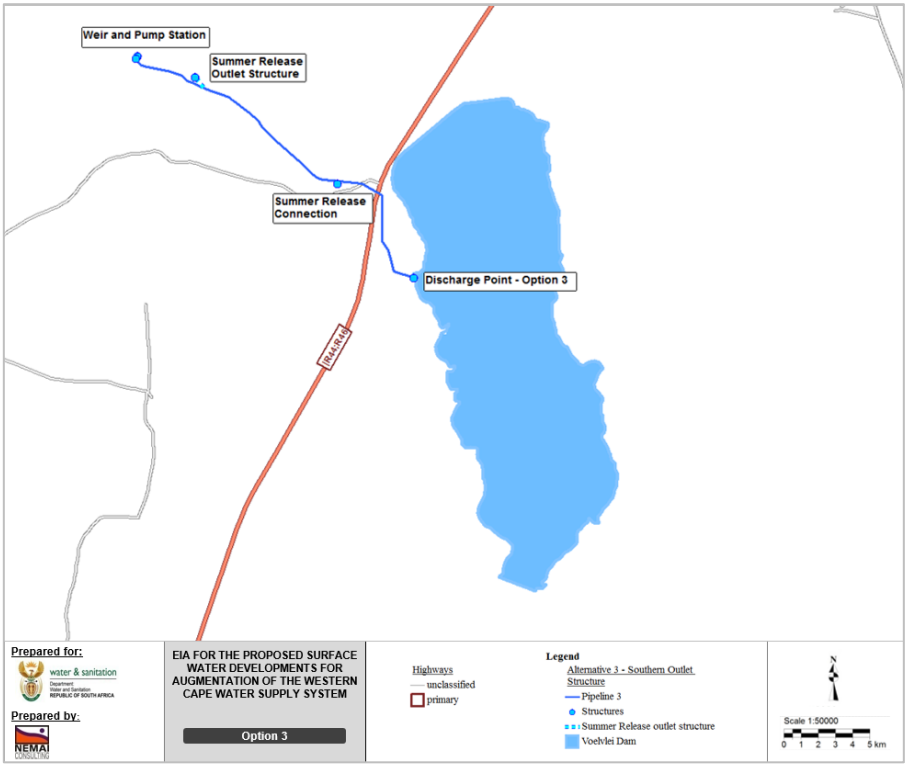

Figure 6: Pipeline alternative 3

5.1.2 Site Laydown Areas

Two site laydown areas are proposed at the Discharge Point of Pipeline Alternative 2; both approximately 0.4 hectares in size (**Figures 7** and **8**) and only one of these site laydown areas would be required. These site laydown areas would be accessible from the main road, R44 and are adjacent to the Voëlvlei Dam.

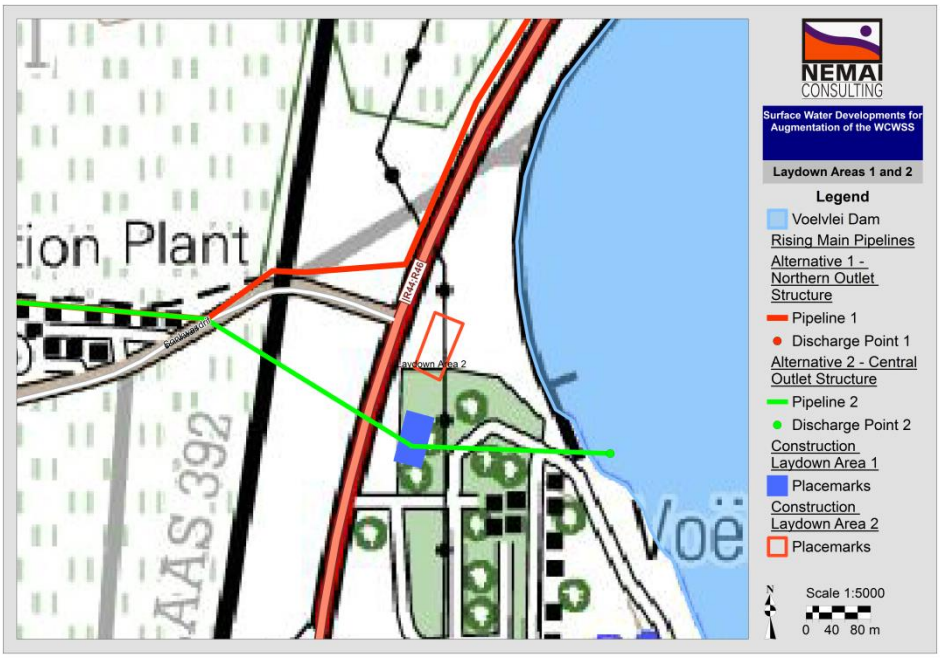

Figure 7: Location of the two proposed laydown areas (Laydown areas 1 and 2) adjacent to the Voëlvlei Dam

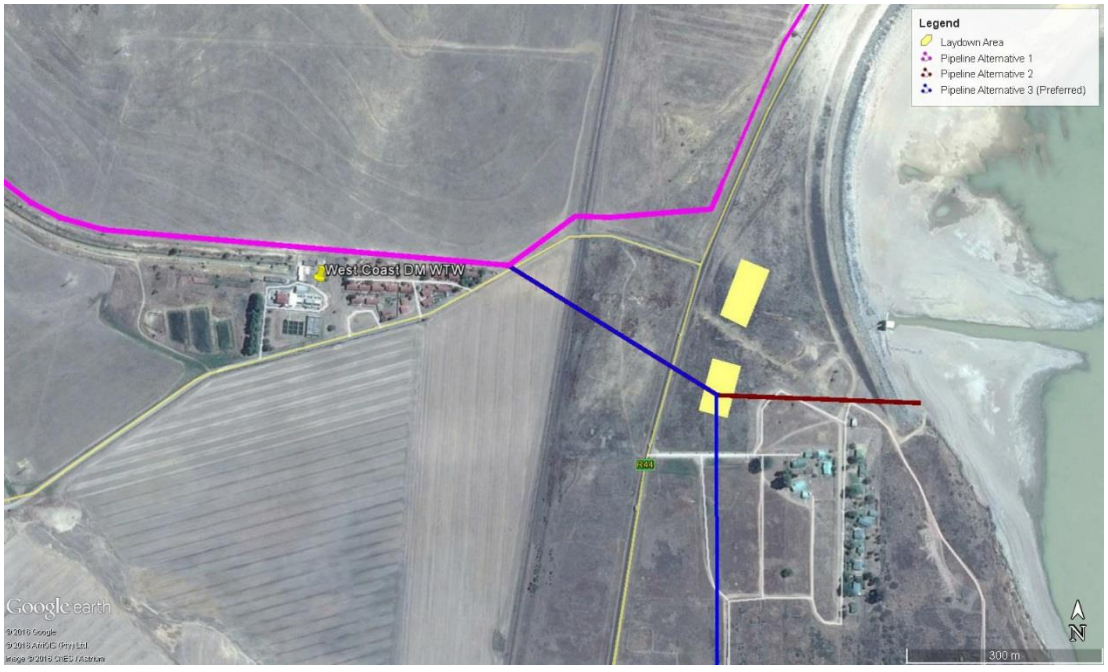

Figure 8: Google Earth image of the two proposed laydown areas (Laydown areas 1 and 2) adjacent to the Voëlvlei Dam

The main site laydown area is proposed at the pump station and weir site for purposes of construction (**Figures 9** and **10**). This laydown site is approximately 0.85 hectares in size and is adjacent to the Berg River. The site will be accessible from the existing unnamed farm roads.

Figure 9: Proposed site laydown area 1 at the pump station and weir site adjacent to the Berg River

Figure 10: Google Earth image of the proposed site laydown area 1 at the pump station and weir site adjacent to the Berg River.

5.1.3 Access Roads

As most of the pipeline route follows an existing farm road, construction vehicles will be able to access the pipeline construction site from this road. Access roads to the weir and pump station site will be via existing unnamed farm roads in the study area (**Figure 11**).

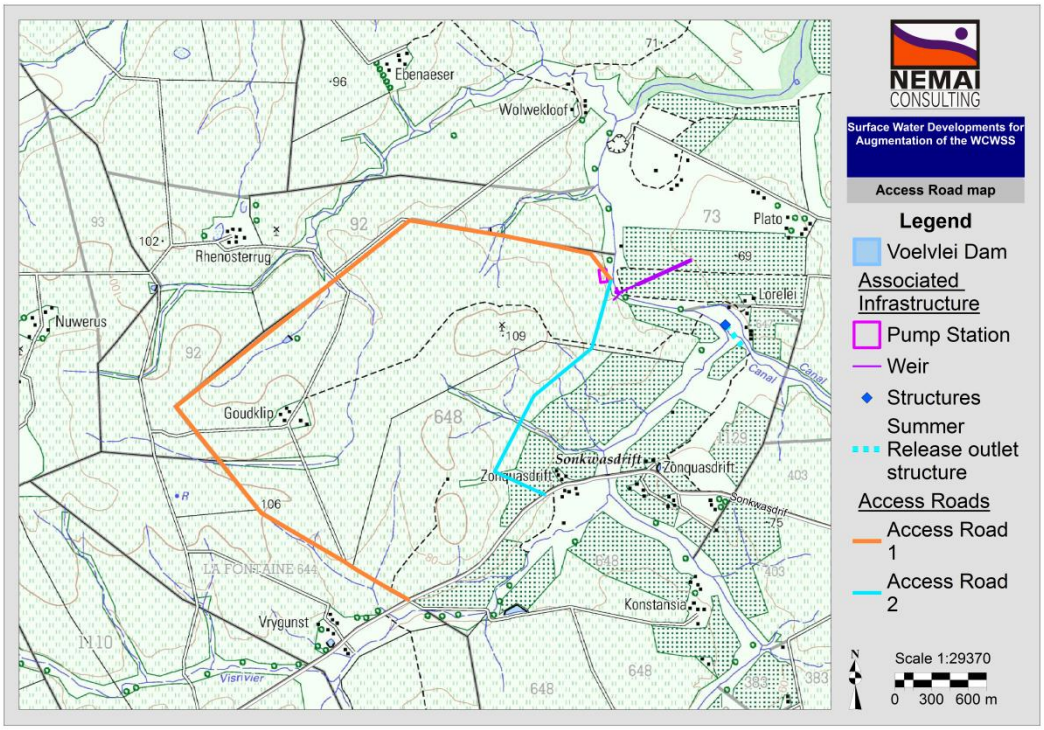

Figure 11: Proposed access roads to weir and pump station.

6 METHODOLOGY

The White Paper on the Conservation and Sustainable Use of South Africa's Biological Diversity (1997) and the National Environmental Management Act 1998 (Act No 107 of 1998) specify that due care must be taken to conserve and avoid negative impacts on biodiversity, as well as the sustainable, equitable and efficient use of biological resources.

6.1 **Flora**

The flora assessment consisted of two complementary approaches:

- A desktop analysis, which included literature review, topographical maps, and Google Earth imagery; and
- Site visits were conducted from 24-26 January 2017.

Satellite imagery of the area was obtained from Google Earth and was studied in order to acquire a three dimensional impression of the topography and land use and also to identify

potential “hot-spots” or specialized habitats such as rivers, watercourses and dams on or near the proposed development sites.

The Pretoria Computerised Information System (PRECIS) list of Red Data plants recorded in the 3319AC and 3318BD quarter degree grid squares was obtained from SANBI (http://posa.sanbi.org/searchspp.php). The list was consulted to verify the record of occurrence of the plant species seen in the vicinity of the proposed development sites. The sites sampled are only a very small portion of the whole grid and so habitats suitable for certain species in the PRECIS list may not be present at the areas sampled. The vegetation map published in Mucina and Rutherford (2006) was consulted to identify vegetation units that are found in the study area. The desktop component of the study of the habitats of the red-data-listed plants was conducted before the site visits.

The habitats on the proposed development sites were inspected in a random zigzag fashion, paying particular attention to areas that at first sight appeared to be sensitive. All general observations were noted such as grasses, herbs (forbs), shrubs and trees. The habitats suitable for Red Data listed species known to occur in the quarter degree grid squares were examined intensively for the presence of such species. Attention was also paid to the occurrence of medicinal, alien and declared weed species. Field guides such as van Wyk *et al.,* (1997), Pooley (1998), van Oudshoorn (1999), Bromilow, 2010 and Manning (2009) were utilised during the field work and in instances where confirmation was required; pictures of plant species were emailed to Prof van Wyk from University of Pretoria for identification.

Exotic and invasive plant species were categorised according to the framework laid out by The Conservation of Agricultural Resources Act (CARA) (Act 43 of 1983). CARA defines weeds as alien plants, with no known useful economic purpose that should be eradicated. Invader plants, also considered by the Act, can also be of alien origin but may serve useful purposes as ornamental plants, as sources of timber, or other benefits such as medicinal uses (Henderson, 2001). These plants need to be managed and prevented from spreading.

Invasive species are controlled by the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) - Alien and Invasive Species (AIS) Regulations which became law on 1 October 2014. The AIS Regulations list four (4) different categories of invasive species that must be managed, controlled or eradicated from areas where they may cause harm to the environment, or that are prohibited to be brought into South Africa.

Invasive plant species are divided into four categories:

- Category 1a: Invasive species which must be combatted and eradicated. Any form of trade or planting is strictly prohibited.
- Category 1b: Invasive species which must be controlled and wherever possible, removed and destroyed. Any form or trade or planting is strictly prohibited.
- Category 2: Invasive species, or species deemed to be potentially invasive, in which a permit is required to carry out a restricted activity. Category 2 species include commercially important species such as pine, wattle and gum trees.
- Category 3: Invasive species which may remain in prescribed areas or provinces. Further planting, propagation or trade, is however prohibited.

According to van Oudtshoorn (1999), a grass species reacts to grazing in one of two ways: it can either become more or less abundant. **Table 1** describes the classification of grasses.

Table 1. Classification of grasses (van Oudtshoorn, 1999).

Class	Description	Examples
Decreasers	Grasses that are abundant in good veld, but that decrease in number when the veld is overgrazed or undergrazed.	*Themeda trianda, Digitaria eriantha*
Increaser 1	Grasses that are abundant in underutilised veld. These grasses are usually unpalatable, robust climax species that grow without any defoliation	*Hyperthelia dissoluta, Trachypogon spicatus*
Increaser 2	Grasses that are abundant in overgrazed veld. These grasses increase due to the disturbing effect of overgrazing and include mostly pioneer and subclimax species	*Aristida adscensionis, Eragrostis rigidor*
Increaser 3	Grasses that are commonly found in overgrazed veld. These are usually unpalatable, dense climax grasses	*Sporobolus africanus, Elionurus muticus*
Invaders	All plants that are not indigenous to an area. These plants are mostly pioneer plants and are difficult to eradicate	*Arundo donax*

6.2 **Mammals**

Mammal site visits were conducted in January 2017 and during these visits, the observed and presence of mammals associated with the recognized habitat types of the study sites were recorded during the day. No night surveys were undertaken. Adjoining properties were also scanned for important faunal habitats. During the site visits, mammals were identified by spoor, burrow and visual sightings through random transect walks. Terrestrial and arboreal rats, mice (non-volant small mammals) were sampled using LFAHD-P Sherman large folding aluminium heavy duty perforated traps (23x7.5x9cm/250grams) (**Figure 12**) that were set approximately 20 m apart and baited with oats and butter and left overnight. Placement of traps were either on the ground near to burrow systems and areas of potential

foraging activity such as logs and base of trees, or low branches situated above the ground. Locals were interviewed to confirm occurrences or absences of species.

Figure 12. Sherman traps used for small mammals such as rats and mice

6.3 Avifauna

Avifauna site assessment was conducted to record the presence of bird species associated with the habitat systems on the studied site and to identify possible sensitive areas. The study sites where surveyed on foot and in the process sightings were recorded through random transects walks. Adjoining properties (such as the Voëlvlei Dam and the ponds) were also scanned for important bird species and/or habitats. Birds were identified visually using 10X42 Bushnell Waterproof binoculars where necessary, by call and from feathers. Where necessary, identifications were verified using Sasol Birds of Southern Africa (Sinclair *et al.* 2002) and the Chamberlain Guide to Birding Gauteng (Marais and Peacock, 2008).

6.4 Reptiles

Reptile species are sensitive to major habitat fragmentation and modification. As a result of human presence along the canal and around the farms; coupled with habitat fragmentation (farming) and high levels of disturbances, modifications to the original reptilian fauna are expected to have already occurred. The reptile assessments were conducted during the day. During the field visits, the observed and derived presence of reptiles associated with the recognised habitat types of the study sites was recorded. This was done with due regard to the known distributions of Southern African reptiles. Reptiles were identified by sightings during random transect walks. Possible burrows or other reptile retreats were inspected for any inhabitants. Locals (especially the farm owners and workers) were interviewed to confirm occurrences or absences of species in the study area.

6.5 Amphibians

According to Carruthers (2001), amphibians are extremely sensitive to habitat transformation and degradation. The identification technique which was used for this study was frog's call. According to Carruthers (2001), a frog's call is a reliable means of identifying species. Frog calls were compared with pre-recorded calls from du Preez and Carruthers (2009)'s cd and identified from this comparison. Samplings were conducted on the moist to semi-aquatic areas. During these surveys; fieldworks were augmented with species lists compiled from personal records; data from the South African frog atlas project (SAFAP) (1999-2003) and published data. Locals (especially the farm owners and workers) were interviewed to confirm occurrences or absences of species in the study area.

7 WESTERN CAPE BIODIVERSITY SECTOR PLAN: SPATIAL ASSESSMENT

The Western Cape Biodiversity Sector Plan: Spatial Assessment consists of data layers depicting Critical Biodiversity Areas (CBAs), Ecological Support Areas (ESAs) and other information to be used in land- and resource- use decision-making. This GIS dataset is a beta version, 'quick-reference' layer indicating the location of all known CBAs, ESAs and other spatial biodiversity planning categories, as per the Western Cape Biodiversity Sector Plan: Spatial Assessment (Pence and Pretorius, 2016). A Biodiversity Sector Plan serves as

the primary spatial biodiversity informant guiding proactive conservation action and directing land-use planning and reactive decision-making in local, provincial and national spheres of government.

