Botanical Assessment for Flood Damage Repairs to Structures on MR309 in Seweweekspoort, Eden District and Central Karoo District Municipalities

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Prepared for HATCH Africa (Pty) Ltd

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National Legislation and Regulations governing this report

This is a 'specialist report' and is compiled in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended, and the Environmental Impact Assessment Regulations, 2014.

Appointment of Specialist

Bergwind Botanical Surveys & Tours CC was appointed by HATCH Africa (Pty) Ltd to provide specialist botanical consulting services for *Flood Damage Repairs to Structures on MR309 in Seweweekspoort, Eden District Municipality and Central Karoo District Municipality*. The consulting services comprise a botanical impact assessment of the flora and vegetation in the designated study area for the proposed project.

Details of Specialists

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Expertise

Dr David J. McDonald:

- Qualifications: BSc. Hons. (Botany), MSc (Botany) and PhD (Botany).

- Botanical ecologist with over 30 years' experience in the field of Vegetation Science.
- Founded Bergwind Botanical Surveys & Tours CC in 2006.
- Has conducted over 400 specialist botanical / ecological studies.
- Has published numerous scientific papers and attended numerous conferences both nationally and internationally (details available on request).

Mr Paul I. Emms

- Qualifications: ND Horticulture, BSc. (Biodiversity & Conservation Biology), Hons. (Botany), MSc (Botany).
- Botanist with seven years' experience in the field of botanical surveys.
- Has conducted over 150 specialist botanical studies.

Independence

The views expressed in the document are the objective, independent views of Dr McDonald and Mr Emms and the survey was carried out under the aegis of Bergwind Botanical Surveys and Tours CC. Neither Dr McDonald, Mr Emms, nor Bergwind Botanical Surveys and Tours CC have any business, personal, financial or other interest in the proposed development apart from fair remuneration for the work performed.

Conditions relating to this report

The content of this report is based on the authors' best scientific and professional knowledge as well as available information. Bergwind Botanical Surveys & Tours CC, its staff and appointed associates, reserve the right to modify the report in any way deemed fit should new, relevant or previously unavailable or undisclosed information become known to the author from on-going research or further work in this field, or pertaining to this investigation.

This report must not be altered or added to without the prior written consent of the authors. This also refers to electronic copies of the report, which are supplied for the purposes of inclusion as part of other reports, including main reports. Similarly, any recommendations, statements or conclusions drawn from or based on this report must make reference to this report. If these form part of a main report relating to this investigation or report, this report must be included in its entirety as an appendix or separate section to the main report.

THE SPECIALIST

I, Paul Ivor Emms, as the appointed specialist hereby declare/affirm the correctness of the information provided or to be provided as part of the application, and that I:

• in terms of the general requirement to be independent:

  - other than fair remuneration for work performed/to be performed in terms of this application, have no business, financial, personal or other interest in the activity or application and that there are no circumstances that may compromise my objectivity; or
  - am not independent, but another specialist that meets the general requirements set out in Regulation 13 have been appointed to review my work (Note: a declaration by the review specialist must be submitted);

• in terms of the remainder of the general requirements for a specialist, am fully aware of and meet all of the requirements and that failure to comply with any the requirements may result in disqualification;

• have disclosed/will disclose, to the applicant, the Department and interested and affected parties, all material information that have or may have the potential to influence the decision of the Department or the objectivity of any report, plan or document prepared or to be prepared as part of the application;

• have ensured/will ensure that information containing all relevant facts in respect of the application was/will be distributed or was/will be made available to interested and affected parties and the public and that participation by interested and affected parties was/will be facilitated in such a manner that all interested and affected parties were/will be provided with a reasonable opportunity to participate and to provide comments;

• have ensured/will ensure that the comments of all interested and affected parties were/will be considered, recorded and submitted to the Department in respect of the application;

• have ensured/will ensure the inclusion of inputs and recommendations from the specialist reports in respect of the application, where relevant;

• have kept/will keep a register of all interested and affected parties that participate/d in the public participation process; and

• am aware that a false declaration is an offence in terms of regulation 48 of the 2014 NEMA EIA Regulations.

Note: The terms of reference of the review specialist must be attached.

Signature of the specialist:

Name of company: Bergwind Botanical Surveys & Tours CC………………………………….

Date: ……9 December 2016………………………………………………………………………

CONTENTS

1. Introduction

The Seweweekspoort Pass is a 17km long gravel road (MR309) that meanders through the Swartberg Mountains, linking the towns of Laingsburg and Ladismith. The pass, which was completed in 1862, was constructed as a 'boer road' along the valley bottom and course of the Huis River through the narrow Seweweekspoort. The road was originally constructed to serve as a link between inhabitants on either side of the Swartberg. The pass is now incorporated in the Swartberg Nature Reserve that is joined to the Gamkapoort Nature Reserve and Towerkop Nature Reserve.

Seweweekspoort Pass crosses the Huis River about 30 times along the 17km stretch, making the road susceptible to flood damage. Overtopping of the road leads to damage to both the causeways and sections of road at a number of the crossings. At certain sections, where the river runs parallel to the road, flooding causes the road surface material to be completely washed away. The Eden District Municipality and Central Karoo District Municipality have identified which structures require repair work or upgrading. Major upgrading works would need to be undertaken at 27 sites. Two sites would require new retaining walls whereas the remaining sites would require new culverts and causeways. The proposed strategy to prevent disruption of traffic flow would entail bypasses at each of the 25 river-crossing sites. This would require removal of natural vegetation next to each crossing and the construction of temporary gravel sections to divert the traffic. A botanical assessment is required in order to determine the impacts of the proposed traffic bypasses, upgrades and repair work. Bergwind Botanical Surveys and Tours CC was appointed by HATCH Africa (Pty) Ltd (HATCH) to carry out the botanical assessment for the proposed scope of works.