The following are the biodiversity priority categories:

- CBA;
- CBA: Degraded;
- ESA;
- ESA: Plantation on CR Veg;
- ESA: Plantation supporting CBA;
- ESA: Restore;
- Other Natural Area;
- Protected Area;

The proposed developments fall within both CBA and ESA: restore categories (**Figure 13**).

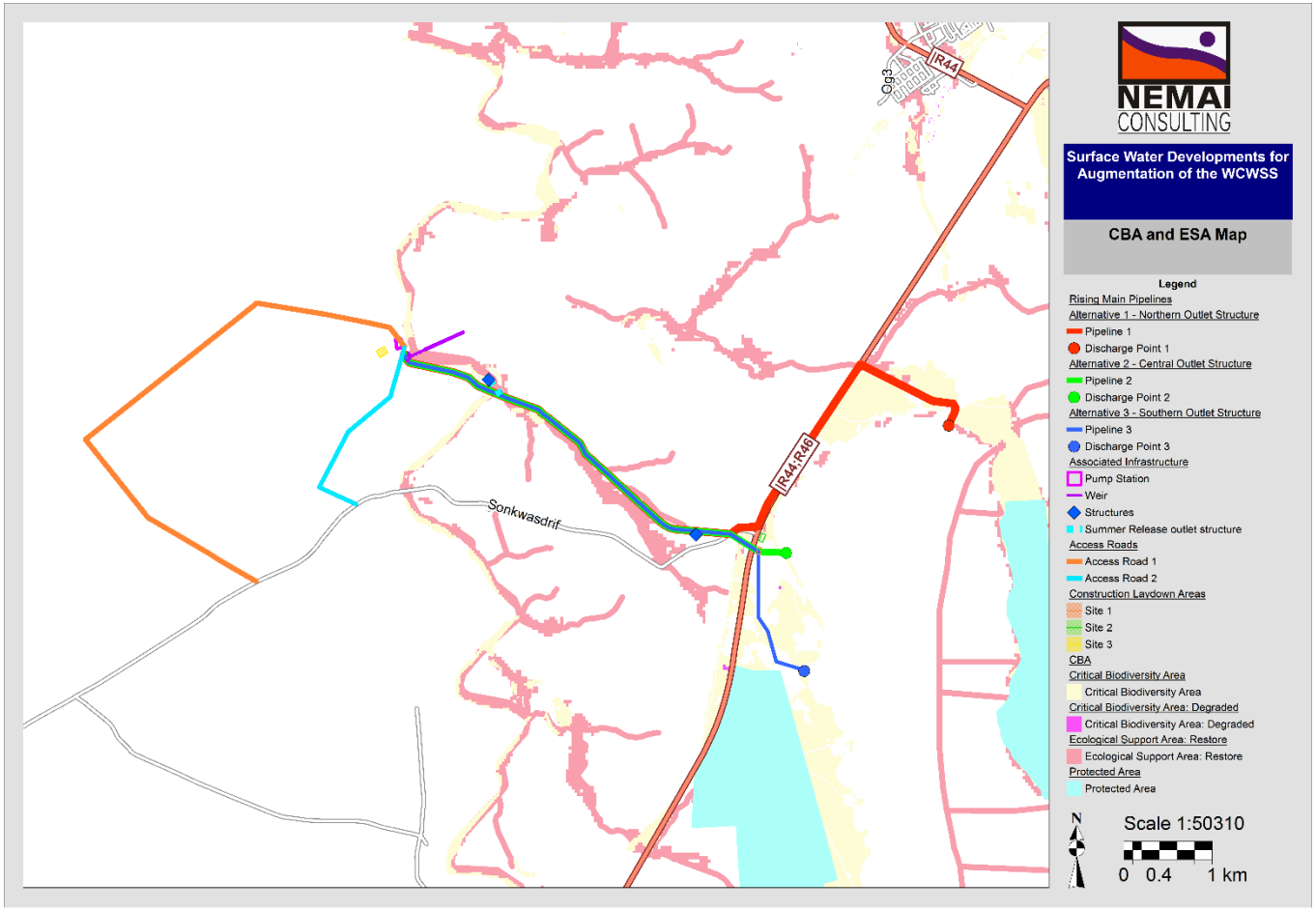

Figure 13: Western Cape Biodiversity Framework in relation to the project area

8 LIMITATIONS AND GAPS

The constraints or limitations to the survey included:

- The field survey was conducted outside of the peak spring-flowering period (August to October) when most geophytes in the region are in flower. This restricts the assessment in terms of the noticeable botanical attributes. Assumptions with regard to the botanical value of the site were therefore made on the basis of habitat condition and knowledge of species most likely to occur in the area.

- Since environmental impact studies deal with dynamic natural systems additional information may come to light at a later stage and Nemai Consulting can thus not accept responsibility for conclusions and mitigation measures made in good faith based information gathered or databases consulted at the time of the investigation.

9 REGIONAL VEGETATION

The proposed developments fall within the Fynbos Biome (SANBI, 2012) (**Figure 14**). The Fynbos Biome extends across the southern corner of South Africa in a 100-200km wide coastal belt in the Western Cape Province. Fynbos is characterised as schlerophyllous shrub-land and this biome is comprised of two major vegetation types, the Fynbos and the Renosterveld. The Fynbos Biome forms the main part of the Cape Floristic Region (CFR), which is recognised globally as a biodiversity hotspot, due to the high numbers of endemic plant and invertebrate taxa.

The CFR covers approximately 87 892 km^2 within the Western Cape and slightly into the Eastern Cape Province of South Africa. This region is extremely rich in plant species, with approximately 9 600 different species of plants having been documented with at least 70% of these endemic to this region. The diversity of plant taxa arises from the diversity of soil types, topography and climatic conditions across the region.

The chain of large mountain ranges within the region is viewed as essential water catchment areas, and as such has historically received the focus of conservation action in the region. This has unfortunately neglected the low lying Fynbos areas which hold high levels of

biodiversity. Much of the vegetation types of the lowlands have been converted into agricultural fields or rangelands, or succumbed to the expansion of infrastructure development. The disruption of the natural fire regimes has impacted negatively on many of the Fynbos plant species as these species utilise specific fire frequencies to set seed and germinate. Infestation by alien invasive plant species, such as certain Australian Acacia and Eucalyptus species, has also converted much of the natural habitat areas into alien "forests", devoid of the natural biodiversity of the region. The Fynbos Biome is predicted to be severely impacted upon by climate change, with estimates of as high as a 50% loss of the Fynbos Biome. The drastic climatic changes predicted could alter the conditions required for the persistence of the biome, such as changes in rainfall patterns and temperature, which in turn lead to changes in the plant communities which are able to persist in the area.

According to SANBI (2012), the project area falls within three Vegetation types, namely Atlantis Sand Fynbos, Swartland Alluvium Fynbos and Swartland Shale Renosterveld (**Figure 15**). Although the proposed developments fall within two Critically Endangered vegetation units (Swartland Alluvium Fynbos and Swartland Shale Renosterveld), the area is quite disturbed and transformed as a result of farming activities (**Figure 16**).

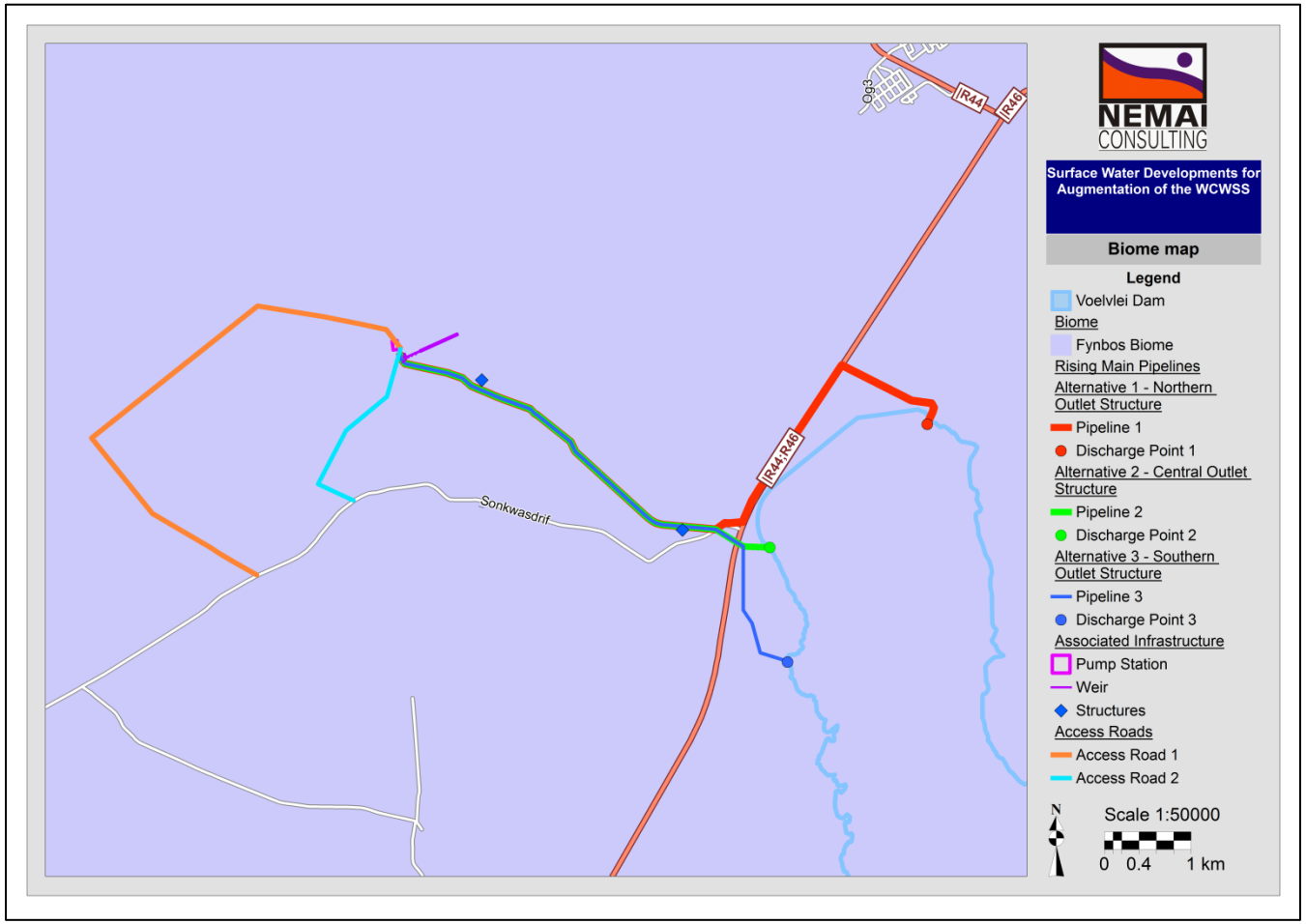

Figure 14: Biome in project area

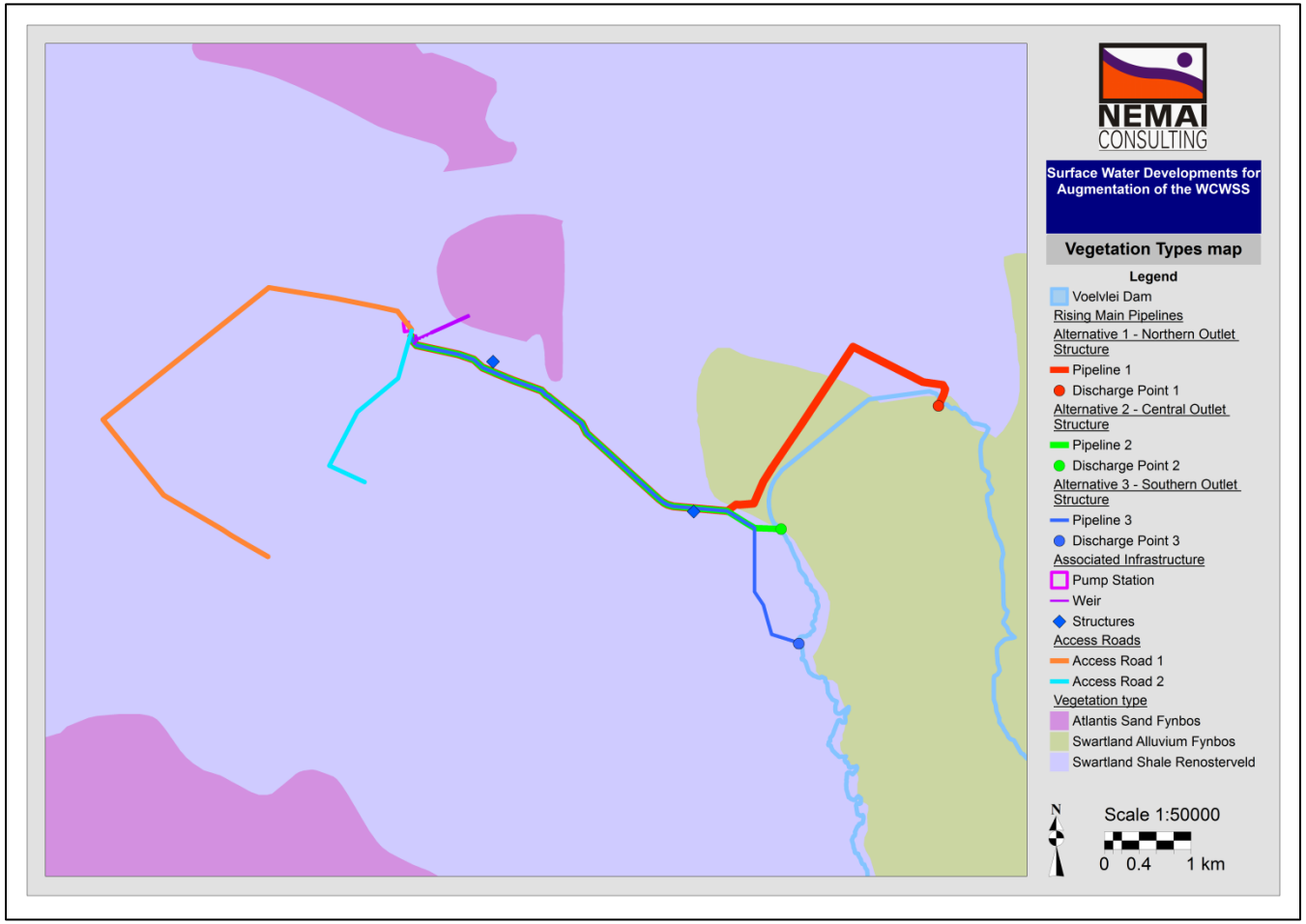

Figure 15: Vegetation Types in project area

Figure 16: Transformed land next to the Berg River

The description of each vegetation types follows below:

9.1 Atlantis Sand Fynbos

Atlantis Sand Fynbos vegetation type is found in Western Cape Province. It extends from Rondeberg to Blouberg on the West Coast coastal flats; along the Groen River on the eastern side of the Dassenberg-Darling Hills through Riverlands to the area between Atlantis and Kalbaskraal, also between Klipheuwel and the Paardeberg with outliers west of the Berg River east and north of Riebeek-Kasteel between Hermon and Heuningberg (Mucina and Rutherford, 2006).

Conservation

This vegetation type is listed as **Vulnerable**, with a conservation target of 30%. About 6% is conserved in Riverlands, Paardenberg and at Pella Research Site. Some 40% has been transformed, mainly for cultivation (agricultural smallholdings and pastures), also by urban sprawl of Atlantis and for setting up pine and gum plantations. Woody aliens include *Acacia saligna*, *A. cyclops* and various species of *Eucalyptus* and *Pinus* (Mucina and Rutherford (2006).

9.2 Swartland Alluvium Fynbos

Swartland Alluvium Fynbos is found in Western Cape Province and extends from Swartland lowlands at west-facing piedmonts of the Groot Winterhoekberge near Porterville, Saronberg, Elandskloofberge to the Limietberge near Wellington; broad valley bottoms of the Paarl, Drakenstein, Franschhoek and Banhoek Valleys, with some extensions west of Paarl Mountain and to Klapmuts (Mucina and Rutherford, 2006).

Conservation

This vegetation type is listed as **Critically endangered** with a conservation target of 30%. Nearly 10% is conserved in the Waterval Nature Reserve, Winterhoek (mountain catchment area) and private reserves such as Elandsberg, Langerug and Wiesenhof Wildpark. More than 75% is already transformed for vineyards, olive orchards, pine plantations, urban settlements and by building of the Voëlvlei Dam (**Figure 17)** and Wemmershoek Dams. Alien *Acacia saligna* and *Hakea sericea* are prominent in places (Mucina and Rutherford, 2006).

Figure 17: Voëlvlei Dam

9.3 Swartland Shale Renosterveld

Swartland Shale Renosterveld is found in Western Cape Province. It forms a large, generally continuous areas of the Swartland and the Boland on the West Coast lowlands, from Het Kruis in the north, southwards between the Piketberg and Olifantsrivierberge, widening appreciably in the region around Moorreesburg between Gouda and Hopefield, and encompassing Riebeek-Kasteel, Klipheuwel, Philadelphia, Durbanville, Stellenbosch to the south and Sir Lowry's Pass Village near Gordon's Bay (Mucina and Rutherford, 2006).

Conservation

This vegetation type is listed as **critically endangered** with a conservation target of 26%, but since 90% of the area has been totally transformed (mainly for cropland), the target remains unattainable. The remnants are found in isolated pockets, usually on steeper ground. So far only a few patches have been included in conservation schemes (e.g. Elandsberg, Paardenberg). Aliens include *Acacia saligna* (very scattered over 65%), *A. mearnsii* (very

scattered over 62%) as well as several species of *Prosopis* and *Eucalyptus*. Alien annual grasses of the genera *Avena, Briza, Bromus, Lolium, Phalaris* and *Vulpia* are a primary problem in remnant patches. Other serious aliens include herbs such as *Erodium cicutarium, E. moschatum, Echium plantagineum* and *Petrorhagia prolifera* (Mucina and Rutherford, 2006).