2. Terms of Reference

2.1. Terms of Reference

Botanical assessments must follow guidelines set out in the following documents:

- Department of Environmental Affairs and Development Planning (DEA&DP) Guidelines for Involving Biodiversity Specialists in the EIA Process (Brownlie, 2005);
- The requirements of the Botanical Society of South Africa (BotSoc) in developing an approach to the botanical investigation;
- The requirements of CapeNature for providing comments on agricultural, environmental, mine planning and water-use related applications;
- Ecosystem Guidelines for Environmental Assessment in the Western Cape (Cadman, 2016), and

- Appendix 6 of the Environmental Impact Assessment Regulations, 2014 (Government Gazette, 2014).

2.2. Specific Terms of Reference

- Provide a description of the vegetation at each of the 27 sites;
- Identify and describe biodiversity patterns at community and ecosystem level (main vegetation type, plant communities in the vicinity and threatened/vulnerable ecosystems), at species level (threatened Red List species, presence of alien species) and in terms of significant landscape features;
- Identify and assess potential impacts of the project for the proposed activity at each of the 27 sites, including impacts associated with the construction and operation phases, using prescribed impact rating methodology provided by HATCH;
- Identify and describe potential cumulative impacts of the proposed construction activities in relation to proposed and existing construction/developments in the surrounding area;
- Outline mitigation measures, if applicable, that would need to be carried out if the proposed works are to be approved; and
- Review previous botanical work applicable to the area and any relevant biodiversity plans compiled in terms of the National Environmental Management Biodiversity Act (No. 10 of 2004).

3. The Study Area

3.1. Locality

Seweweekspoort is located directly north of Amalienstein and Zoar, two small towns that lie approximately midway between the larger towns of Ladismith to the west and Calitzdorp to the east on the R62 (Route 62) (Figures 1 and 2). The starting point for the area of study is located at the northern end of the pass at KM40.9 (Figure 3). The study area ends 17.2 km away at the southern end point at KM58.1. A single homestead lies approximately midway along the poort. The property known as Aristata Seweweekspoort, has several self-catering units. The property is named after the Ladismith sugarbush (*Protea aristata*), a slow growing protea endemic to the Klein Swartberg and classified as VULNERABLE due to its susceptibility to too frequent fires (sanbi.org).

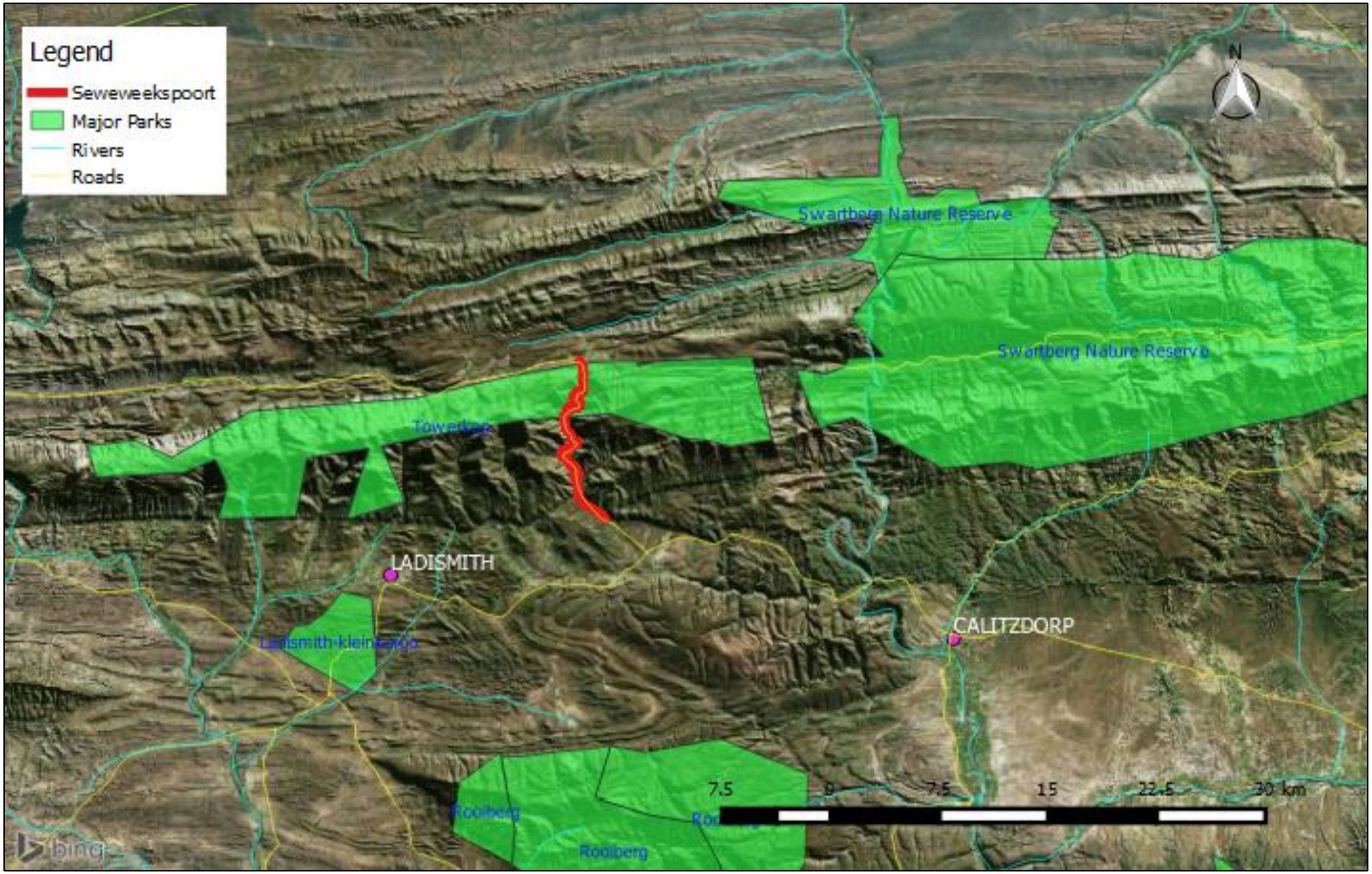

Figure 1. Locality map of Seweweekspoort in relation to Ladismith and Calitzdorp represented on a Bing aerial image.

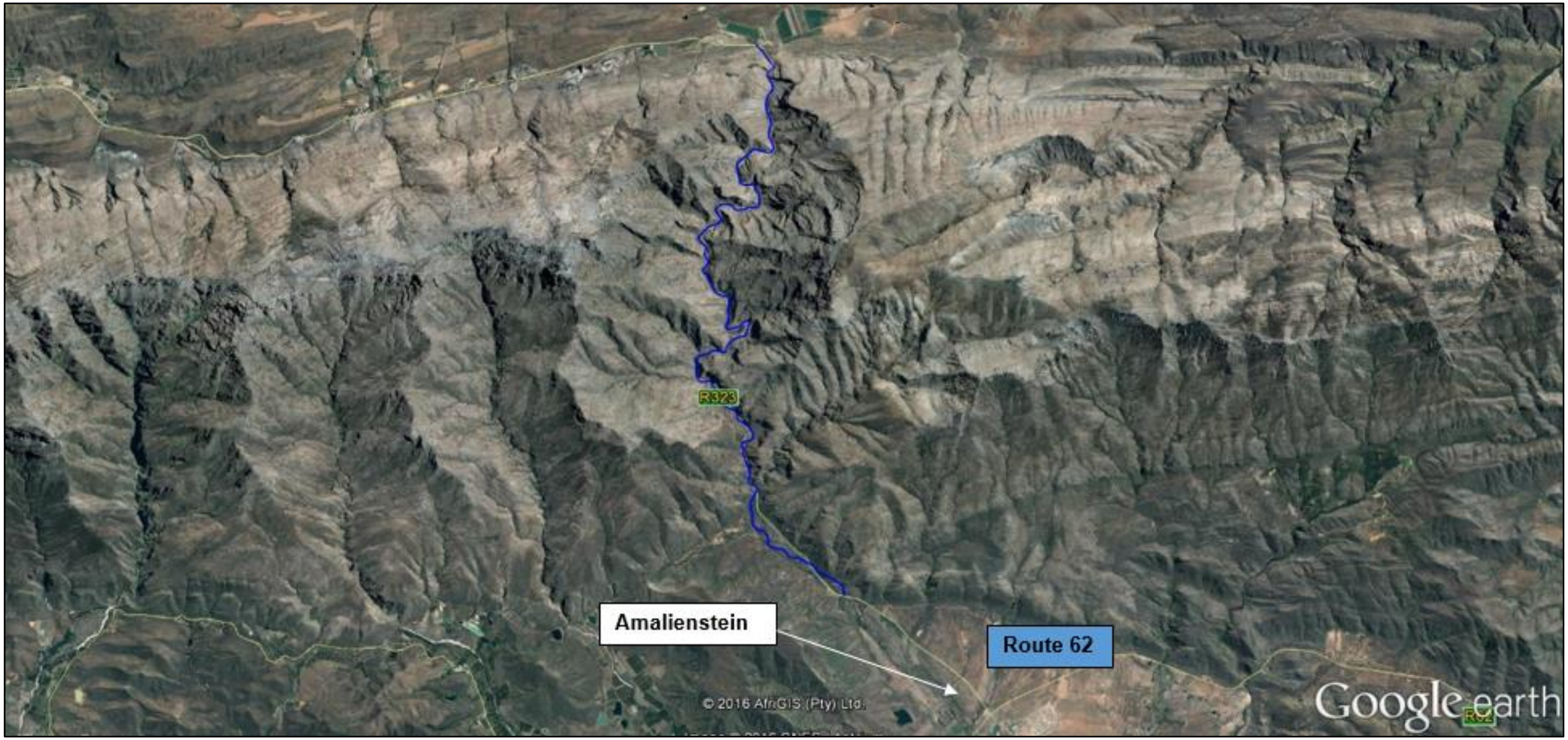

Figure 2. Google Earth™ aerial image showing the locality of Seweweekspoort along the Huis River (blue line) meandering through the Klein Swartberg range.