10 TERRESTRIAL THREATENED ECOSYSTEMS

The South African National Biodiversity Institute (SANBI), in conjunction with the Department of Environmental Affairs (DEA), released a draft report in 2009 entitled "Threatened Ecosystems in South Africa: Descriptions and Maps", to provide background information on the above List of Threatened Ecosystems (SANBI, 2009). The purpose of this report was to present a detailed description of each of South Africa's ecosystems and to determine their status using a credible and practical set of criteria. The following criteria were used in determining the status of threatened ecosystems:

- Irreversible loss of natural habitat;
- Ecosystem degradation and loss of integrity;
- Limited extent and imminent threat;
- Threatened plant species associations;
- Threatened animal species associations; and
- Priority areas for meeting explicit biodiversity targets as defined in a systematic conservation plan.

In terms of section 52(1) (a), of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004), a national list of ecosystems that are threatened and in need of protection was gazetted on 9 December 2011 (Government Notice 1002 (Driver *et. al*, 2004). The list classified all threatened or protected ecosystems in South Africa in terms of four categories; Critically Endangered (CR), Endangered (EN), Vulnerable (VU), or Protected. The purpose of categorising these ecosystems is to prioritise conservation areas in order to reduce the rates of ecosystem and species extinction, as well as preventing further degradation and loss of structure, function, and composition of these ecosystems. It is estimated that threatened ecosystems make up 9.5% of South Africa, with critically endangered and endangered ecosystems accounting for 2.7%, and vulnerable ecosystems 6.8% of the land area. It is therefore vital that Threatened Terrestrial Ecosystems inform proactive and reactive

conservation and planning tools, such as Biodiversity Sector Plans, municipal Strategic Environmental Assessments (SEAs) and Environmental Management Frameworks (EMFs), Environmental Impact Assessments (EIAs) and other environmental applications (Mucina *et al*. 2006).

The following threatened ecosystems are affected by the project (**Figure 18**). Much of the original natural habitats in the Drakenstein and Swartland Local Municipalities have been converted for agricultural, residential or urban use. In addition, invasion by alien plants has led (and is continuing to lead) to significant loss of biodiversity and transformation of ecosystems. Poor fire management of the fire-dependent vegetation types has also led to loss of biodiversity.

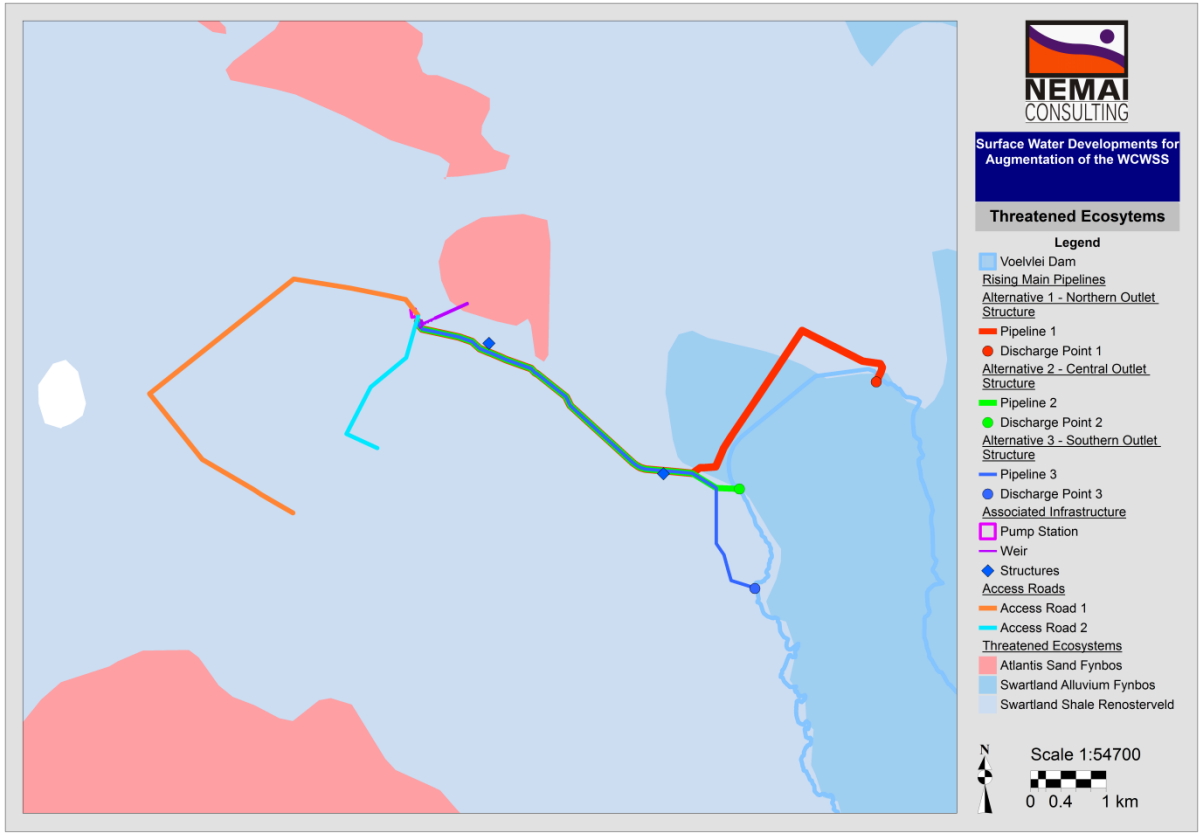

Figure 18. Terrestrial Threatened Ecosystems occurring on the proposed development areas.

11 PROTECTED AREAS

11.1 **Provincial Nature Reserves**

The Voëlvlei Nature Reserve (**Figure 19**) is located on the Dam but is not impacted on by the proposed developments. The following flora species are known to be found in the Reserve: Silky Needlebush (*Hakea sericea*), Swartveld Conebush (*Leucadendron corymbosum*), Common Shale Conebush (*Leucadendron lanigerum lanigerum*), Common Sunshine Conebush (*Leucadendron salignum*), Star Conebush (*Leucadendron stellare*), Arid Pincushion (*Leucospermum calligerum*), Grey-leaf Sugarbush (*Protea laurifolia*) and Common (Cape) Sugarbush (Protea repens). The studies conducted by Baard (1993) and van Bloemestein (2005) indicate that six reserves where established in order to protect the Geometric tortoise, and those being the largest reserve was the Elandsberg Private Nature Reserve (EPNR) and the second largest reserve was Voëlvlei Nature Reserve. This Reserve is managed by the Cape Nature as indicate din **Figure 20** below.

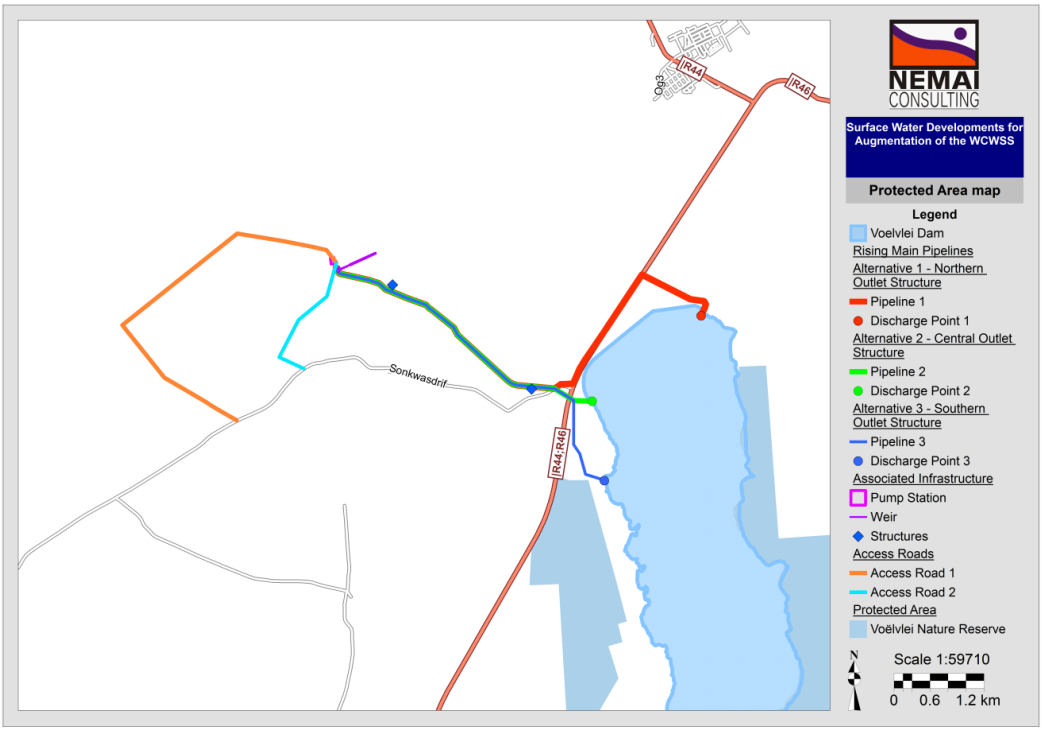

Figure 19. Voëlvlei Nature Reserve

Figure 20. A picture indicating Voëlvlei Nature Reserve

12 RESULTS AND DISCUSSION

12.1 **Flora**

12.1.1 Desktop study results

The proposed project site is located within 3319AC and 3318BD quarter degree squares in terms of the 1:50 000 grid of South Africa. South African National Biodiversity Institute (SANBI) uses this grid system as a point of reference to determine any Red Data plant species or any species of conservation importance occurring in South Africa. This can be used to determine the list of species which may potentially occur within an area. **Appendix A** provides details on the Red Data plant species which have been recorded in 3319AC and 3318BD grid cells. The definitions of the conservation status are provided in **Table 2**. Due to the fact that threatened species have historically been noted in the area, it is imperative that, before the construction

phase, detailed searches for these rare/threatened and protected species are made during the appropriate time of year when plants are likely to be more noticeable.

Table 2. Definitions of Red Data status (Raimondo *et al*. 1999)

Symbol	Status	Description
CR	Critically Endangered	A taxon is **Critically Endangered** when the best available evidence indicates that it meets any of the five International Union for Conservation of Nature (IUCN) criteria for Critically Endangered, and is therefore facing an extremely high risk of extinction in the wild
EN	Endangered	A taxon is **Endangered** when the best available evidence indicates that it meets any of the five IUCN criteria for Endangered, and is therefore facing a very high risk of extinction in the wild.
VU	Vulnerable	A taxon is **Vulnerable** when the best available evidence indicates that it meets any of the five IUCN criteria for Vulnerable and it is therefore considered to be facing a high risk of extinction in the wild.
NT	Near Threatened	A taxon is **Near Threatened** when available evidence indicates that it is close to meeting any of the five IUCN criteria for Vulnerable and it is therefore likely to qualify for a threatened category in the near future.
	Rare	A taxon is **Rare** when it does not meet any of the four South African criteria for rarity, but is not exposed to any direct or plausible potential threat and does not qualify for a category of threat according to the five IUCN criteria.
	Declining	A taxon is **Declining** when it does not meet any of the five IUCN criteria and does not qualify for the categories Critically Endangered, Endangered, Vulnerable or Near Threatened, but there are threatening processes causing a continuing decline in the population.

12.1.2 Plant species recorded along the proposed development areas

The project area is historically known to occur in critically endangered vegetation units (Swartland Alluvium Fynbos and Swartland Shale Renosterveld), but at the present state the area is quite disturbed and transformed as a result of farming activities such as vineyard and wheat faming. The riparian vegetation (along the Berg River), which is known to contain higher species biodiversity, is now predominantly invaded by alien plant species such as *Eucalyptus camaldulensis* (**Figure 21**), *Ricinus communis, Sesbania punicea, Pinus species, Populous deltoids etc.* Some of the indigenous herb vegetation characteristics of the riparian vegetation found were *Zantedeschia aethiopica* and *Typha capensis.* Most of the proposed development

areas are located in an already disturbed landscape, e.g. the two proposed access roads follow the existing gravel roads on the farms, the three proposed pipeline routes follow the existing canal, and the discharge points are located on or near the Voëlvlei dam.

Figure 21. Riparian vegetation heavily invaded by *Eucalyptus camaldulensis*

The canal is mostly dominated by alien plant species sand weeds such as *Hakea sericea, Conyza bonariensis, Acacia longifolia, Pinus halepensis*, *Paraserianthes lophantha*, and in some areas near the ponds, water-loving plant species such as *Typha capensis, Phragmites australis, Juncus kraussii* and alien grasses such as *Briza maxima* were recorded in abundance. Other herb species such as *Sarcocornia pillansii*, *Bassia diffusa* and *Nidorella foetida* were recorded along the canal. The proposed Laydown Areas 1 and 2 are dominated mostly by the alien *Acacia longifolia* and other indigenous plant species such as *Searsia rosmarinifolia, Ursinia anthemoides, Elytropappus rhinocerotis* and *Stoebe plumosa*.

The species recorded during the field visits confirmed the study area's location within the Fynbos Biome of South Africa. All of the species recorded in the study area are listed in **Table**

3 below. No plant species of conservation significance were recorded on site due to the anthropogenic activities such as farming areas and most of the pipelines running along the roads.

Table 3. Plant species recorded in the proposed development areas

Scientific name	Common name	Ecological status	Form
Acacia longifolia	Long-leaved wattle	Category 1b	Tree
Agave sisalana	Sisal	Invader 2	Succulent
Acacia melanoxylon	Blackwood	Invader 2	Shrub
Aloe sp		Medicinal	Succulent
Amaranthus hybridus	Pigweed	Exotic	Herb
Anthospermum aethiopicum	Jakkalsstert		Herb
Arctotis venusa	Free state daisy		Herb
Athanasia trifurcata	kouterbos),		Herb
Aspalathus ciliaris			Herb
Bassia diffusa			Herb
Briza maxima	Large quaking grass	Exotic	Grass
Casuarina equisetifolia	Horsetail tree	Invader 2	Tree
Conyza bonariensis	Flax-leaf fleabane	Weed	Herb
Cynodon dactylon	Couch Grass	Increaser 2	Grass
Dodonaea angustifolia			Herb
Ehrharta calycina	Purple veldtgras		Grass
Ehrharta longiflora	Oat-seed grass		Grass
Elytropappus rhinocerotis	Rhinoceros bush		Herb
Eucalyptus camaldulensis	Red River gum	Category 1b/2	Tree
Hakea sericea	Silky Hakea	Category 1b	Shrub
Hyparrhenia hirta	Common Thatching Grass	Increaser 1	Grass
Juncus kraussii	Salt marsh rush		Sedge
Leonotis leonurus	Wild Dagga	Medicinal	Herb
Melia azedarach	Persian Lilac/Syringa	Invader 3	Tree
Melinis repens	Natal Red Top	Increaser 2	Grass
Morus alba	White mulberry	Category 2	Tree
Imperata cylindrica	Speargrass		Grass
Nidorella foetida	Nidorella		Herb
Opuntia ficus-indica	Prickly pear	Category 1b	Shrub
Oftia africana			Herb
Othonna parviflora			Herb
Paraserianthes lophantha	Cape Wattle	Category 1b	Shrub
Populus deltoides	Poplar plant		Tree
Pinus halepensis	Aleppo pine	Invader 2	Tree
Pinus pinaster	Cluster pine	Invader 2	Tree

Scientific name	Common name	Ecological status	Form
Plantago major	Broadleaf plantain	Weed	Herb
Pseudognaphalium luteo-album	Jersey Cudweed	Exotic/Medicinal	Herb
Ricinus communis	Caster-oil plant	Category 1b	Shrub
Rubus sp.	bramble).		Herb
Sarcocornia pillansii			Herb
Searsia rosmarinifolia	Roosmaryntaaibos		Shrub
Sesbania punicea	Red sesbania	Category 1b	Shrub
Sporobolus virginicus	Brakgras		Grass
Stoebe (Seriphium) plumosa	Slangbos		Herb
Taraxacum sp			herb
Talinum sp.			Herb
Ursinia anthemoides	Marigold		Herb
Zantedeschia aethiopica	White or common arum lily		Herb
Xanthium strumarium	Large cocklebur	Category 1b	Herb

12.1.3 Alien invasive species recorded in the proposed development areas.

Alien invader plants are species that are of exotic, non-native or of foreign origin that typically invade undeveloped or disturbed areas. Invaders are a threat to our ecosystem because by nature they grow fast, reproduce quickly and have high dispersal ability (Henderson, 2001). This means that invader plants and seeds spread rapidly and compete for the growing space of our own indigenous plants. If these invader plants out-compete indigenous plants there is a shift in the species composition of the area and the changing our plant communities causes a decline in species richness and biodiversity (Henderson, 2001). Many factors allow alien invasive plants to succeed, particularly the absence of their natural enemies. This makes it difficult to control invasive plants without bringing in natural enemies and eliminating the high competition they have over the indigenous vegetation (Bromilow, 2010). Alien invasive plant species within the study area were observed to occur in clumps, scattered distributions or as single individuals on site. Invader and weed species must be controlled to prevent further infestation and it is recommended that all individuals of invader species (Especially Category 1) must be removed and eradicated (Henderson, 2001). Species such as *Opuntia ficus-indica* (**Figure 22**), *Xanthium strumarium* (**Figure 23)**, and *Ricinus communis* (**Figure 24**) (all Category 1b) were common in the study area.

Figure 22: Alien plant *Opuntia ficus-indica* recorded on

Figure 23. Alien plant *Xanthium strumarium* recorded along the Canal

Figure 24. Alien plant *Ricinus communis* recorded along the Berg River.

There are methods to eradicate alien invasive species, such as:

- Mechanical methods - felling, removing or burning invading alien plants;
- Chemical methods - using environmentally safe herbicides;
- Biological control - using species-specific insects and diseases from the alien plant's country of origin and
- Integrated control - combinations of the above three approaches. Often an integrated approach is required in order to prevent serious impacts (http://www.dwaf.gov.za/wfw/default.aspx).

It is important that the Environmental Management Programme (EMPr) takes into account suitable methods to ensure that alien invasive plant species are controlled in areas affected by the construction activities.

12.1.4 Threatened Species and Species of Conservation Concern and medicinal plants recorded on proposed development areas.

According to the National Environmental Management Biodiversity Act 2004 (Act 10 of 2004 as amended), there is a dire need to conserve biodiversity in each province and as such, all natural and/or indigenous resources must be utilised sustainably. At the proposed sites, there

are a number of plants that are used to provide medicinal products (**Appendix A**). In some cases there is merit in protecting or translocating them before the proposed development commences. While many of these plants are indigenous or exotic weeds that have medicinal value (and for which no action is necessary with respect to conservation), their economic value means that they are considered to be in need of protection.

According to the South African Red data list categories done by SANBI (**Figure 25**), **threatened species** are species that are facing a high risk of extinction. Any species classified in the IUCN categories Critically Endangered, Endangered or Vulnerable is a threatened species whereas **Species of conservation concern** are species that have a high conservation importance in terms of preserving South Africa's high floristic diversity and include not only threatened species, but also those classified in the categories Extinct in the Wild (EW), Regionally Extinct (RE), Near Threatened (NT), Critically Rare, Rare, Declining and Data Deficient - Insufficient Information (DDD).

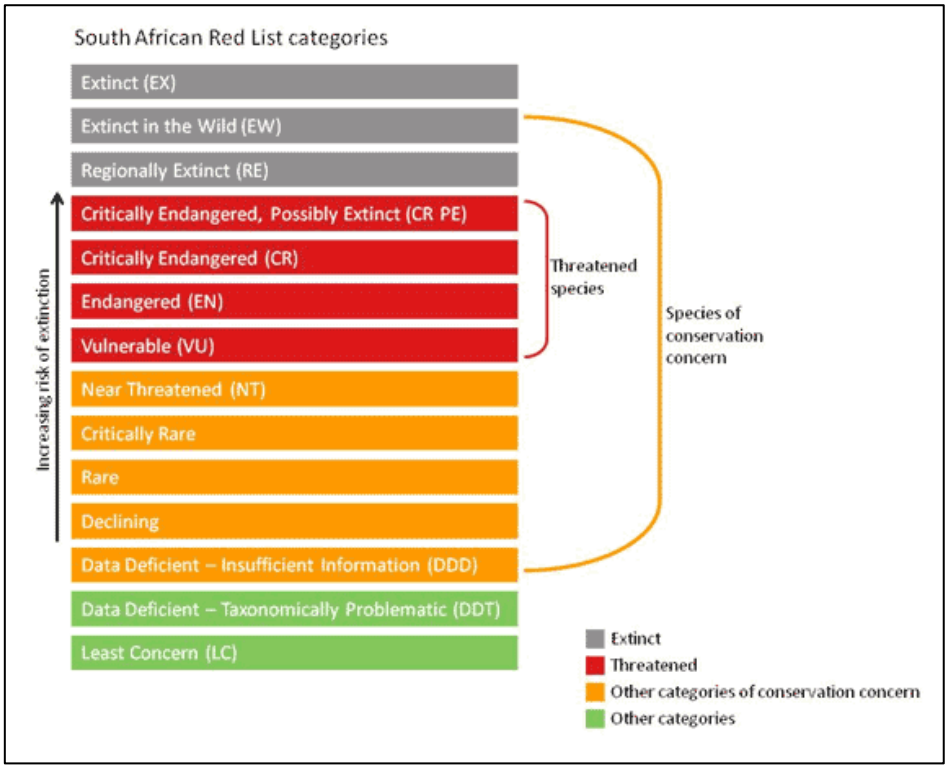

Figure 25. South African Red data list categories (SANBI website)

During the field surveys, no threatened species or plant species of conservation importance were noted on the proposed development areas and this could be attributed to the farming activities in the area. The proposed main pipelines run along the existing canal from the proposed pump station to the main R44 road and the three pipelines routes almost follow the existing roads and these could be the factors attributed to lack of species of conservation importance on site. The plant species of conservation importance listed on **Appendix A**, which are previously recorded in the region, were not recorded on the proposed development areas, but could potentially be found in the Voëlvlei Nature Reserve. Suitable habitats of these Red Data plant species are limited along the proposed pipeline and access routes.

12.2 **Fauna**

The evaluation of faunal presence is based on the presence / absence of mammals, birds, reptiles and amphibians at the proposed development areas. The survey determined the current status of threatened animal species occurring, or likely to occur within the proposed areas, describing the available and sensitive habitats. Faunal data was obtained during a field survey of the proposed development, which was carried out on foot. The data was supplemented by previous surveys conducted in similar habitats, literature investigations, and historic data. Different habitats were explored to identify any sensitive or endangered species. Mammal nomenclature is referred to using Stuart & Stuart, (1998), Skinner & Chimimba (2005), Friedman & Daly (2004); bird names by Hockey et al. (2005); reptile names by Branch (1988), Branch (2001) and Amphibian names by Minter *et al.* 2004.

12.2.1 Mammals

12.2.1.1 Desktop survey results

The potential mammal species that could be found on the proposed development sites are those which have been recorded in the grid cells 3319AC and 3318BD (ADU, 2016) and are listed in **Table 4** below. According to this list, Bontebok, Cape Mountain Zebra, Honey Badger and African White-tailed Rat were mammal species of conservation importance known to occur in the region. Due to the habitat disturbance and human interactions in most parts of the study area, the list is likely to overestimate the occurrence of mammal species in the area and thus should be viewed with a degree of caution. Most of the species on this list were probably recorded in the nearby Voëlvlei Nature Reserve.

Table 4: Mammal species recorded in the grid cells 3319AC and 3318BD (ADU, 2016), which could potentially occur on the proposed development areas.

Family	Genus	Species	Subspecies	Common name	Red list category
Bathyergidae	*Cryptomys*	*hottentotus*		Southern African Mole-rat	Least Concern
Bathyergidae	*Georychus*	*capensis*		Cape Mole-rat	Least Concern
Bovidae	*Alcelaphus*	*buselaphus*		Hartebeest	Not listed
Bovidae	*Antidorcas*	*marsupialis*		Springbok	Least Concern
Bovidae	*Damaliscus*	*pygargus*	*pygargus*	Bontebok	Vulnerable
Bovidae	*Oreotragus*	*oreotragus*		Klipspringer	Least Concern
Bovidae	*Oryx*	*gazella*		Gemsbok	Least Concern
Bovidae	*Pelea*	*capreolus*		Vaal Rhebok	Least Concern
Bovidae	*Raphicerus*	*campestris*		Steenbok	Least Concern
Bovidae	*Raphicerus*	*melanotis*		Cape Grysbok	Least Concern
Bovidae	*Sylvicapra*	*grimmia*		Bush Duiker	Least Concern
Bovidae	*Tragelaphus*	*oryx*		Common Eland	Least Concern
Canidae	*Canis*	*mesomelas*		Black-backed Jackal	Least Concern
Canidae	*Otocyon*	*megalotis*		Bat-eared Fox	Least Concern
Canidae	*Vulpes*	*chama*		Cape Fox	Least Concern
Chrysochloridae	*Chlorotalpa*	*sclateri*		Sclater's Golden Mole	Data Deficient
Chrysochloridae	*Chrysochloris*	*asiatica*		Cape Golden Mole	Data Deficient
Equidae	*Equus*	*quagga*		Plains Zebra	Not listed
Equidae	*Equus*	*zebra*	*zebra*	Cape Mountain Zebra	Vulnerable
Felidae	*Caracal*	*caracal*		Caracal	Least Concern
Felidae	*Felis*	*silvestris*		Wildcat	Least Concern
Felidae	*Panthera*	*pardus*		Leopard	Least Concern

Family	Genus	Species	Subspecies	Common name	Red list category
Gliridae	*Graphiurus*	*ocularis*		Spectacled African Dormouse	Least Concern
Herpestidae	*Atilax*	*paludinosus*		Marsh Mongoose	Least Concern
Herpestidae	*Cynictis*	*penicillata*		Yellow Mongoose	Least Concern
Herpestidae	*Herpestes*	*ichneumon*		Egyptian Mongoose	Least Concern
Herpestidae	*Herpestes*	*pulverulentus*		Cape Gray Mongoose	Least Concern
Hyaenidae	*Proteles*	*cristata*		Aardwolf	Least Concern
Hystricidae	*Hystrix*	*africaeaustralis*		Cape Porcupine	Least Concern
Leporidae	*Lepus*	*capensis*		Cape Hare	Least Concern
Leporidae	*Lepus*	*saxatilis*		Scrub Hare	Least Concern
Molossidae	*Chaerephon*	*nigeriae*		Nigerian Free-tailed Bat	Not listed
Muridae	*Acomys*	*subspinosus*		Cape Spiny Mouse	Least Concern
Muridae	*Aethomys*	*namaquensis*		Namaqua Rock Mouse	Least Concern
Muridae	*Dasymys*	*capensis*		Water Rat	Not listed
Muridae	*Gerbilliscus*	*afra*		Cape Gerbil	Least Concern
Muridae	*Mus*	*minutoides*		Southern African Pygmy Mouse	Least Concern
Muridae	*Mus*	*musculus*	*musculus*		Not listed
Muridae	*Myomyscus*	*verreauxi*		Verreaux's Mouse	Least Concern
Muridae	*Otomys*	*irroratus*		Southern African Vlei Rat	Least Concern
Muridae	*Otomys*	*saundersiae*		Saunders' Vlei Rat	Least Concern
Muridae	*Rhabdomys*	*pumilio*		Xeric Four-striped Grass Rat	Least Concern
Mustelidae	*Aonyx*	*capensis*		African Clawless Otter	Least Concern
Mustelidae	*Ictonyx*	*striatus*		Striped Polecat	Least Concern
Mustelidae	*Mellivora*	*capensis*		Honey Badger	Near Threatened
Mustelidae	*Poecilogale*	*albinucha*		African Striped Weasel	Data deficient

Family	Genus	Species	Subspecies	Common name	Red list category
Nesomyidae	*Dendromus*	*melanotis*		Gray African Climbing Mouse	Least Concern
Nesomyidae	*Dendromus*	*mesomelas*		Brants's African Climbing Mouse	Least Concern
Nesomyidae	*Mystromys*	*albicaudatus*		African White-tailed Rat	Endangered
Orycteropodidae	*Orycteropus*	*afer*		Aardvark	Least Concern
Procaviidae	*Procavia*	*capensis*		Rock Hyrax	Least Concern
Soricidae	*Crocidura*	*cyanea*		Reddish-gray Musk Shrew	Data Deficient
Soricidae	*Myosorex*	*varius*		Forest Shrew	Data Deficient
Soricidae	*Suncus*	*varilla*		Lesser Dwarf Shrew	Data Deficient
Suidae	*Sus*	*scrofa*		Wild Boar	Introduced
Vespertilionidae	*Neoromicia*	*capensis*		Cape Serotine	Least Concern
Viverridae	*Genetta*	*tigrina*		Cape Genet	Least Concern

12.2.1.2 Mammals recorded on site

The proposed development areas consisted of suitable habitats for mammalian species such as rivers, riparian vegetation and grasslands. During the field assessments, some small rodent species were observed on the study area but the identity of these species could not be verified. **Table 5** indicates the species nine (9) recorded on sites while the species that were confirmed to occur by locals are indicated by an asterix (*****). The traps set did not yield any positive results as no mammals were captured.

Table 5. Mammals recorded on the proposed development areas

Scientific name	English name	Status
Lepus saxatilis	Scrub Hare	Least concern
Sylvicapra grimmia	Grey /Common Duiker	Least concern
Canis mesomelas *	Black-backed Jackal	Least Concern
Papio ursinus	Baboon	Least Concern
Hystrix africaeaustralis	Cape porcupine (**Figure 26**)	Least Concern
Raphicerus melanotis	Cape or southern grysbok	Least Concern
Antidorcas marsupialis	Springbok*	Least Concern
Raphicerus campestris	Steenbok	Least Concern
Gerbilliscus afra	Cape gerbil	Least Concern

Figure 26. Cape porcupine quill recorded along the canal

12.2.1.3 Habitat available for species of conservation importance

Data sourced from SANBI (ADU, 2015) indicates that there are mammal species which are known to occur in the general vicinity of the site. **Table 6** below indicates the suitable habitat together with the probability of occurrence. The probability of occurrence is based on the presence of suitable habit where the species is likely to occur.

Table 6. A Red Data Listed mammal species which could potentially occur in the proposed development sites with suitable habitat and the probability of occurrence (Friedmann & Daly (2004), Skinner & Chimimba (2005)).

Common name	Red list category	Suitable habitat	Probability of occurrence
Bontebok	Vulnerable	Inhabits coastal grass plains with fynbos vegetation	Medium
Cape Mountain Zebra	Vulnerable	Found on mountainous slopes and plateaus	Low
Honey Badger	Near Threatened	The honey badger may be found in a vast diversity of habitats, from harsh scrublands and savannas to lush tropical rainforests. It	Medium

Common name	Red list category	Suitable habitat	Probability of occurrence
		is a very opportunistic creature and so is able to survive in most conditions.	
African White-tailed Rat	Endangered	Its habitat is confined to highveld grasslands and montane grasslands. It tends to inhabit burrows of meerkats and cracks in the soil during the day and venture out at night.	Low

12.2.2 Avifauna

12.2.2.1 Desktop survey results

The Important Bird and biodiversity Areas (IBA) Programme identifies and works to conserve a network of sites critical for the long-term survival of bird species that are globally threatened, have a restricted range and are restricted to specific biomes/vegetation types (Barnes, 2000). Several Conservation and planning tools were consulted for relevancy for the project and these included IBAs. The proposed developments fall within the Boland Mountains IBA (**Figure 27**). The IBA encompasses a continuous chain of mountains and includes several State forests, mountain catchment areas and provincial nature reserves. The Boland Mountains IBA also includes the Voëlvlei Dam, which provides habitat for a range of waterbirds, which congregate in high numbers at this site. It is particularly important for the near-endemic South African Shelduck *Tadorna cana*, large flocks of which use the site as a safe refuge for their annual post-breeding moult (BirdLife South Africa, 2016). A total of 1 400 Shelduck has been recorded in a single count, which represents c. 3% of the species' global population. These birds probably move in from the Swartland farmland to the west and north and from the Karoo to the east to undergo their moult at the dam. Voëlvlei Dam also provides habitat for large numbers of non-threatened waterbirds such as Egyptian Goose (*Alopochen aegyptiaca)*, Spur-winged Goose (*Plectropterus gambensis)* and Red-knobbed Coot (*Fulica cristata)* (Barnes, 1998).

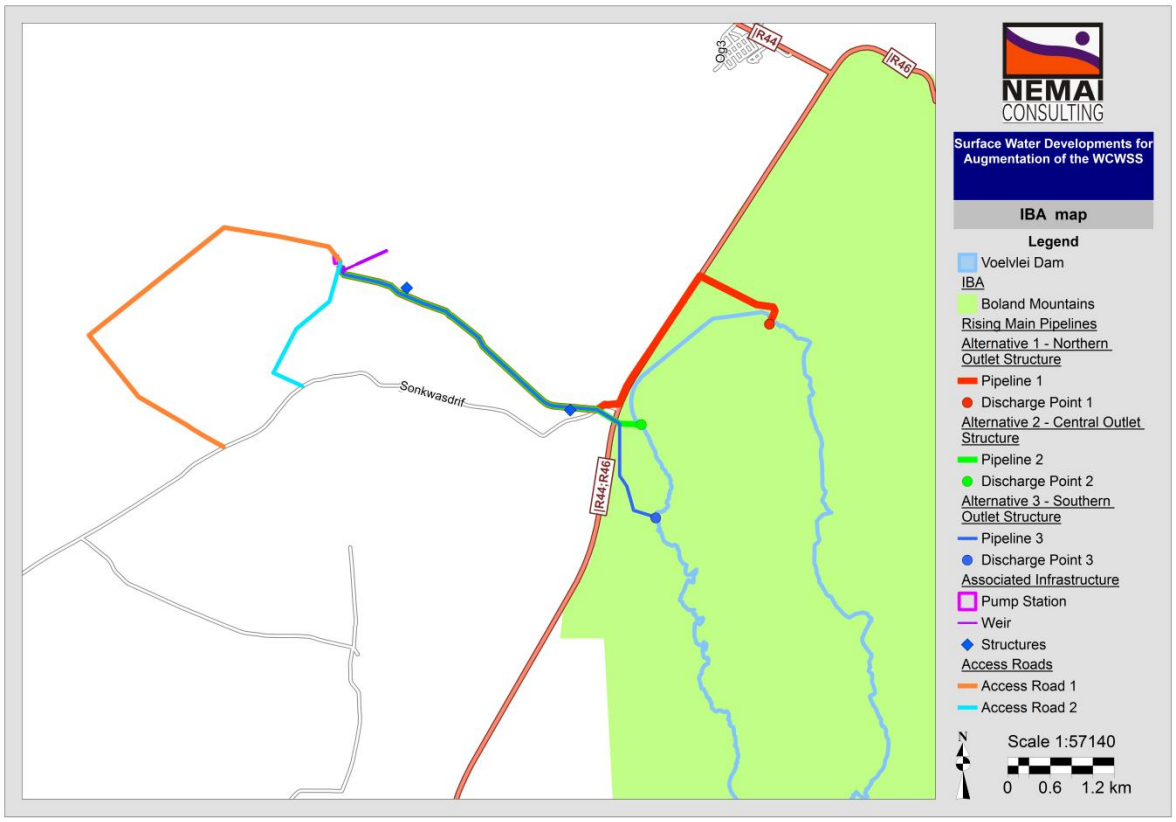

Figure 27. The proposed developments fall within the Boland Mountains IBA.

Observations regarding the number and diversity of birds will provide valuable input to sound management practices. According to the Southern African Bird Atlas Project (SABAP) 2, a number of sensitive bird species have been noted in grid cell 3319AC and 3318BD which might occur on site (**Table 7**).