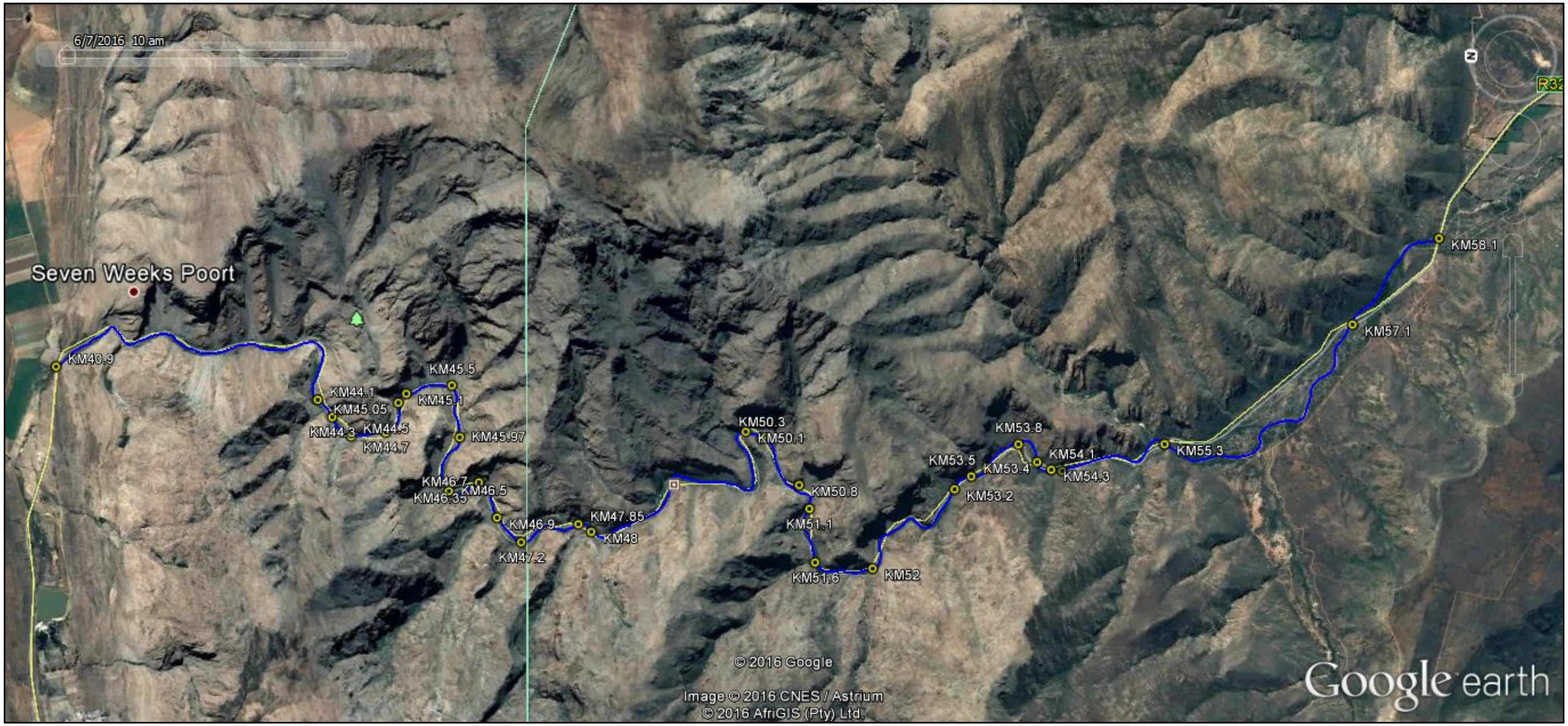

Figure 3. Google Earth™ aerial image showing study area with the locations of the structures (numbered yellow circle icons) through Seweweekspoort. The blue line represents the Huis River. Note the position of north on the rotated image.

3.2. Geology, topography and soils

Seweweekspoort is arguably one of the most impressive mountain passes is South Africa. The pass is impressive due to the fact that it winds through the long and meandering poort that has cut through the steep and rugged Swartberg Mountain range. The pass is very narrow in places, with several tributaries joining the Huis River along its course. Seweweekspoort Peak, that lies to the east of the study area, is the second-highest peak in the Western Cape at 2 325m above sea level.

The greater part of the study area is characterized by *"acidic lithosol soils derived from Ordovician sandstones of the Table Mountain Group (Cape Supergroup)"* (Rebelo *et al.* 2006 in Mucina & Rutherford, 2006). The southern end of the study area, where the road leaves the deep kloof, is characterized by clay soils derived from the Bokkeveld and Witteberg Group Shales (Rebelo *et al.* 2006 in Mucina & Rutherford, 2006). A shale band (with clays derived from the Cederberg Formation) traverses the pass at the northern end of the study area (see Central Shale Band Vegetation distribution in Figure 7.

3.3. Climate

The study area has a Mediterranean climate that is characterised by hot dry summers and cool, wet winters. Temperatures range from 29˚C (maximum) to 2˚C (minimum) during February and July respectively (www.worldweatheronline.com) (Figure 4). The peak rainfall period is from March to September (www.worldweatheronline.com) (Figure 5). Mean annual precipitation for the region varies from 170 – 850 mm (mean: 475 mm), (Rebelo *et al.* 2006 in Mucina & Rutherford, 2006) (Figure 6). Frost occurs on average for 3 days per year (Rebelo *et al.* 2006 in Mucina & Rutherford, 2006). Figure 6 shows climate chart for the South Swartberg Sandstone Fynbos ecosystem since this ecosystem aligns most closely with the climatic pattern.

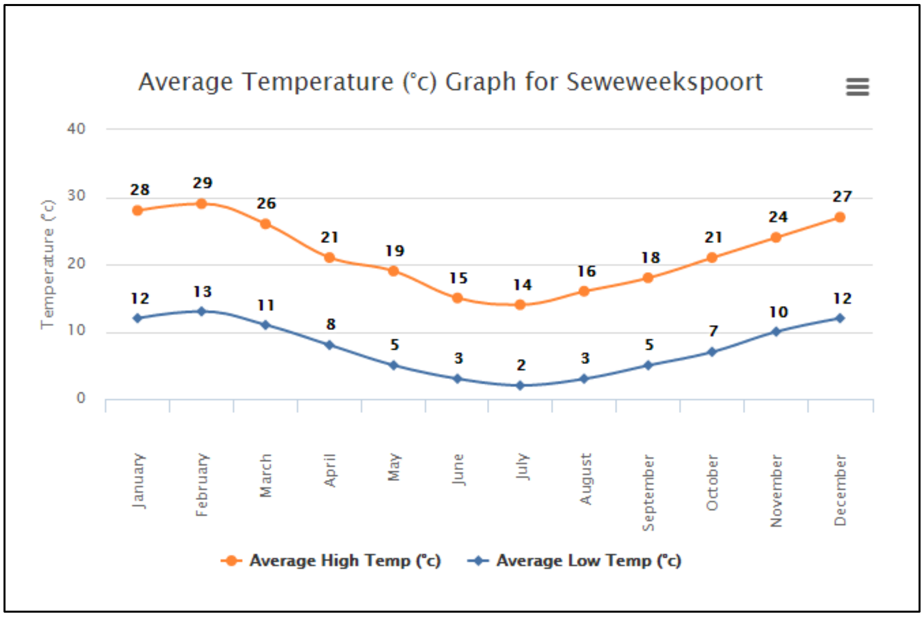

Figure 4. Temperature graph for Seweweekspoort showing mean maximum and minimum monthly temperatures.