Table 7: Bird species recorded in cell 3319AC and 3318BD which could occur in the area

Species	Common Name	Threat Status
Pelecanus onocrotalus	Great White Pelican	NT
Ciconia nigra	Black Stork	NT
Phoenicopterus roseus	Greater Flamingo	NT
Phoeniconaias minor	Lesser Flamingo	NT
Sagittarius serpentarius	Secretary bird	NT
Polemaetus bellicosus	Martial Eagle	VU
Circus ranivorus	African Marsh-Harrier	VU
Circus maurus	Black Harrier	NT
Falco biarmicus	Lanner Falcon	NT
Falco naumanni	Lesser Kestrel	VU
Anthropoides paradiseus	Blue Crane	VU
Gyps coprotheres	Cape Vulture (Griffon)	VU

Species	Common Name	Threat Status
Sterna caspia	Caspian Tern	NT
Alcedo semitorquata	Half-collared Kingfisher	NT

Note: NT=Near Threatened; VU=Vulnerable

12.2.2.2 Field work results

A numbers of bird species in South Africa have declined mainly due to massive habitat transformation and degradation as well as increased levels of human disturbances, extensive habitat transformation due to mining, industrial and commercial and agricultural activities. Human activity has transformed grasslands in South Africa to a point where few pristine examples exist (Low and Rebelo, 1996). Factors such as increased pasture management (overgrazing), decrease in grassland management due to frequent fires and land-use alteration (urbanisation) also contribute in the decline of species. Many avifaunal species are adaptable as they are habitat generalists and can therefore accommodate a certain degree of habitat degradation and transformation (Harrison *et al*. 1997). Other species are extremely habitat specific and have to rely on certain habitat units for breeding, hunting or foraging and roosting. Habitat-specific species are sensitive to environmental change, with destruction of habitat being the leading cause of species decline worldwide (Barnes, 2000).

Within the vegetation types found in the study area and immediate surrounding areas, two major bird habitat systems were identified, namely Dam and Rivers, Cultivated areas and patches of alien vegetation trees.

Cultivated Land (**Figure 28**): The cultivated areas are mostly utilised by bird species as a feeding areas due to the presents of insects, seeds and bulbs. Most of the infrastructures such as access roads, pump station and laydown area 3 are situated in cultivated areas. Important birds that may be attracted to these areas include Blue crane, Lesser Krestel, White Stork, Secretarybird and other raptors. Blue cranes were observed feeding on these cultivated lands, especially in areas where the Access Roads are going to be built.

Figure 28. Cultivated lands on site.

Dam and Rivers (**Figure 29**): In most parts of the country, dams have become important attractants to various bird species. Several waterfowl, such as Spur-winged geese, Egyptian geese, and numerous duck species frequent these areas for either feeding or breeding. Blue Cranes are known to use dams to roost. Various Storks may also frequent these water bodies. The Voëlvlei Dam provides habitat for a range of waterbirds, which congregate in high numbers at this site (**Figure 30**). Rivers (e.g. Berg River on site) represent important habitat for many species, including Black Stork and a variety of other water birds. Rivers also represent feeding areas for fish eating raptors such as the African Fish Eagle and most importantly also represent important flight paths for many species. Blue Cranes tend to roost in dams and pans at night, possibly as a protective measure against predators. Cranes also need water for drinking and typically take nestlings to water within 24 hours of hatching (Bidwell, 2004), and prefer nest sites close to dams.

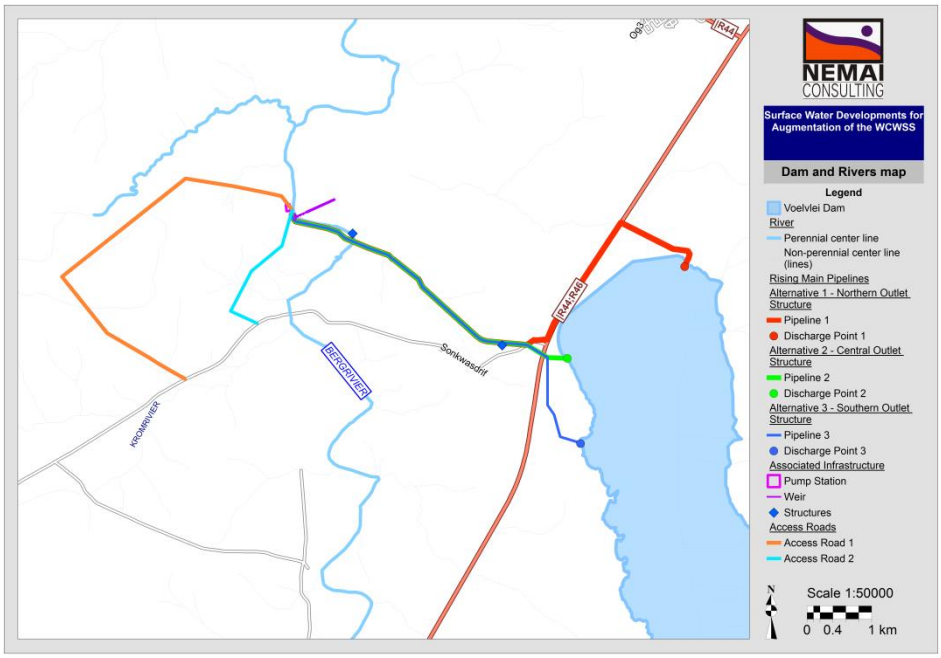

Figure 29. Dam and Rivers on site.

Figure 30. Waterfowl birds on Voëlvlei Dam

Stands of Alien vegetation: Patches of alien trees were observed throughout the study area (**Figure 31**) and these areas will mostly be important to physically smaller bird species as they provide perching, roosting and nesting habitat for various raptor species, as well as larger birds such as francolins, Guineafowl, Herons and Hadeda Ibises. Stands of exotic *Eucalyptus* create attractive habitat for priority species such as Black Sparrowhawk (*Accipiter melanoleucus)*, Rufous-chested Sparrowhawk (*Accipiter rufiventris)* and Jackal Buzzard (*Buteo rufofuscus)* (Bidwell, 2004).

Figure 31. Patches of alien trees on site

Twenty eight (28) bird species (**Table 8**) were recorded during the field surveys. Species recorded were typical of Fynbos biome. Protected and Red Data bird species recorded within the study sites are indicated in **Bold** below.

Table 8. Bird species recorded on the proposed development site

Species number	Common name	Scientific name
49	**Great (Eastern) White Pelican**	***Pelecanus onocrotalus***
62	Grey Heron	*Ardea cinerea*
63	Black-headed Heron	*Ardea melanocephala*
71	Cattle Egret	*Bubulcus ibis*
91	African Sacred Ibis	*Threskiornis aethiopicus*
94	Hadeda Ibis	*Bostrychia hagedash*
102	Egyptian Goose	*Alopochen aegyptiaca*
103	South African Shelduck	*Tadorna cana*
104	Yellow-billed duck	*Anas undulata*
116	Spur-winged goose	*Plectropterus gambensis*
152	**Jackal Buzzard**	***Buteo rufofuscus***
200	Common Quail	*Coturnix coturnix*
203	Helmeted Guineafowl	*Numida meleagris*
208	**Blue Crane**	***Anthropoides paradiseus***
228	Red-knobbed Coot	*Fulica cristata*
272	Curlew Sandpiper	*Calidris ferruginea*
349	Speckled (Rock) Pigeon	*Columba guinea*
354	Cape turtle-Dove	*Streptopelia capicola*
355	Laughing Dove	*Streptopelia senegalensis*
518	Barn (European) Swallow	*Hirundo rustica*
548	Pied Crow	*Corvus albus*
716	African (Grassveld) Pipit	*Anthus cinnamomeus*
732	Common Fiscal (Fiscal Shrike)	*Lanius collaris*
813	Cape Weaver	*Ploceus capensis*
814	Southern masked-Weaver	*Ploeus velatus*
824	Southern Red Bishop	*Euplectes orix*
846	Common Waxbill	*Estrilda astrild*
885	Cape Bunting	*Emberiza capensis*

12.2.2.3 Red data bird species recorded on site

One of the two Red Data bird species found on site was the Blue Crane (*Anthropoides paradiseus)*. This species is endemic to southern Africa. It is a national bird of South Africa and has declined mostly due to loss of habitat (human population growth), direct and indirect poisoning and also powerline collisions. It is a bird of open grasslands and other upland habitats and is mostly found in natural vegetation in the eastern parts of their distribution (e.g. Mpumalanga and KwaZulu-Natal), but also utilises cultivated pastures and crop lands. One breeding pair was noted on Gouklip Farm, near the proposed Pump station and Laydown Area 3 (**Figures 32** and **33**).

Figure 32. A breeding pair of Blue crane noted on Gouklip Farm, near the proposed Pump station and Laydown Area 3

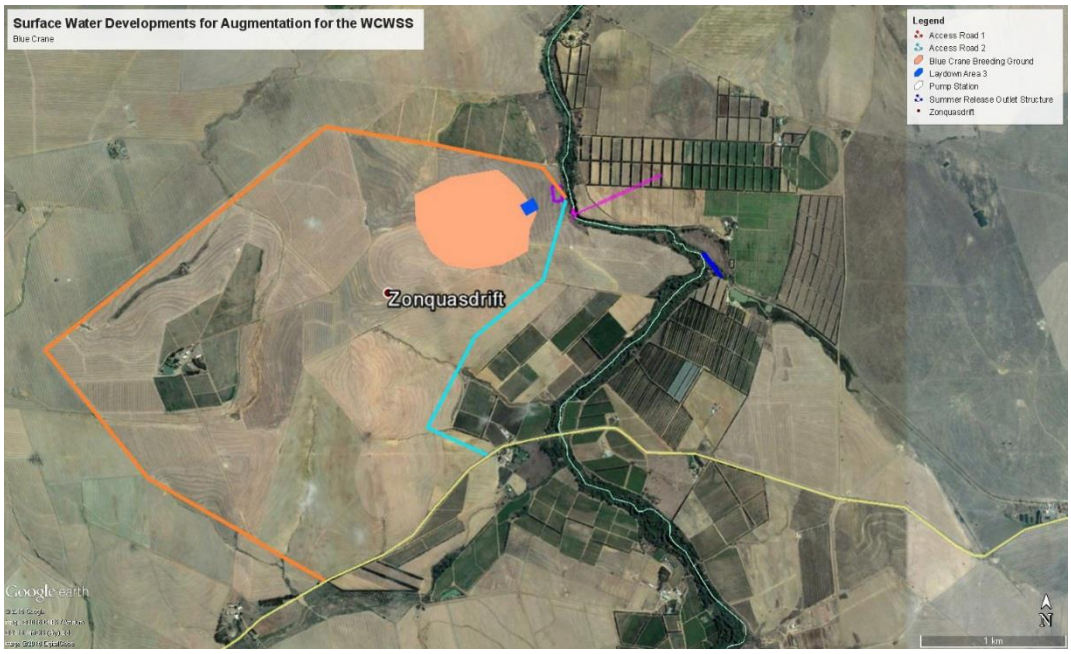

Figure 33. A breeding pair of Blue crane noted near the proposed Pump station and Laydown Area 3

Much of the fynbos in the Swartland has been transformed for agriculture. Though this obviously resulted in considerable natural habitat being destroyed, numerous species have in fact adapted well to this transformation. One such species, which is highly relevant to this study, is the Blue Crane. This species has thrived on the grain lands and pastures in the southern and western Cape. The Blue Crane has relatively recently expanded its range into the Swartland (Young 2009b), where it feeds on *inter alia* fallen grain and recently germinated crops. They also feed on supplementary food put out for small stock, and can congregate in huge numbers around these feed lots.

It is important to note that during construction phase, any breeding pairs and/or nest sites located during this survey must be plotted and should be treated as focal sites for subsequent monitoring.

Another Red Data bird species found on site was the Great White Pelican (*Pelecanus onocrotalus*) (**Figure 34**). This species is generally known to be Found on large inland waters, and on the coast (Barnes, 1998). Taylor *et al.* (2015) listed this species as Vulnerable (D2). This species was recorded in the Voëlvlei Dam.

Figure 34. Great White Pelican in Voëlvlei Dam

12.2.2.4 Occurrence of Endemic Species recorded along the proposed infrastructure route

One endemic species recorded on site was the Jackal Buzzard (*Buteo rufofuscus*) (**Figure 35**). Bird species endemic to southern Africa are important as they do not occur anywhere else in the world. A marginal of the World's bird species have small, restricted ranges, being confined to a particular area, and they are thus endemic to that area. Typically a bird is termed endemic if it is constricted to a range of 50,000 km^2 or smaller. According to Taylor *et al.* (2015), regionally endemic species pose special conservation responsibilities to the region's conservation authorities, government and land owners. The constricted range makes these species vulnerable to population reduction. According to Barnes (2000), this species is known to be found in cliffs and ridges, and also on open grasslands. South Africa is known to boast a number of endemic restricted to fynbos biome. The proposed development is not likely to

be associated with large-scale loss of habitat, thus it is highly unlikely that the proposed development would exert an impact of any significance on this endemic bird species.

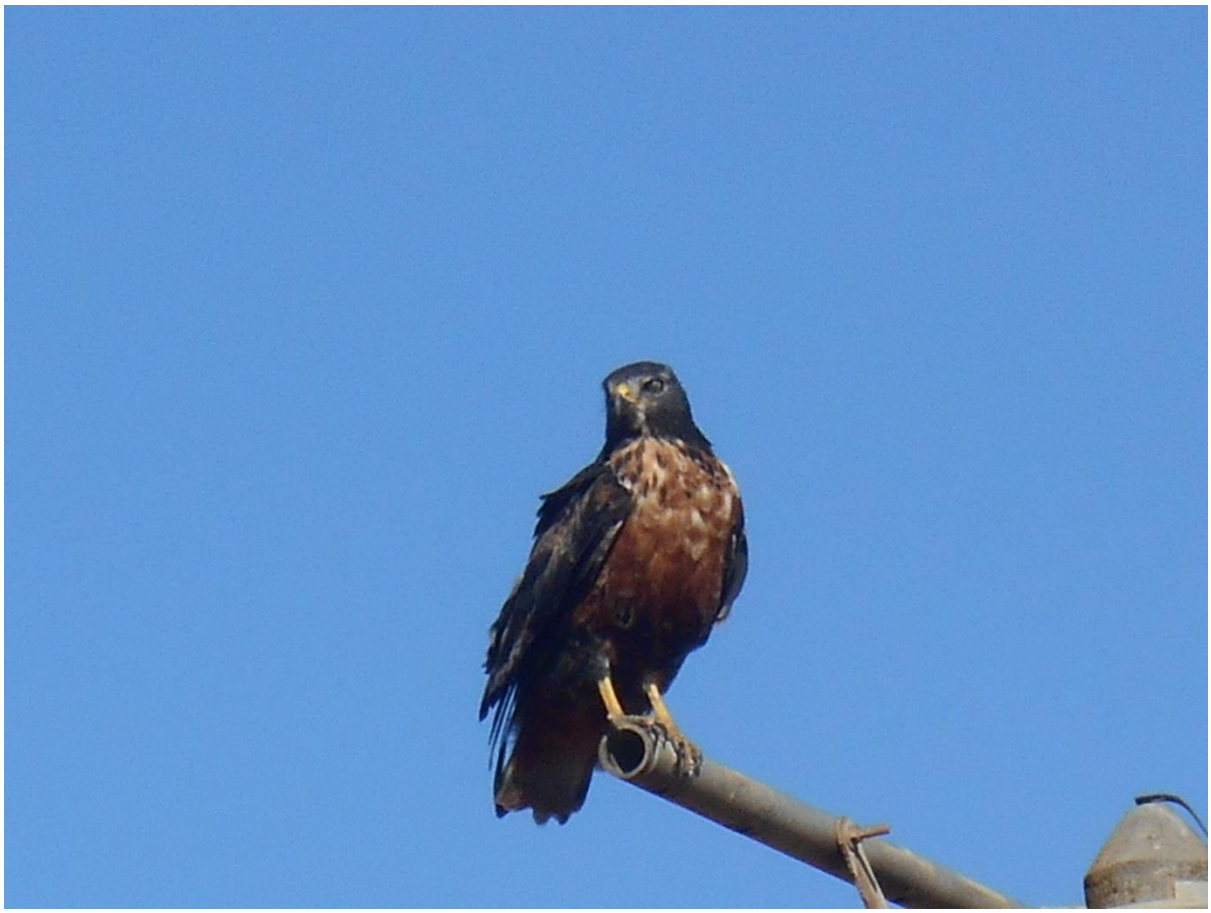

Figure 35. Jackal Buzzard recorded along the proposed pipeline Route 1, near the main R44 road

12.2.2.5 Habitat requirements for Red Data bird species

Table 9 below provides an important guideline of what could potentially be encountered anywhere in the study area in suitable habitat, and should not be used as a guideline for actual densities on the ground. In addition, it must be pointed out that the species below could have been recorded anywhere within the squares of 3319AC and 3318BD and not necessarily within the exact proposed site for this project.

Table 9. Red Data Bird species recorded in grid cells 3319AC and 3318BD which could potentially occur in the study area (SABAP 1) (Harrison *et al*. 1997, Barnes (2000), SABAP2, Young (2009b), Tarboton *et al*. 1987, Taylor *et al.* 2015)).

Common Name	Red list category	Preferred Habitat	Probability of Occurrence
Great White Pelican	Near Threatened	Found on large inland waters, and on the coast	CONFIRMED
Black Stork	Near Threatened	Associated with rivers, dams and cliffs.	Low
Greater Flamingo	Near Threatened	Inhabits relatively shallow water bodies, including saline lagoons, salt pans, estuaries, and large saline or alkaline lakes. Breeding occurs on sandbanks, mudflats, open beaches, or sandy or rocky islands	Medium
Lesser Flamingo	Near Threatened	Lesser Flamingo breeds in brackish or salty lakes and lagoons in Southern Africa, and highly alkaline lakes in Eastern Africa. Non breeding birds may be found on coastal mudflats, salt works and sewage treatment works where salinities are high.	Medium
Secretarybird	Near Threatened	It is usually found in the open grasslands and savannah of the sub-Saharan region	Medium
Martial Eagle	Vulnerable	It tolerates a wide range of vegetation types, being found in open grassland, scrub, Karoo, agricultural lands and woodland. It relies on large trees (or electricity pylons) to provide nest sites as well as windmills and even cliffs in treeless areas.	High
African Marsh-Harrier	Vulnerable	Alien plantations and in natural vegetation along drainage lines.	High
Black Harrier	Near Threatened	Highest expected densities in remnant patches of fynbos.	High
Lanner Falcon	Near Threatened	Lanner falcon can be found in a wide range of habitats ranging from extreme desert to wet, forested mountains up to elevations of 5,000 metres. The species can be found in *eucalyptus* stands in southern Africa and even in urban areas, as long as there are open or lightly wooded areas nearby for hunting, though it tends to avoid heavily forested or very wet areas	Medium
Lesser Kestrel	Vulnerable	An inhabitant of highland farming regions and grassy plains in the winter range, the lesser kestrel prefers open or wooded grassland and cultivated areas during the summer breeding season.	High
Blue Crane	Near Threatened	This crane breeds in dry grasslands at high elevations where there is less disturbance. They may roost and breed in wetlands if available and	**CONFIRMED**

Common Name	Red list category	Preferred Habitat	Probability of Occurrence
		some individuals prefer to nest in arable and pastureland. In autumn and winter they usually move to lower altitudes.	
Cape Vulture (Griffon)	Vulnerable	Inhabits open grassland, savanna and shrubland, and is often found roosting on crags in mountainous regions	Low
Caspian Tern	Near Threatened	Found in a variety of coastal and inland habitats including coastal lagoons, salt marshes, estuaries, coastal inshore waters, continental shelf waters, bogs and marshes, freshwater lakes, water storage areas and inland seas	Low
Half-collared Kingfisher	Near Threatened	It feeds almost exclusively on fish and can be found near water at all times. It can be found on shores and around larger bodies of water in southern and eastern Africa.	Medium

12.2.3 Reptiles

The riparian vegetation, watercourses, human habitation, cultivated lands and grasslands on site provide suitable habitats for reptile species recorded on site. Reptiles are extremely secretive and difficult to observe during field surveys. Riparian habitats are traditionally rich in reptile diversity and densities due to the habitat supporting a high abundance of prey species, such as frogs, birds and small mammals (Branch, 2001). Vegetative cover is also greater within this habitat type. Species are also very often "ousted" into watercourses/wetlands and riparian zones due to transformation of lands for urban and agricultural purposes.

12.2.3.1 Desktop survey results

The Field Guide to the Snakes and other Reptiles of Southern Africa (Branch, 2001) and South African Red Data Book Reptiles (Branch, 1988) were books used during the field surveys. **Table 10** lists reptile species which are recorded in the grid cells 3319AC and 3318BD based on the data from the South African Reptile Conservation Assessment (ADU, 2016). According to the list, Oelofsen's Girdled Lizard and Geometric Tortoise are the reptiles' species of conservation importance known to occur in the region (grid cells) but not necessarily on the proposed development areas.

Table 10. Reptile species recorded in grid cells 3319AC and 3318BD which could occur in the study area (ADU, 2016)

Family	Genus	Species	Subspecies	Common name	Red list category	Atlas region endemic
Agamidae	*Agama*	*atra*		Southern Rock Agama	Least Concern (SARCA 2014)	
Agamidae	*Agama*	*hispida*		Spiny Ground Agama	Least Concern (SARCA 2014)	
Colubridae	*Crotaphopeltis*	*hotamboeia*		Red-lipped Snake	Least Concern (SARCA 2014)	
Cordylidae	*Cordylus*	*cordylus*		Cape Girdled Lizard	Least Concern (SARCA 2014)	Yes
Cordylidae	*Cordylus*	*oelofseni*		Oelofsen's Girdled Lizard	Near Threatened (SARCA 2014)	Yes
Cordylidae	*Karusasaurus*	*polyzonus*		Karoo Girdled Lizard	Least Concern (SARCA 2014)	
Elapidae	*Naja*	*nigricincta*	*woodi*	Black Spitting Cobra	Least Concern (SARCA 2014)	
Gekkonidae	*Afrogecko*	*porphyreus*		Marbled Leaf-toed Gecko	Least Concern (SARCA 2014)	Yes
Gekkonidae	*Goggia*	*lineata*		Striped Pygmy Gecko	Least Concern (SARCA 2014)	
Gekkonidae	*Pachydactylus*	*formosus*		Southern Rough Gecko	Least Concern (SARCA 2014)	Yes
Gekkonidae	*Pachydactylus*	*geitje*		Ocellated Gecko	Least Concern (SARCA 2014)	Yes
Gerrhosauridae	*Tetradactylus*	*tetradactylus*		Cape Long-tailed Seps	Least Concern (SARCA 2014)	Yes
Lacertidae	*Pedioplanis*	*lineoocellata*	*pulchella*	Common Sand Lizard	Least Concern (SARCA 2014)	
Lamprophiidae	*Boaedon*	*capensis*		Brown House Snake	Least Concern (SARCA 2014)	
Lamprophiidae	*Duberria*	*lutrix*	*lutrix*	South African Slug-eater	Least Concern (SARCA 2014)	Yes
Lamprophiidae	*Psammophis*	*crucifer*		Cross-marked Grass Snake	Least Concern (SARCA 2014)	
Lamprophiidae	*Psammophis*	*notostictus*		Karoo Sand Snake	Least Concern (SARCA 2014)	
Lamprophiidae	*Pseudaspis*	*cana*		Mole Snake	Least Concern (SARCA 2014)	
Lamprophiidae	*Psammophylax*	*rhombeatus*	*rhombeatus*	Spotted Grass Snake	Least Concern (SARCA 2014)	
Scincidae	*Acontias*	*meleagris*		Cape Legless Skink	Least Concern (SARCA 2014)	Yes
Scincidae	*Trachylepis*	*homalocephala*		Red-sided Skink	Least Concern (SARCA 2014)	Yes

Family	Genus	Species	Subspecies	Common name	Red list category	Atlas region endemic
Testudinidae	*Chersina*	*angulata*		Angulate Tortoise	Least Concern (SARCA 2014)	
Testudinidae	*Homopus*	*areolatus*		Parrot-beaked Tortoise	Least Concern (SARCA 2014)	Yes
Testudinidae	*Psammobates*	*geometricus*		Geometric Tortoise	Critically Endangered (SARCA 2	Yes
Viperidae	*Bitis*	*arietans*	*arietans*	Puff Adder	Least Concern (SARCA 2014)	

12.2.3.2 Reptiles recorded on site

The reptile assessments indicate that the grasslands and riparian vegetation are of high importance to reptiles. Some sections of the study areas have resulted in increased habitat modification and transformation mainly due to farming activities in the area. The increased human presence and associated disturbances (illegal reptile collecting, indiscriminate killing of all snake species, frequent fires) are all causal factors in the alteration and disappearance of reptile diversity in many areas (Jacobsen, 2005). Termite mounds were present on the study area and some large mounds had been damaged by previous foraging by Antbears. This resulted in the exposing of tunnels into the interior of the termite mound. Old termite mounds offer important refuges especially during veld fires as well as cold winter months for numerous frog, lizard, snake and smaller mammal species (Jacobsen, 2005). Large number of species of mammal, birds, reptiles and amphibians feed on the emerging alates (winged termites). No termite mounds were destroyed during the brief field survey. All overturned rock material was carefully replaced in its original position. **Table 11** indicates the species recorded on sites confirmed to occur by locals and are indicated by an asterix (*****).

Table 11. Reptiles recorded in the proposed development areas

Genus	Species	Subspecies	Common name	Status
Chersina	*angulata*		Angulate Tortoise*	Protected
Naja	*nivea*		Cape cobra *	Least Concern
Bitis	*arietans*	*arietans*	Puff Adder*	Least Concern
Pseudaspis	*cana*		Mole snake	Protected

12.2.3.3 Protected reptile species recorded on site

According to the information gathered from the farm owners and workers, there are two protected reptile species occurring on the proposed Access roads routes (Gouklip farm), namely Angulate tortoise and Mole Snake. The Angulate tortoise is considered not threatened, as it is common and abundant in home ranges. It is, however, listed on the CITES Appendix II, together with other tortoise species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled. In South Africa, it is further classified as a protected species by the Nature Conservation Ordinance No. 19 of 1974 (as amended in 2000) and it may not be collected, transported, or possessed in, or imported into or exported from, the Western Cape Province without special permission in the form of a permit from the relevant conservation authorities

The Mole Snake is also protected under the Western Cape Nature Conservation Act as a protected species (Appendix II). The usefulness of this species needs further promotion.

12.2.3.4 Habitat requirements for Red Data reptile species

According to the South African Reptile Conservation Assessment (ADU, 2016) (**Table 12**), the two red data reptile species which were recorded in the grid cells 3319AC and 3318BD are Oelofsen's Girdled Lizard and Geometric Tortoise. **Table 12** indicates their probabilities of occurrence along the routes and the probability of occurrence is based on the suitable habit where the species is likely to occur. Even though the Geometric Tortoise was not found during the field surveys, this species is known to occur in the Voëlvlei Nature Reserve (Boucher, 2010; van Bloemestein, 2005). A walk down survey and monitoring plan will need to be developed before the construction commences in order to protect the habitat and the species.

Table 12. Red Listed reptile species which are known to occur in the general vicinity of the project area, which could potentially be found on the proposed development sites (Branch, 1988, Bates *et al.* 2014).

Species	Scientific name	Suitable habitat	Probability of Occurrence
Oelofsen's Girdled Lizard	*Cordylus oelofseni*	A rock-dwelling species sheltering in narrow cracks along road cuttings or in small sandstone outcrops at higher elevavtions. Also occurs in dense colonies on fynbos mountain plateaux.	Medium
Geometric Tortoise	*Psammobates geometricus*	The habitat type of geometric tortoise is known as the renosterveld, which is located at the extreme southwestern part of the Western Cape Province of South Africa. The renosterveld forms part of the Fynbos Biomes, a vegetation zone characterized by a Mediterranean climate. The general habitat comprises low-lying, undulating plains (seldom rocky terrain, but never koppies) with dominant low to medium-high shrub	High

Species	Scientific name	Suitable habitat	Probability of Occurrence
		layer, herbaceous storey with perennial grasses.	

12.2.4 Amphibians

Amphibians are an important component of South Africa's exceptional biodiversity and are such worthy of both research and conservation effort. This is made additionally relevant by international concern over globally declining amphibian populations, a phenomenon currently undergoing intensive investigation but is still poorly understood (Wyman, 1990 & Wake, 1991). This decline seems to have worsened over the past 25 years and amphibians are now more threatened than either mammals or birds, though comparisons with other taxa are confounded by a shortage of reliable data.

12.2.4.1 Desktop survey results

Frogs are useful environmental bio-monitors (bio-indicators) and may acts as an early warning system for the quality of the environment. Frogs and tadpoles are good species indicator on water quality, because they have permeable, exposed skins that readily absorb toxic substances. Tadpoles are aquatic and greatly exposed to aquatic pollutants (Blaustein, 2003). The presence of amphibians is also generally regarded as an indication of intact ecological functionality and therefore construction activities within these habitat units should be undertaken in an ecologically-sensitive manner.

According to Frog Atlas of Southern African (ADU, 2016) for the grid cells 3319AC and 3318BD, the following Red Data frog species are known to occur in the region of the proposed development sites-namely Cape Rain Frog and Cape Caco. **Table 13** indicates frogs that were recorded in grid cells 3319AC and 3318BD, which could potentially be found on the proposed development sites.

Table 13: Amphibian species recorded in the grid cell 3319AC and 3318BD (ADU, 2016), which could potentially occur on the proposed development sites

Family	Genus	Species	Common name	Red list category	Atlas region endemic
Brevicepitidae	*Breviceps*	*gibbosus*	Cape Rain Frog	Vulnerable	Yes
Bufonidae	*Vandijkophrynus*	*angusticeps*	Sand Toad	Least Concern	
Bufonidae	*Sclerophrys*	*capensis*	Raucous Toad	Least Concern	
Pyxicephalidae	*Amietia*	*fuscigula*	Cape River Frog	Least Concern	
Pipidae	*Xenopus*	*laevis*	Common Platanna	Least Concern	
Pyxicephalidae	*Arthroleptella*	*bicolor*	Bainskloof Moss Frog	Least Concern	Yes
Pyxicephalidae	*Cacosternum*	*boettgeri*	Common Caco	Least Concern	
Pyxicephalidae	*Cacosternum*	*capense*	Cape Caco	Vulnerable	Yes
Pyxicephalidae	*Strongylopus*	*bonaespei*	Banded Stream Frog	Least Concern	
Pyxicephalidae	*Cacosternum*	*platys*	Flat Caco	Least Concern	
Pyxicephalidae	*Strongylopus*	*grayii*	Clicking Stream Frog	Least Concern	
Pyxicephalidae	*Tomopterna*	*delalandii*	Cape Sand Frog	Least Concern	

12.2.4.2 Field work results

The Berg River, Voëlvlei Dam and Canal hold water on a permanent basis and are probably important breeding habitat for most of the frog species which occur at the sites. Only two frog species were recorded on site (**Table 14**). None of the species recorded were of conservation importance.

Table 14: Amphibian species recorded on the proposed development areas

Genus	Species	Common name
Amietia	*fuscigula*	Cape River Frog
Strongylopus	*grayii*	Clicking Stream Frog

12.2.4.3 Habitat requirements for Red Data amphibian species

Data sourced from ADU (2016) indicates that two Red data frog species are known to occur in the region of the proposed development sites-namely Cape Rain Frog and Cape Caco. **Table 15** indicates their probability of occurrence on the study area and the probability of occurrence is based on the suitable habit where the species is likely to occur.

Table 15. Red data Listed frog species which are known to occur in the general vicinity of the project area, which could potentially be found on the proposed development areas (Branch, 1988).

Species	Scientific name	Suitable habitat	Probability of Occurrence
Cape Rain Frog	*Breviceps gibbosus*	Cape rain frogs occur in a variety of disturbed habitats, such as pine plantations, agricultural landscapes and residential gardens. They inhabit the renosterveld and fynbos and adapt well to residential and agricultural landscapes.	High
Cape Caco	*Cacosternum capense*	It lives in undulating low-lying areas with poorly drained loamy to clay soils, although it is known from some shallow sand habitats. The dominant vegetation in which it historically occurred was Renosterveld heath land, which can leach and acidify the surface water. However, its contemporary presence in disturbed agricultural land indicates that acidic water is not a prerequisite for this species	High

13 TERRESTRIAL ECOLOGICAL SENSITIVITY ANALYSIS OF THE STUDY AREA

The ecological function describes the intactness of the structure and function of the vegetation communities which in turn support faunal communities. It also refers to the degree of ecological connectivity between the identified vegetation communities and other systems within the landscape. Therefore, systems with a high degree of landscape connectivity among each other are perceived to be more sensitive.

High – Sensitive vegetation communities with either low inherent resistance or resilience towards disturbance factors or vegetation that are considered important for the maintenance of ecosystem integrity. Most of these vegetation communities represent late succession ecosystems with high connectivity with other important ecological systems.

Medium – Vegetation communities that occur at disturbances of low-medium intensity and representative of secondary succession stages with some degree of connectivity with other ecological systems.

Low – Degraded and highly disturbed vegetation with little ecological function.

The Terrestrial Ecology Sensitivity Map (**Figure 36**) was based on the following criteria:

- CBA (High);
- Ecological Support Area: Restore (Medium);
- Voëlvlei Dam (High);
- Voëlvlei Nature Reserve (High);
- Critically Endangered Terrestrial threatened ecosystems (High);
- Critically Endangered Vegetation Types (High);

As mentioned, a Search, Rescue and Relocation Plan needs to be developed that takes into consideration Red data, protected and endangered flora and fauna species (amongst others). In this regard, attention will be given to the red data reptile species, namely Geometric Tortoise. All relocations will need to comply with the requirements of Cape Nature and Nature Conservation Ordinance of the Western Cape Province.