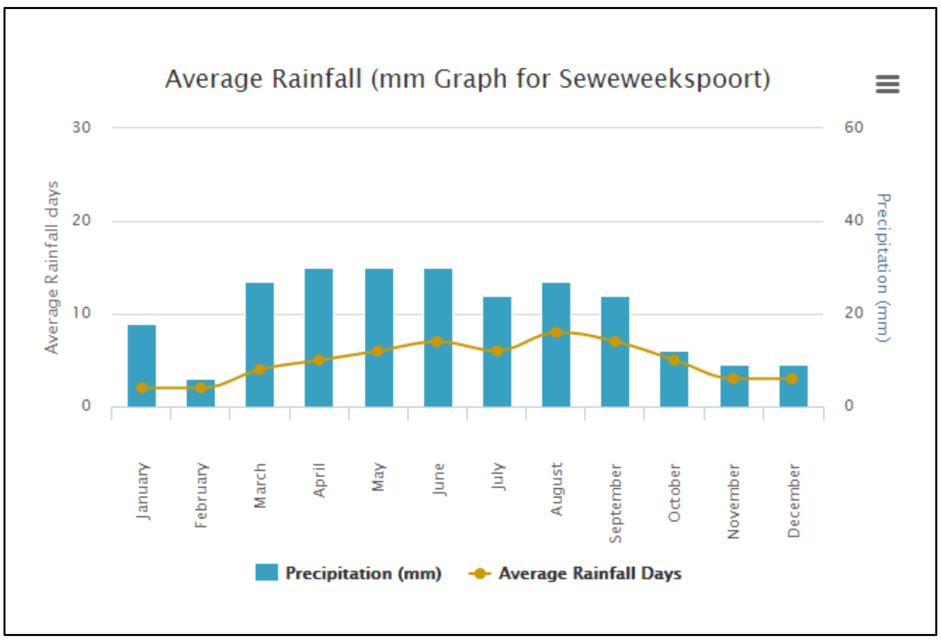

Figure 5. Rainfall graph for Seweweekspoort showing mean monthly rainfall and rainfall days**.**

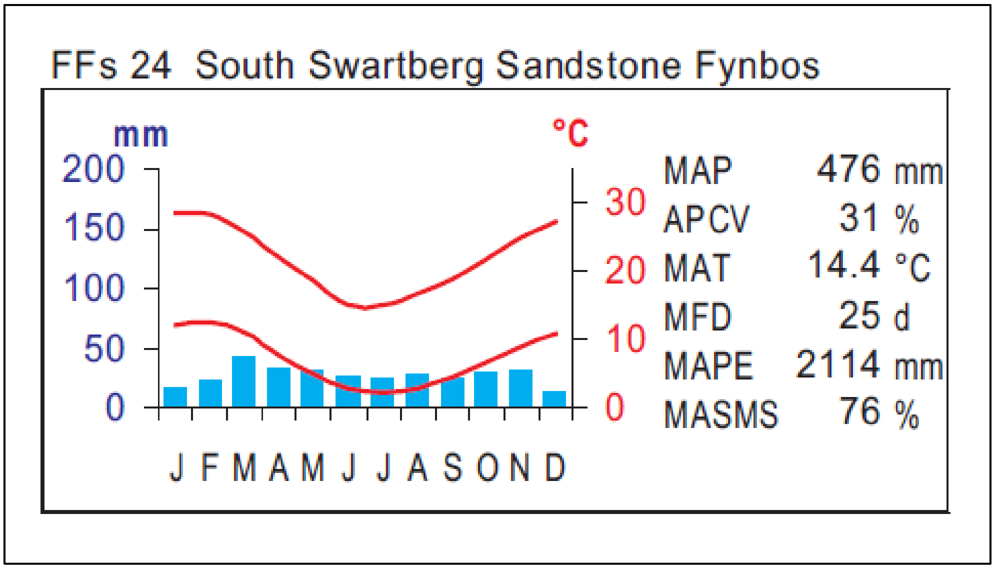

Figure 6. Climate diagram of the South Swartberg Sandstone Fynbos ecosystem. Blue bars show the median monthly precipitation. The upper and lower red lines show the mean daily maximum and minimum temperature respectively. MAP: Mean Annual Precipitation; APCV: Annual Precipitation Coefficient of Variation; MAT: Mean Annual Temperature; MFD: Mean Frost Days (days when screen temperature was below 0˚C); MAPE: Mean Annual Potential Evaporation; MASMS: Mean Annual Soil Moisture Stress (% of days when evaporative demand was more than double the soil moisture supply) (Rebelo *et al.* in Mucina & Rutherford, 2006).

4. Evaluation Method

The initial site visits were carried out on 19 and 20 September 2016. A site meeting was held on 26 October 2016. The vegetation was surveyed on foot at each of the 27 sites. Sample waypoints were recorded to evaluate the ecological condition and to map each habitat type. Waypoints were logged with a Garmin GPSmap 60CSx. Sample photographs were georeferenced. The sensitivity of the sites was determined using the following criteria:

- *Ecological condition*: this is the actual condition of the various habitats, which considers (1) quality of the vegetation; (2) species composition; (3) disturbance regime; (4) degree of intactness; (5) the spatial connectivity of the site with adjoining habitats; (6) and non-botanical elements that form part of the broader biodiversity picture and that inform to what degree the botanical component supports biodiversity.

- *Ecosystem status:* informed by the list of Threatened Terrestrial Ecosystems in South Africa (Government Gazette, 2011). The ecosystems are based on the vegetation types in *The Vegetation of South Africa, Lesotho and Swaziland* (Mucina & Rutherford, 2006).
- *Biodiversity planning*: The Western Cape Biodiversity Framework (WCBF) (Pence, 2014), with specific reference to the Central Karoo District Municipality and Kannaland_Oudshoorn Municipality, is the most up to date biodiversity plan, that indicates where Critical Biodiversity Areas (CBAs), Ecological Support Areas (ESAs), Mountain Catchment Areas (MCAs) and Protected Areas (PAs) have been assigned. The shapefiles of WCBF were obtained from Biodiversity GIS (bgis.sanbi.org).
- *Important species*: the presence or absence of threatened (i.e. Red List) and ecologically important species informs the ecological condition and sensitivity of the sites and affected area as a whole.
- *Botanical literature*: These were used to gain a better local contextual understanding of the botanical importance of the site.