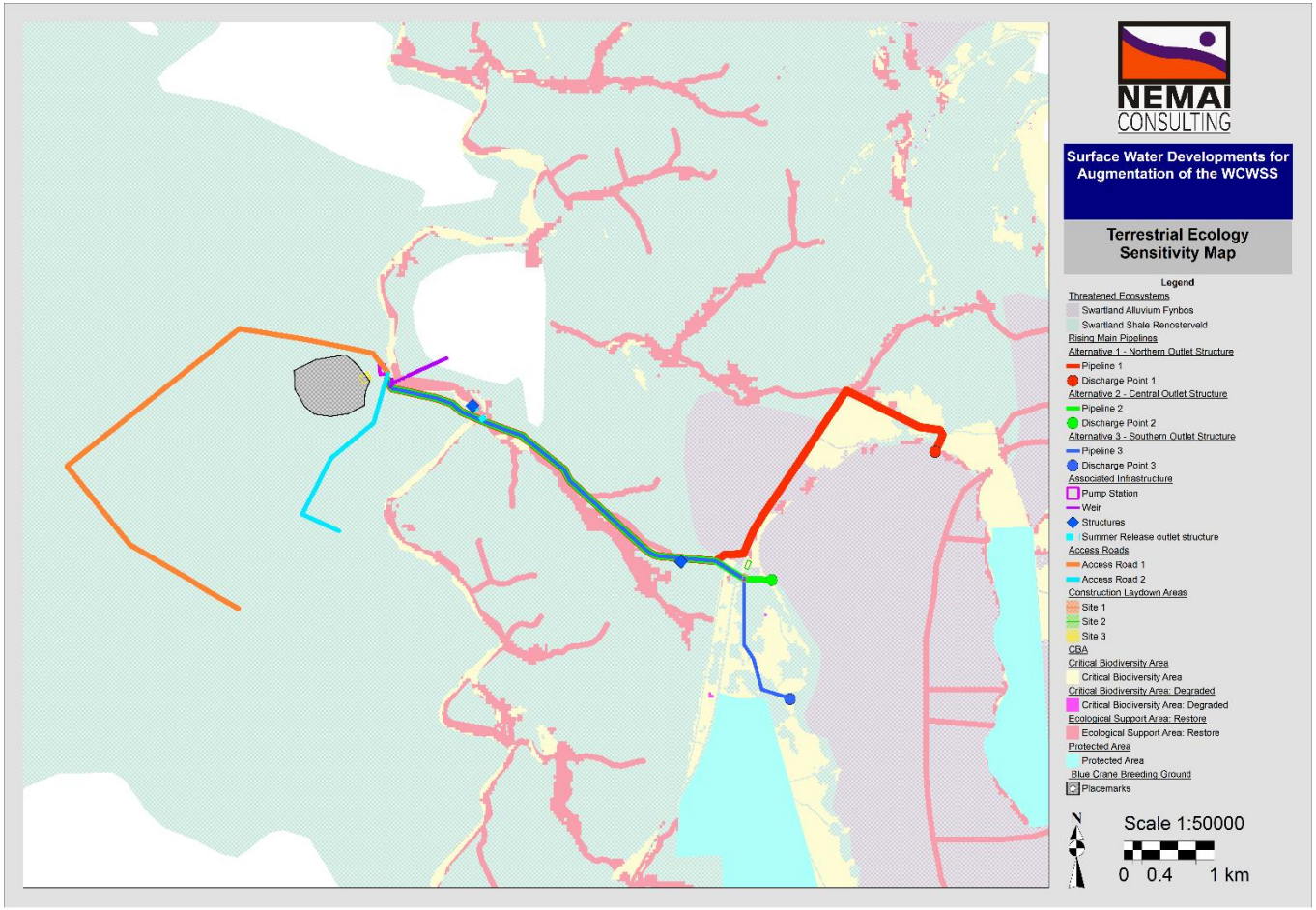

Figure 36. Terrestrial Ecological Sensitivity of the proposed development areas

14 ENVIRONMENTAL IMPACT ASSESSMENT

14.1 **Methodology**

The EIA quantitative impact assessment will further focus on the direct and indirect impacts associated with the project area (**Table 16**). All impacts will be analysed with regard to their nature, extent, magnitude, duration, probability and significance. The following definitions apply:

Nature	The project could have a positive, negative or neutral impact on the environment.
Extent	**Local** – extend to the site and its immediate surroundings. **Regional** – impact on the region but within the province. **National** – impact on an interprovincial scale. **International** – impact outside of South Africa.
Magnitude	Degree to which impact may cause irreplaceable loss of resources: **Low** – natural and social functions and processes are not affected or minimally affected. **Medium** – affected environment is notably altered; natural and social functions and processes continue albeit in a modified way. **High** – natural or social functions or processes could be substantially affected or altered to the extent that they could temporarily or permanently cease.
Duration	**Short term** – 0-5 years. **Medium term** – 5-11 years. **Long term** – impact ceases after the operational life cycle of the activity either because of natural processes or by human intervention. **Permanent** – mitigation either by natural process or by human intervention will not occur in such a way or in such a time span that the impact can be considered transient.
Probability	**Almost certain** – the event is expected to occur in most circumstances. **Likely** – the event will probably occur in most circumstances. **Moderate** – the event should occur at some time. **Unlikely** – the event could occur at some time. **Rare/Remote** – the event may occur only in exceptional circumstances.
Significance	Provides an overall impression of an impact's importance, and the degree to which it can be mitigated. The range for significance ratings is as follows- **0** – Impact will not affect the environment. No mitigation necessary. **1** – No impact after mitigation. **2** – Residual impact after mitigation. **3** – Impact cannot be mitigated.

14.2 Assessment of Environmental Impacts and Suggested Mitigation Measures

Only the environmental issues identified during the appraisal of the receiving environment and potential impacts are assessed below. Mitigation measures are provided to prevent (first priority), reduce or remediate adverse environmental impacts (**Table 16**).

Table 16. Recommended mitigation measures with significance rating before and after mitigation for the proposed Berg River-Voëlvlei Augmentation Scheme

FLORA PRE – CONSTRUCTION PHASE						
Potential Impact			Mitigation			
Site clearing			• During site preparation, topsoil and subsoil are to be stripped separately from each other and must be stored separately from spoil material for use in the rehabilitation phase. It should be protected from wind and rain, as well as contamination from diesel, concrete or wastewater. • Larger exotic species that are not included in the Category 1b list of invasive species could also be allowed to remain for aesthetic purposes. • Construction activities should be restricted to the development footprint area and then the compliance in terms of footprint can be monitored by ECO. • No tree or shrub outside of the works area shall be felled, lopped, cut or pruned or burnt without the prior written approval of the ECO. • ECO will ensure awareness of the Nature Reserve to the workers during the toolbox meetings • The removal of plant material for medicinal purposes is prohibited. • All flora species of conservation importance, bulbs and aloes that are found during the search and rescue action or construction should be removed and placed in the nursery and should be utilised during rehabilitation. • The removal of any plant material from site, including flowers or bulbs is strictly prohibited unless unavoidable and essential for the purposes of construction.			
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FAUNA PRE – CONSTRUCTION PHASE						
Potential Impact	Mitigation					
Search and Rescue of animals on site.	• Prior to construction, animal species of conservation importance (such as Geometric Tortoise and Blue Crane) must be rescued and relocated. An experienced person who knows the animals in the region well will identify any possible Red Data fauna on site and acquire the necessary permits to relocate fauna will be obtained if avoidance is not possible. • Training of construction workers to recognise threatened animal species will reduce the probability of fauna being harmed unnecessarily.					
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Positive	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Positive	Local	Low	Short-term	Likely	1

FAUNA PRE – CONSTRUCTION PHASE						
Potential Impact	Mitigation					
Site clearing	• During site preparation special care must be taken during the clearing of the works area to minimise damage or disturbance of roosting and nesting sites, especially the pair of breeding pair recorded in Gouklip farms. • The contact details for animal rescue such as snakes' removal shall be made available at the construction site, so as to rescue them should they be found on the construction site. • Trenches shall be inspected regularly for fauna that may have fallen into them and become trapped. All fauna found in trenches must be rescued. • Any incidents of poaching, wilful disturbance or damage to wild animals as well as accidental damage to or death of wild animals should be reported to the ECO and recorded. • Photographs of sensitive animals (Greater White pelican, Jackal Buzzard, Geometric Tortoise, and Blue Crane) must be displayed in the construction camp to heighten awareness of the creatures.					
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance

FAUNA PRE – CONSTRUCTION PHASE						
Potential Impact		Mitigation				
	Negative	Local	Low	Short-term	Likely	1

FLORA CONSTRUCTION PHASE						
Potential Impact				Mitigation		
Soil contamination, vegetation loss and vegetation disturbance due to fuel and chemical spills.				• Appropriate measures should be implemented in order to prevent potential soil pollution through fuel and oil leaks and spills and then compliance monitored by an appropriate person. • Make sure construction vehicles are maintained and serviced to prevent oil and fuel leaks. • Emergency on-site maintenance should be done over appropriate drip trays and all oil or fuel must be disposed of according to waste regulations. Drip-trays must be placed under vehicles and equipment when not in use. • Implement suitable erosion control measures		
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FLORA CONSTRUCTION PHASE						
Potential Impact			Mitigation			
Vegetation and habitat disturbance due to the accidental introduction of alien species.			• Promote awareness of all personnel. • The establishment of pioneer species should be considered with the natural cycle of rehabilitation of disturbed areas, which assists with erosion control, dust and establishment of more permanent species. This can be controlled during construction phase and thereafter more stringent measures should be implemented during the rehabilitation and post rehabilitation. • Larger exotic species that are not included in the Category 1b list of invasive species could also be allowed to remain for aesthetic purposes			
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FLORA CONSTRUCTION PHASE						
Potential Impact			Mitigation			
Vegetation and habitat disturbance due to pollution and littering during construction phase.			• The Contractor should employ personnel on site responsible for preventing and controlling of litter. Promote good housekeeping with daily clean-ups on site. • During construction, refresher training can be conducted to construction workers with regards to littering, *ad hoc* veld fires, and dumping. • No fires are allowed on site.			
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FLORA CONSTRUCTION PHASE						
Potential Impact				Mitigation		
Damage to plant life outside of the proposed development area.				• Construction activities should be restricted to the development footprint area and then the compliance in terms of footprint can be monitored by ECO. • Areas which could be deemed as no go should be clearly marked.		
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FAUNA CONSTRUCTION PHASE						
Potential Impact				Mitigation		
Disturbance to animals				• Animals residing within the designated area shall not be unnecessarily disturbed. • During construction, refresher training can be conducted to construction workers with regards to littering and poaching. • The Contractor and his/her employees shall not bring any domestic animals onto site. • Toolbox talks should be provided to contractors regarding disturbance to animals. Particular emphasis should be placed on talks regarding snakes.		
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FAUNA CONSTRUCTION PHASE						
Potential Impact				Mitigation		
Animal passage out of construction site				• Allow for safe animal passage through and specifically out of the construction site.		
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FLORA OPERATIONAL PHASE						
Potential Impact				Mitigation		
The proposed construction activities may affect biodiversity through the encroachment of exotic vegetation following soil disturbance, in addition the maintenance of the area would disturb naturalised species within the area.				• Newly cleared soils will have to be re-vegetated and stabilised as soon as construction has been completed and there should be an on-going monitoring program to control and/or eradicate newly emerging invasives.		
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FLORA OPERATIONAL PHASE						
Potential Impact				Mitigation		
Rehabilitation of the site				• All areas to be affected by the proposed project will be rehabilitated after construction and all waste generated by the construction activities will be stored in a temporary demarcated storage area, prior to disposal thereof at a licensed registered landfill site. • As much vegetation growth as possible should be promoted within the proposed development areas in order to protect soils and to reduce the percentage of the surface area which is left as bare ground. In this regard special mention is made of the need to use indigenous vegetation species as the first choice during landscaping. The plant material to be used for rehabilitation should be similar to what is found in the surrounding area.		
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Positive	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Positive	Local	Low	Short-term	Likely	1

FAUNA OPERATIONAL PHASE						
Potential Impact				Mitigation		
Disturbance of faunal species				• The disturbance of fauna should be minimized. • Animals residing within the designated area shall not be unnecessarily disturbed. • Poaching and illegal hunting are strictly prohibited.		
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Positive	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Positive	Local	Low	Short-term	Likely	1

15 ANALYSIS OF THE ALTERNATIVES

Two (2) access road options and three (3) pipeline alternatives have been proposed for this project. The preference for each alternative is provided in Table **17** below.

Table 17: Project preferences and alternative options

	Options	Preference	Motivation
Access Roads	Option 1	First preference	This route is more preferred as it runs along the gravel road on the farms.
	Option 2	Second preference	This route could have an impact on the breeding pair of Red data Blue Crane bird species
Pipelines Routes	Alternative 1	Second preference	This is by far the longest route of them all and most sections fall within the CBA. Large area will need to be cleared.
	Alternative 2	First preference	Only the Discharge Point 2 falls within the CBA. Also this route is too short and the clearing of vegetation will be minimal as compared to Alternative 1.
	Alternative 3	Least preferred	This route is situated adjacent to the Voëlvlei Nature Reserve and there is higher probability of encountering and destroying the habitat of the CR Geometric Tortoise

16 CONCLUSION AND RECOMMENDATIONS

The project area falls within three Vegetation types, namely Atlantis Sand Fynbos, Swartland Alluvium Fynbos and Swartland Shale Renosterveld. Although the proposed developments fall within two Critically endangered vegetation units (Swartland Alluvium Fynbos and Swartland Shale Renosterveld), the area is quite disturbed and transformed as a result of farming activities. Access roads, most section of the proposed pipelines and laydown areas are either situated along the existing gravel roads or along the existing canal, which have little or no natural vegetation remaining. Remnants of indigenous vegetation still exist along the Berg River, even though the riparian vegetation is now highly invaded by the gum tree (*Eucalyptus camaldulensis).*

During the field surveys, no threatened species or plant species of conservation importance were noted on the proposed development areas and this could be attributed to the farming activities in the area and also habitat fragmentation due to initial construction of the canal activities and also the fact that almost the proposed pipeline routes follow the existing roads.

According to the literature review, Voëlvlei Nature Reserve was established to preserve the Critically Endangered reptile species, the Geometric Tortoise. No activities are supposed to take place inside this reserve as to preserve this species and its habitat. The proposed pipeline 3 and its discharge points are situated near the reserve and should this be preferred option, a Search, rescue and relocation plan needs to be developed for this species and Cape Nature is to be consulted to ensure that the Plan incorporates all the authority's requirements.

Exotic vegetation is encountered in the project area and is mostly associated with over-grazing and disturbances linked to farming activities. Areas will be cleared during the construction phase of the project and all disturbed areas will need to be appropriately rehabilitated to ensure that a cumulative impact is not caused in this regard. Through the Search, Rescue and Relocation Plans, a concerted effort will be made to prevent the loss of red data, protected and endangered fauna and flora species that will be affected by the project. In terms of the alternatives provided for this project, Access Road 1 is more preferred as it runs along the gravel road on the farms. A breeding pair of Red data bird species Blue Crane were observed near the Pump station and during construction, this species should not be unnecessarily disturbed. With regards to proposed pipelines, both pipeline Alternatives 1 and 3 fall within the

CBA and ESA: restore categories and only the Discharge Point 2 falls within the CBA and therefore Alternative 2 is the preferred option. The proposed Alternative 3 is situated adjacent to the Voëlvlei Nature Reserve and there is higher probability of encountering and destroying the habitat of Geometric Tortoise and therefore this route is recommended as the least preferred one.

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Appendix A. The following threatened plant species have been recorded in grid cells 3319AC and 3318BD and could potentially be found on the proposed development sites

Family	Species	Threat status	Growth forms
Amaryllidaceae	*Brunsvigia elandsmontana Snijman*	CR	Geophyte
Amaryllidaceae	*Strumaria watermeyeri L.Bolus subsp. watermeyeri*	Rare	Geophyte
Aponogetonaceae	*Aponogeton angustifolius Aiton*	VU	Epihydate, herb, hydrophyte, hyperhydate
Aquifoliaceae	*Ilex mitis (L.) Radlk. var. mitis*	Declining	Shrub, tree
Asphodelaceae	*Bulbine monophylla Poelln.*	CR	Geophyte, herb, succulent
Asphodelaceae	*Trachyandra chlamydophylla (Baker) Oberm.*	VU	Geophyte, succulent
Asphodelaceae	*Trachyandra filiformis (Aiton) Oberm.*	NT	Geophyte, succulent
Asphodelaceae	*Trachyandra paniculata Oberm.*	Threatened	Geophyte, succulent
Asteraceae	*Arctotis angustifolia L.*	CR	Herb
Asteraceae	*Athanasia adenantha (Harv.) Källersjö*	EN	Shrub
Asteraceae	*Athanasia crenata (L.) L.*	EN	Shrub
Asteraceae	*Capelio caledonica B.Nord.*	Rare	Dwarf shrub
Asteraceae	*Cineraria alchemilloides DC. subsp. alchemilloides*	Rare	Herb, suffrutex

Family	Species	Threat status	Growth forms
Asteraceae	*Comborhiza longipes (K.Bremer) Anderb. & K.Bremer*	Rare	Suffrutex
Asteraceae	*Cotula filifolia Thunb.*	CR	Herb, tenagophyte
Asteraceae	*Cotula pusilla Thunb.*	NT	Herb
Asteraceae	*Lidbeckia pectinata P.J.Bergius*	Rare	Suffrutex
Asteraceae	*Marasmodes oligocephala DC.*	CR	Shrub
Asteraceae	*Marasmodes spinosa S.Ortiz*	EN	Shrub
Asteraceae	*Marasmodes undulata Compton*	CR	Shrub
Asteraceae	*Metalasia octoflora DC.*	VU	Dwarf shrub, shrub
Asteraceae	*Oedera viscosa (L'Hér.) Anderb. & K.Bremer*	NT	Dwarf shrub
Asteraceae	*Othonna ciliata L.f.*	VU	Succulent, suffrutex
Asteraceae	*Phaneroglossa bolusii (Oliv.) B.Nord.*	Rare	Succulent, suffrutex
Asteraceae	*Relhania fruticosa (L.) K.Bremer*	NT	Dwarf shrub
Asteraceae	*Senecio albifolius DC.*	Rare	Herb
Asteraceae	*Steirodiscus gamolepis Bolus ex Schltr.*	EN	Herb
Boraginaceae	*Echiostachys ecklonianus (H.Buek) Levyns*	EN	Herb

Family	Species	Threat status	Growth forms
Boraginaceae	*Lobostemon capitatus (L.) H.Buek*	VU	Dwarf shrub
Bruniaceae	*Thamnea hirtella Oliv.*	Rare	Dwarf shrub
Campanulaceae	*Merciera tetraloba C.N.Cupido*	EN	Dwarf shrub, herb
Colchicaceae	*Wurmbea inusta (Baker) B.Nord.*	VU	Geophyte
Crassulaceae	*Crassula bergioides Harv.*	NT	Herb, succulent
Ericaceae	*Erica capitata L.*	NT	Dwarf shrub
Ericaceae	*Erica doliiformis Salisb.*	Rare	Shrub
Ericaceae	*Erica mitchellensis Dulfer*	Rare	Shrub
Ericaceae	*Erica oxysepala Guthrie & Bolus*	VU	Shrub
Ericaceae	*Erica rehmii Dulfer*	VU	Shrub
Fabaceae	*Indigofera psoraloides (L.) L.*	EN	Herb
Fabaceae	*Lebeckia plukenetiana E.Mey.*	EN	Herb
Fabaceae	*Lotononis complanata B.-E.van Wyk*	EN	Dwarf shrub
Fabaceae	*Lotononis prostrata (L.) Benth.*	NT	Dwarf shrub
Fabaceae	*Lotononis rigida (E.Mey.) Benth.*	VU	Dwarf shrub

Family	Species	Threat status	Growth forms
Fabaceae	*Otholobium bolusii (H.M.L.Forbes) C.H.Stirt.*	NT	Dwarf shrub
Fabaceae	*Otholobium uncinatum (Eckl. & Zeyh.) C.H.Stirt.*	NT	Dwarf shrub
Fabaceae	*Podalyria cordata R.Br.*	VU	Shrub
Fabaceae	*Podalyria sericea (Andrews) R.Br. ex Aiton f.*	VU	Shrub
Fabaceae	*Rafnia crispa C.H.Stirt.*	CR	Dwarf shrub, herb
Fabaceae	*Rafnia lancea (Thunb.) DC.*	EN	Dwarf shrub
Fabaceae	*Wiborgia tenuifolia E.Mey.*	NT	Shrub
Geraniaceae	*Monsonia speciosa L.*	EN	Herb
Geraniaceae	*Pelargonium asarifolium (Sweet) Loudon*	VU	Geophyte, succulent
Geraniaceae	*Pelargonium chelidonium (Houtt.) DC.*	EN	Geophyte, succulent
Geraniaceae	*Pelargonium reflexum (Andrews) Pers.*	EN	Geophyte, succulent
Grubbiaceae	*Grubbia rourkei Carlquist*	Rare	Shrub
Gunneraceae	*Gunnera perpensa L.*	Declining	Herb, hydrophyte
Haemodoraceae	*Wachendorfia brachyandra W.F.Barker*	VU	Geophyte
Hyacinthaceae	*Albuca albucoides (Aiton) J.C.Manning & Goldblatt*	EN	Geophyte

Family	Species	Threat status	Growth forms
Hyacinthaceae	*Lachenalia contaminata Aiton*	NT	Geophyte
Hyacinthaceae	*Lachenalia longibracteata E.Phillips*	Declining	Geophyte
Hyacinthaceae	*Lachenalia mediana Jacq. var. mediana*	VU	Geophyte
Hyacinthaceae	*Lachenalia mediana Jacq. var. rogersii (Baker) W.F.Barker*	EN	Geophyte
Hyacinthaceae	*Lachenalia pallida Aiton*	Declining	Geophyte
Hyacinthaceae	*Lachenalia polyphylla Baker*	EN	Geophyte
Hyacinthaceae	*Lachenalia purpureo-caerulea Jacq.*	CR	Geophyte
Hyacinthaceae	*Lachenalia pustulata Jacq.*	NT	Geophyte
Hypoxidaceae	*Pauridia minuta (L.f.) T.Durand & Schinz*	NT	Geophyte
Hypoxidaceae	*Spiloxene alba (Thunb.) Fourc.*	VU	Geophyte
Hypoxidaceae	*Spiloxene minuta (L.) Fourc.*	EN	Geophyte
Iridaceae	*Aristea lugens (L.f.) Steud.*	EN	Herb
Iridaceae	*Aristea nigrescens J.C.Manning & Goldblatt*	EN	Herb
Iridaceae	*Babiana angustifolia Sweet*	NT	Geophyte, herb
Iridaceae	*Babiana melanops Goldblatt & J.C.Manning*	VU	Geophyte, herb

Family	Species	Threat status	Growth forms
Iridaceae	*Babiana odorata L.Bolus*	EN	Geophyte, herb
Iridaceae	*Babiana patula N.E.Br.*	Declining	Geophyte, herb
Iridaceae	*Babiana rubrocyanea (Jacq.) Ker Gawl.*	VU	Geophyte, herb
Iridaceae	*Babiana secunda (Thunb.) Ker Gawl.*	CR	Geophyte, herb
Iridaceae	*Babiana stricta (Aiton) Ker Gawl.*	NT	Geophyte, herb
Iridaceae	*Babiana villosa (Aiton) Ker Gawl.*	NT	Geophyte, herb
Iridaceae	*Babiana villosula (J.F.Gmel.) Ker Gawl. ex Steud.*	EN	Geophyte, herb
Iridaceae	*Bobartia fasciculata J.B.Gillett ex Strid*	NT	Herb
Iridaceae	*Geissorhiza erosa (Salisb.) R.C.Foster*	EN	Geophyte
Iridaceae	*Geissorhiza furva Ker Gawl. ex Baker*	EN	Geophyte, herb
Iridaceae	*Geissorhiza imbricata (D.Delaroche) Ker Gawl. subsp. bicolor (Thunb.) Goldblatt*	NT	Geophyte, herb
Iridaceae	*Geissorhiza imbricata (D.Delaroche) Ker Gawl. subsp. imbricata*	NT	Epiphyte, geophyte, herb
Iridaceae	*Geissorhiza purpureolutea Baker*	NT	Geophyte, herb
Iridaceae	*Geissorhiza setacea (Thunb.) Ker Gawl.*	EN	Geophyte, herb

Family	Species	Threat status	Growth forms
Iridaceae	*Geissorhiza tulbaghensis F.Bolus*	EN	Geophyte, herb
Iridaceae	*Gladiolus exilis G.J.Lewis*	NT	Geophyte, herb
Iridaceae	*Gladiolus meliusculus (G.J.Lewis) Goldblatt & J.C.Manning*	NT	Geophyte, herb
Iridaceae	*Gladiolus recurvus L.*	VU	Geophyte, herb
Iridaceae	*Gladiolus watsonius Thunb.*	NT	Geophyte, herb
Iridaceae	*Hesperantha spicata (Burm.f.) N.E.Br. subsp. spicata*	VU	Geophyte, herb
Iridaceae	*Ixia abbreviata Houtt. var. abbreviata*	NT	Geophyte, herb
Iridaceae	*Ixia campanulata Houtt.*	EN	Geophyte, herb
Iridaceae	*Ixia dubia Vent.*	Declining	Geophyte, herb
Iridaceae	*Ixia metelerkampiae L.Bolus*	Rare	Geophyte, herb
Iridaceae	*Ixia monadelpha D.Delaroche*	EN	Geophyte, herb
Iridaceae	*Ixia mostertii M.P.de Vos*	EN	Geophyte, herb
Iridaceae	*Ixia polystachya L. var. longistylis M.P.de Vos*	EN	Geophyte, herb
Iridaceae	*Ixia rouxii G.J.Lewis*	CR	Geophyte, herb
Iridaceae	*Ixia vinacea G.J.Lewis*	EN	Geophyte, herb

Family	Species	Threat status	Growth forms
Iridaceae	*Ixia viridiflora Lam. var. minor M.P.de Vos*	CR	Geophyte, herb
Iridaceae	*Ixia viridiflora Lam. var. viridiflora*	EN	Geophyte, herb
Iridaceae	*Lapeirousia azurea (Eckl. ex Baker) Goldblatt*	EN	Geophyte, herb
Iridaceae	*Lapeirousia corymbosa (L.) Ker Gawl.*	Declining	Geophyte, herb
Iridaceae	*Moraea angulata Goldblatt*	CR	Geophyte, herb
Iridaceae	*Moraea cooperi Baker*	VU	Geophyte, herb
Iridaceae	*Moraea punctata Baker*	EN	[No lifeform defined]
Iridaceae	*Moraea tricolor Andrews*	EN	Geophyte, herb
Iridaceae	*Moraea tulbaghensis L.Bolus*	EN	Geophyte, herb
Iridaceae	*Moraea versicolor (Salisb. ex Klatt) Goldblatt*	VU	Geophyte, herb
Iridaceae	*Moraea villosa (Ker Gawl.) Ker Gawl. subsp. elandsmontana Goldblatt*	VU	Geophyte, herb
Iridaceae	*Moraea villosa (Ker Gawl.) Ker Gawl. subsp. villosa*	VU	Geophyte, herb
Iridaceae	*Sparaxis grandiflora (D.Delaroche) Ker Gawl. subsp. grandiflora*	EN	Geophyte, herb
Iridaceae	*Sparaxis tricolor (Schneev.) Ker Gawl.*	VU	Geophyte, herb
Iridaceae	*Thereianthus longicollis (Schltr.) G.J.Lewis*	Rare	Geophyte, herb

Family	Species	Threat status	Growth forms
Iridaceae	*Tritoniopsis elongata (L.Bolus) G.J.Lewis*	EN	Geophyte, herb
Iridaceae	*Watsonia dubia Eckl. ex Klatt*	EN	Geophyte, herb
Iridaceae	*Watsonia humilis Mill.*	CR	Geophyte, herb
Isoetaceae	*Isoetes capensis A.V.Duthie*	EN	Geophyte, herb, hydrophyte
Isoetaceae	*Isoetes stellenbossiensis A.V.Duthie*	NT	Geophyte, herb, hydrophyte
Isoetaceae	*Isoetes stephansenii A.V.Duthie*	CR	Geophyte, herb, hydrophyte
Lobeliaceae	*Monopsis variifolia (Sims) Urb.*	EN	Herb
Mesembryanthemaceae	*Antimima mucronata (Haw.) H.E.K.Hartmann*	VU	Succulent
Mesembryanthemaceae	*Conophytum turrigerum (N.E.Br.) N.E.Br.*	Rare	Succulent
Mesembryanthemaceae	*Drosanthemum calycinum (Haw.) Schwantes*	NT	Succulent
Mesembryanthemaceae	*Drosanthemum hispifolium (Haw.) Schwantes*	VU	Succulent
Mesembryanthemaceae	*Drosanthemum worcesterense L.Bolus*	Threatened	Succulent
Mesembryanthemaceae	*Erepsia forficata (L.) Schwantes*	Rare	Succulent
Mesembryanthemaceae	*Erepsia ramosa L.Bolus*	VU	Succulent
Mesembryanthemaceae	*Lampranthus coccineus (Haw.) N.E.Br.*	CR	Succulent

Family	Species	Threat status	Growth forms
Mesembryanthemaceae	*Lampranthus dilutus N.E.Br.*	EN	Succulent
Mesembryanthemaceae	*Lampranthus filicaulis (Haw.) N.E.Br.*	VU	Succulent
Mesembryanthemaceae	*Lampranthus leptaleon (Haw.) N.E.Br.*	EN	Succulent
Mesembryanthemaceae	*Lampranthus peacockiae (L.Bolus) L.Bolus*	VU	Succulent
Mesembryanthemaceae	*Lampranthus reptans (Aiton) N.E.Br.*	NT	Succulent
Mesembryanthemaceae	*Lampranthus scaber (L.) N.E.Br.*	EN	Succulent
Mesembryanthemaceae	*Phyllobolus suffruticosus (L.Bolus) Gerbaulet*	EN	Succulent
Orchidaceae	*Ceratandra venosa (Lindl.) Schltr.*	NT	Geophyte, herb
Orchidaceae	*Disa atrorubens Schltr.*	NT	Geophyte, herb
Orchidaceae	*Disa esterhuyseniae Schelpe ex H.P.Linder*	Rare	Geophyte, herb
Orchidaceae	*Disa flexuosa (L.) Sw.*	NT	Geophyte, herb
Orchidaceae	*Disa physodes Sw.*	CR	Geophyte, herb
Orchidaceae	*Disa tenella (L.f.) Sw. subsp. pusilla H.P.Linder*	Rare	Geophyte, herb
Orchidaceae	*Disa tenella (L.f.) Sw. subsp. tenella*	EN	Geophyte, herb
Orchidaceae	*Pterygodium inversum (Thunb.) Sw.*	EN	Geophyte, herb

Family	Species	Threat status	Growth forms
Oxalidaceae	*Oxalis droseroides E.Mey. ex Sond.*	EN	Geophyte
Oxalidaceae	*Oxalis meisneri Sond.*	VU	Geophyte
Oxalidaceae	*Oxalis natans Thunb.*	CR	Geophyte, hydrophyte
Penaeaceae	*Stylapterus ericoides A.Juss. subsp. ericoides*	Rare	Shrub
Polygalaceae	*Muraltia spicata Bolus*	VU	Dwarf shrub
Polygalaceae	*Muraltia trinervia (L.f.) DC.*	NT	Dwarf shrub
Prioniaceae	*Prionium serratum (L.f.) Drège ex E.Mey.*	Declining	Herb, hydrophyte, hyperhydate
Proteaceae	*Aulax pallasia Stapf*	NT	Shrub
Proteaceae	*Diastella fraterna Rourke*	Rare	Dwarf shrub
Proteaceae	*Diastella myrtifolia (Thunb.) Salisb. ex Knight*	CR	Dwarf shrub, shrub
Proteaceae	*Diastella parilis Salisb. ex Knight*	CR	Dwarf shrub
Proteaceae	*Diastella thymelaeoides (P.J.Bergius) Rourke subsp. meridiana Rourke*	VU	Dwarf shrub, shrub
Proteaceae	*Leucadendron argenteum (L.) R.Br.*	EN	Tree
Proteaceae	*Leucadendron chamelaea (Lam.) I.Williams*	CR	Shrub
Proteaceae	*Leucadendron corymbosum P.J.Bergius*	VU	Shrub

Family	Species	Threat status	Growth forms
Proteaceae	*Leucadendron daphnoides (Thunb.) Meisn.*	EN	Shrub
Proteaceae	*Leucadendron gydoense I.Williams*	EN	Shrub
Proteaceae	*Leucadendron lanigerum H.Buek ex Meisn. var. laevigatum Meisn.*	CR	Shrub
Proteaceae	*Leucadendron lanigerum H.Buek ex Meisn. var. lanigerum*	EN	Shrub
Proteaceae	*Leucadendron sessile R.Br.*	NT	Shrub
Proteaceae	*Leucadendron stellare (Sims) Sweet*	CR	Shrub
Proteaceae	*Leucospermum cordifolium (Salisb. ex Knight) Fourc.*	NT	Shrub
Proteaceae	*Leucospermum hypophyllocarpodendron (L.) Druce subsp. hypophyllocarpodendron*	VU	Dwarf shrub
Proteaceae	*Leucospermum innovans Rourke*	EN	Shrub
Proteaceae	*Leucospermum lineare R.Br.*	VU	Shrub
Proteaceae	*Leucospermum tomentosum (Thunb.) R.Br.*	VU	Dwarf shrub
Proteaceae	*Leucospermum tottum (L.) R.Br. var. tottum*	NT	Shrub
Proteaceae	*Leucospermum vestitum (Lam.) Rourke*	NT	Shrub
Proteaceae	*Protea angustata R.Br.*	EN	Dwarf shrub

Family	Species	Threat status	Growth forms
Proteaceae	*Protea burchellii Stapf*	VU	Shrub
Proteaceae	*Protea coronata Lam.*	NT	Shrub
Proteaceae	*Protea effusa E.Mey. ex Meisn.*	NT	Dwarf shrub, shrub
Proteaceae	*Protea grandiceps Tratt.*	NT	Shrub
Proteaceae	*Protea lorea R.Br.*	NT	Dwarf shrub, shrub
Proteaceae	*Protea mucronifolia Salisb.*	CR	Dwarf shrub, shrub
Proteaceae	*Protea recondita H.Buek ex Meisn.*	NT	Dwarf shrub, shrub
Proteaceae	*Protea scabra R.Br.*	NT	Dwarf shrub
Proteaceae	*Protea scolymocephala (L.) Reichard*	VU	Dwarf shrub, shrub
Proteaceae	*Protea scorzonerifolia (Salisb. ex Knight) Rycroft*	VU	Dwarf shrub
Proteaceae	*Serruria candicans R.Br.*	EN	Dwarf shrub
Proteaceae	*Serruria fasciflora Salisb. ex Knight*	NT	Shrub
Proteaceae	*Serruria furcellata R.Br.*	CR	Shrub
Proteaceae	*Serruria rosea E.Phillips*	NT	Shrub
Proteaceae	*Serruria roxburghii R.Br.*	EN	Shrub

Family	Species	Threat status	Growth forms
Proteaceae	*Serruria rubricaulis R.Br.*	NT	Dwarf shrub
Proteaceae	*Serruria triternata (Thunb.) R.Br.*	NT	Shrub
Proteaceae	*Sorocephalus imbricatus (Thunb.) R.Br.*	CR	Shrub
Proteaceae	*Spatalla caudata (Thunb.) R.Br.*	EN	Shrub
Restionaceae	*Elegia extensa Pillans*	EN	Dwarf shrub, restioid
Restionaceae	*Elegia recta (Mast.) Moline & H.P.Linder*	NT	[No lifeform defined]
Restionaceae	*Restio coactilis Mast.*	VU	[No lifeform defined]
Rhamnaceae	*Phylica plumosa L. var. horizontalis (Vent.) Sond.*	VU	Dwarf shrub, shrub
Rhamnaceae	*Phylica plumosa L. var. plumosa*	Declining	Dwarf shrub
Rhamnaceae	*Phylica stenopetala Schltr. var. stenopetala*	VU	Dwarf shrub
Rhamnaceae	*Phylica strigulosa Sond.*	VU	Dwarf shrub
Rhamnaceae	*Phylica thunbergiana Sond.*	EN	Dwarf shrub
Rhamnaceae	*Phylica trachyphylla (Eckl. & Zeyh.) D.Dietr.*	Rare	Shrub
Rutaceae	*Acmadenia macradenia (Sond.) Dummer*	NT	Dwarf shrub
Rutaceae	*Agathosma betulina (P.J.Bergius) Pillans*	Declining	Dwarf shrub, shrub

Family	Species	Threat status	Growth forms
Rutaceae	*Agathosma corymbosa (Montin) G.Don*	EN	Dwarf shrub
Rutaceae	*Agathosma crenulata (L.) Pillans*	Declining	Shrub
Rutaceae	*Agathosma marifolia Eckl. & Zeyh.*	NT	Dwarf shrub
Rutaceae	*Agathosma pulchella (L.) Link*	VU	Dwarf shrub
Rutaceae	*Diosma aspalathoides Lam.*	NT	Shrub
Rutaceae	*Diosma pedicellata I.Williams*	NT	Dwarf shrub, shrub
Rutaceae	*Euchaetis pungens (Bartl. & H.L.Wendl.) I.Williams*	VU	Dwarf shrub, shrub
Scrophulariaceae	*Polycarena capensis (L.) Benth.*	NT	Herb
Thymelaeaceae	*Gnidia humilis Meisn.*	EN	Dwarf shrub
Thymelaeaceae	*Lachnaea grandiflora (L.f.) Baill.*	VU	Dwarf shrub, shrub
Thymelaeaceae	*Lachnaea pusilla Beyers*	VU	Dwarf shrub
Thymelaeaceae	*Lachnaea uniflora (L.) Crantz*	VU	Dwarf shrub

Note: CR=Critically Endangered; EN=Endangered, VU=Vulnerable, NT=Near Threatened