5. Limitations and assumptions

The timing of botanical surveys is often an important factor in determining the sensitivity of a site since most geophytic flora are only visible during the spring flowering period, which varies according to region. The spring period in the Fynbos Biome extends into to the later months of the year with increasing proximity toward the east (Port Elizabeth). At Seweweekspoort, specifically the affected areas, the determination of vegetation sensitivity is not dependent on geophytic flora since perennial species are dominant. The timing of the survey was thus not a limiting factor.

All sites except two (KM54.10 and KM54.40) are located at the existing crossings. Since it was part of the scope of the study to determine where deviations could potentially be aligned (i.e. either left-or right-hand-side) the area of study was defined by surveying the vegetation on both sides of the road on either side of the crossing. The distance from the crossings was defined according to an assumption of the potential alignment route required for each deviation during the initial site visit. This was determined with a high level of accuracy during the site meeting with the assistance of the engineering team.

6. The Vegetation

6.1 General description

According to *The Vegetation Map of South Africa, Lesotho and Swaziland* (VEGMAP) (Mucina, Rutherford and Powrie, 2009) the study area passes through four vegetaion types. They include (1) North Swartberg Sandstone Fynbos, (2) Central Inland Shale Band Vegetation, (3) South Swartberg Sandstone Fynbos, and (4) Montagu Shale Renosterveld (Figure 7). The major portion of the route is classified as South Swartberg Sandstone Fynbos where the pass traveses the Swartberg Mountains. The northern end of the pass is classified as North Swartberg Sandstone Fynbos. Where the road exits the poort at the soutnern end, the vegetation grades into Montagu Shale Renosterveld. The transition between South Swartberg Sandstone Fynbos and North Swartberg Sandstone Fynbos is defined by the narrowly distributed Central Inland Shaleband Vegetation.

An additional azonal vegetaion type not mapped in the VEGMAP but of importance to the study area is Fynbos Riparian Vegetation. The vegetaion type is associated with wetland systems; in this instance along the river channels, where the aforementioned terrestrial vegetation types and riverine vegetaion merges. Note in addition that the description in Table 1 mentions palmiet (*Prionium serratum*) as a defining species, however, there is no other description available that most closely resembles the riverine habitats within the study area apart from that of Rebelo *et al.* (2006 in Mucina & Rutherford, 2006).

6.1.1. Conservation status and Biodiversity Plans

Of the five vegetation types occurring within the study area, none are classified as threatened (Table 1). All of the vegetation types apart from Montagu Shale Renosterveld (61.94% natural area remaining) are extremely well-protected in nature reserves. Fynbos Riparian Vegetation is not listed in the list of Threatened Terrestrial Ecosystems in South Africa (Government Gazette, 2011) but is well protected according to Rebelo *et al.* (2006 in Mucina & Rutherford, 2006).

<u>The entire study area is of very high conservation importance</u> for the following reasons:

1. The Western Cape Biodiversity Framework assigns a portion of the southern end and a small portion at the northern end of the study area as Critical Biodiversity Areas (CBA) and Ecological Support Areas (ESA) (Figure 8).
2. A significant proportion of the study area falls within a formally protected area.
3. The remaining area (middle and southern section) is a Mountain Catchment Area (MCA).

Table 1. Vegetation and landscape descriptions, ecosystem and habitat conservation status.

Vegetation type	^Landscape Features & Vegetation Description	*Ecosystem status	*Ecosystem Protection level	*Percentage of vegetation type remaining intact	*Total area Formally Protected
North Swartberg Sandstone Fynbos	Steep to very steep, mostly north-facing slopes, deeply dissected in parts. East-west-trending rugged mountain ranges. Structurally this is mainly asteraceous, proteoid and restioid fynbos; graminoid fynbos rare.	Least Threatened	Well-protected	97.38%	61570ha
Central Inland Shale Band Vegetation	A narrow 8—200 m (wider in places), linear, smooth and flat feature of high altitude slopes or mountain ridges. Vegetation diverse, from karoo shrublands at lower altitudes, to renosterveld and fynbos shrublands. Fynbos includes all structural types, including graminoid fynbos, and usually waboomveld and asteraceous fynbos at lowest altitudes.	Least Threatened	Well-protected	98.95%	6803ha
South Swartberg Sandstone Fynbos	Steep, very steep and precipitous south-facing slopes, deeply dissected in parts, of rugged mountain ranges. Vegetation is a medium tall shrubland and heathland. Proteoid and restioid fynbos dominate, with ericaceous fynbos at higher altitudes and scrub fynbos at lower altitudes.	Least Threatened	Well-protected	98.51%	50189ha
Montagu Shale Renosterveld	Undulating hilly landscape with broad valleys supporting open, tall shrubland in a medium dense matrix of short, divaricate shrubs, dominated by renosterbos. Transitions with Succulent Karoo units can be observed at lower altitudes.	Least Threatened (previously VULNERABLE)	Poorly-protected	61.94%	3909ha
Fynbos Riparian Vegetation	Narrow, flat or slightly sloping alluvial flats supporting a complex of reed beds dominated by	Not applicable	Not applicable	98.06	1374ha

*CapeNature (2013)

^Extracted from Rebelo *et al.* in Mucina & Rutherford, 2006)

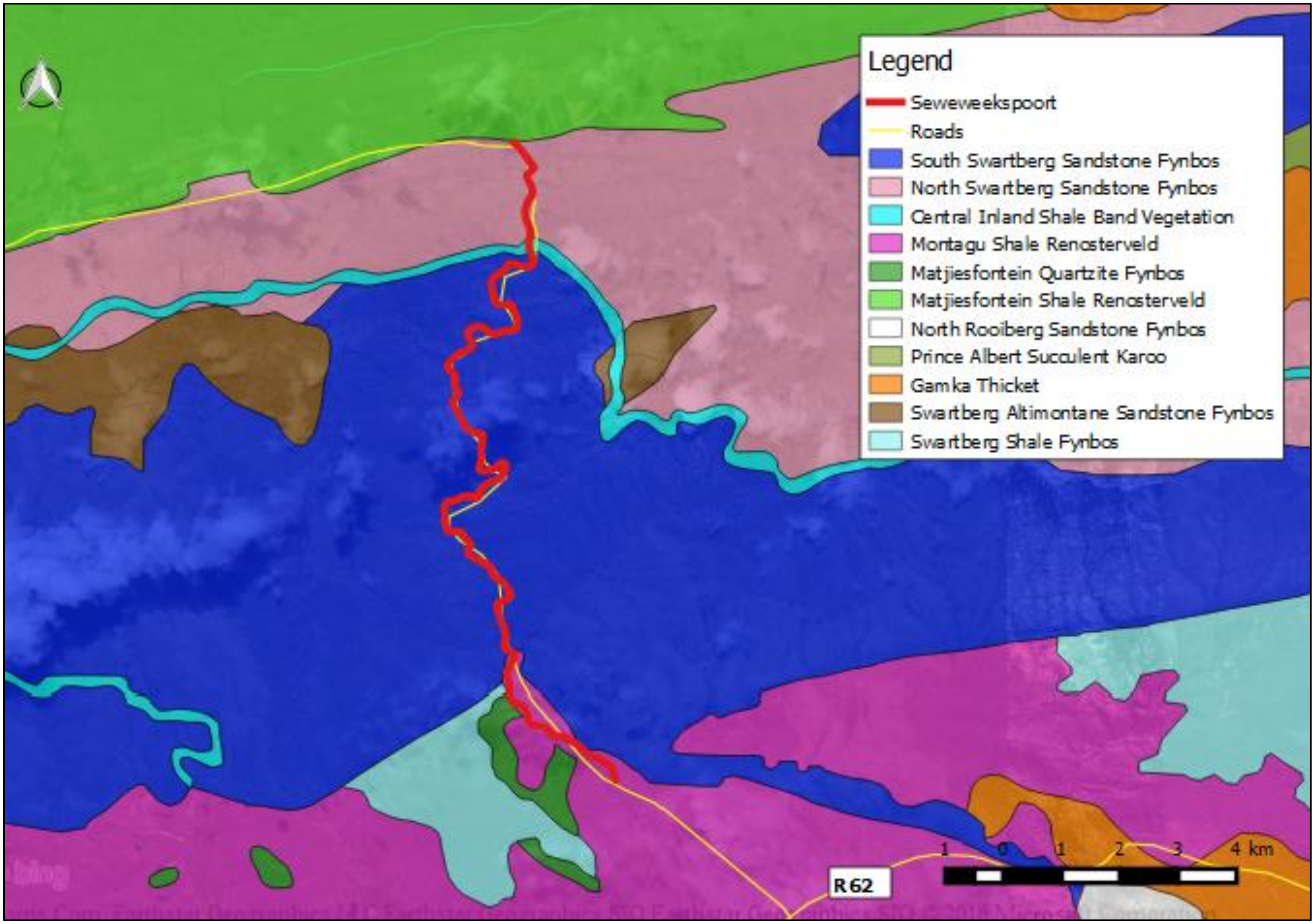

Figure 7. Vegetation Map: The study area superimposed on a portion of *The Vegetation Map of South Africa, Lesotho and Swaziland* (Mucina, Rutherford and Powrie, 2012).

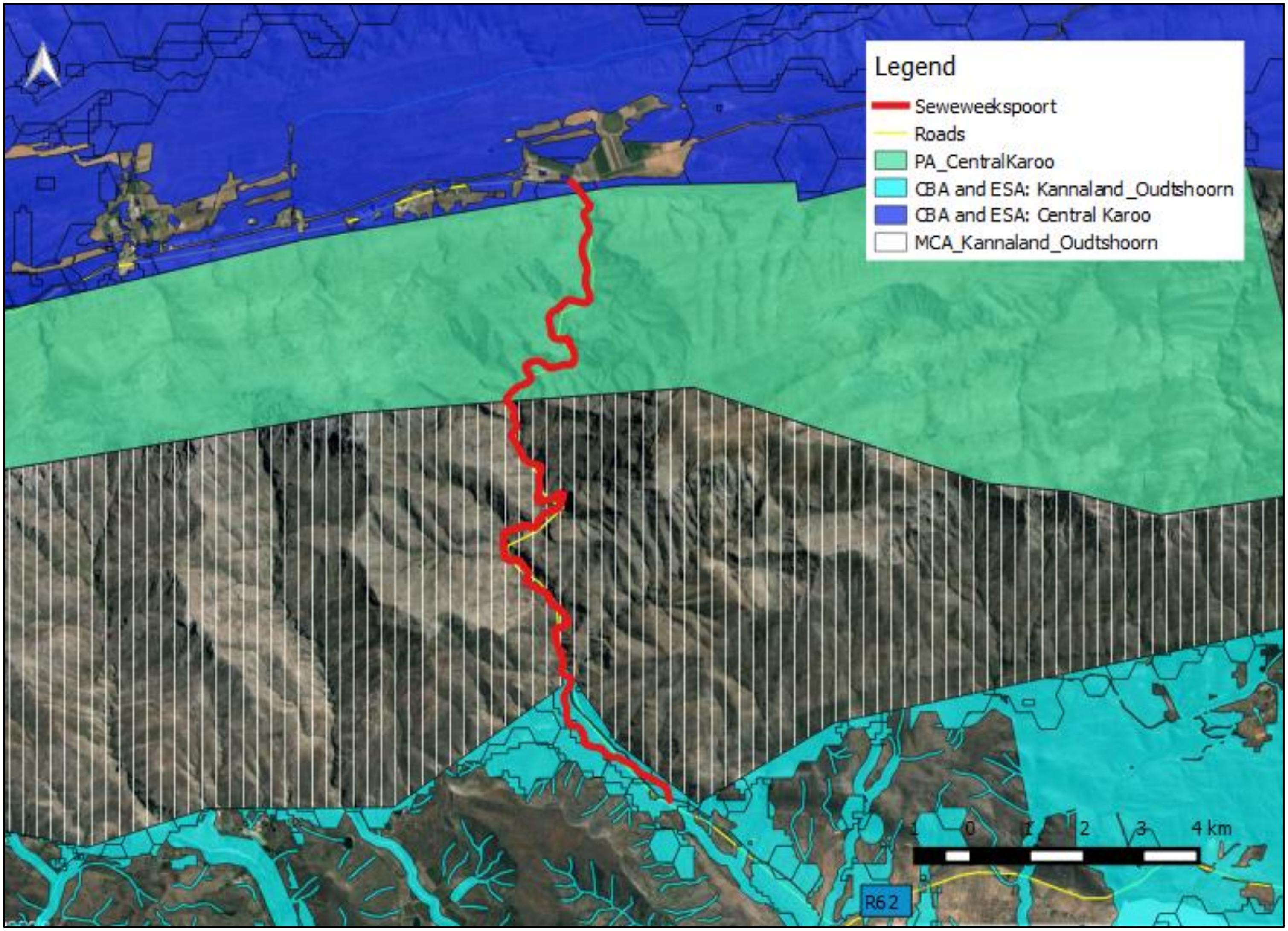

Figure 8. Biodiversity Planning Map: The study area in relation to the Western Cape Biodiversity Framework of the Central Karoo District Municipality and Kannaland-Oudshoorn Municipality showing (a) combined Critical Biodiversity Areas (CBA) and Ecological Support Areas (ESA), (b) Mountain Catchment Areas (MCA) and (c) Protected Areas (PA) (Pence, 2014a).

6.2. The vegetation of the study area

Detailed descriptions of each site is provided in Tabular format below. The structures and proposed scope of works is briefly described at each kilometre road marking (e.g. KM40.9). At each site the dominant plant species are listed since these form the plant communities. This information is presented from the starting point at KM40.9 to the end point at KM58.1. The roadsides are referred to when travelling from start to end point (north to south) as left hand side (LHS) and right hand side (RHS) whereas either side of the river crossing is either referred to as the north side (side closest to the starting point) or south side (side closest to the end point).

Note that the affected habitats for the proposed structure/upgrades at the existing casueways includes the streams, which contain plant communities of (1) midstream, (2) riparian and (3) terrestrial habitats. The riparian and terrestrial habitats often merge, meaning that the vegetation descriptions do not necessarily inlclude a 'clear cut' distinction between the community complex. Midstream communities are dominated by *Isolepis* species, with dominant rushes and sedges occuring along the edges. These include *Juncus cephalotes, Juncus capensis* and *Carpha glomerata*. Where these are mentioned in the descriptions below it should be assumed that they occur within the midtream habitats.

Illustrations	**Affected area**
 **Figure 9.1.** Waypoint 001 (33° 21 '41.05" S; 21° 24' 34.36" E). North side of crossing on RHS (looking east).  **Figure 9.2.** Waypoint 003 (33°21'41.13"S; 21°24'35.55"E). South side of crossing on LHS (looking west).	**KM40.9** **Crossing** River crossing dominated by common reed (*Phragmites australis*) on both sides of the road and crossing. Other dominants include *Cliffortia strobilifera, Elytropappus rhinocerotis, Juncus effusus, Conyza scabrida*, and several weeds and grasses in disturbed area. Additional species include *Lessertia frutescens, Acacia mearnsii* (invasive), *Erica* sp., *Plantago lanceolata* (weed). The RHS is more disturbed than the LHS, specifically on the north side of the crossing at waypoint 001 (Figure 9.1).

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Figure 9.3. North side of crossing on RHS (looking east).


Figure 9.4. LHS (looking east).
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KM44.1
Crossing

RHS: On the RHS of the road a streamlet runs parallel to and within 1m of the road edge. The habitat supports intact wetland/dryland mosaic, with the riparian habitat supporting stands of the riverine tree Brachylaena neriifolia. The species burnt in a recent fire and is currently regenerating (resprouting). The trees will only regain their original height in several years’ time. The dead branches of Brachylaena neriifolia are visible in the background of Figure 9.3. The vegetation is very dense and dominated by Ehrharta ramosa., Phragmites australis, Psoralea cf. affinis, Osteospermum moniliferum, Pelargonium glutinosum and Juncus cephalotes.

LHS: The LHS is dominated by similar species and ecological condition (i.e. intact) as the RHS but does not contain a streamlet next to the roadside. Dominant species include Cliffortia strobilifera, Ehrharta ramosa, Elytropappus rhinocerotis, Mentha longifolia, Osteospermum moniliferum, Othonna parviflora, Pennisetum macrourum and Pelargonium glutinosum.
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Illustrations	Affected area
 **Figure 9.5.** RHS (looking downstream).  **Figure 9.6.** LHS (looking downstream).	**KM44.3** **Crossing** RHS: Intact riparian vegetation dominated by *Phragmites australis, Calopsis paniculata, Ehrharta ramosa, Osteospermum moniliferum, Othonna parviflora, Searsia lucida.* The terrestrial communities are dominated by *Osyris compressa and Buddleja salvifolia,* with *Aloe ferox* occurring in places. LHS: Dominated by *Calopsis paniculata, Phragmites australis, Psoralea affinis*, *Cliffortia strobilifera, Ehrharta ramosa*, and *Searsia lucida*. Additional species include *Osteospermum moniliferum*, *Pelargonium glutinosum, Phylica sp.* and *Lobostemon stachydeus.* Midstream habitat: Dominated by *Gunnera perpensa* (DECLINING), *Isolepis* sp., *Juncus cephalotes, Juncus capensis, Juncus effusus, Mentha longifolia* and *Carpha glomerata.*

Illustrations	**Affected area**
 **Figure 9.7.** RHS (looking downstream).  **Figure 9.8.** LHS (looking downstream).	**KM44.5** **Crossing** RHS: Previously disturbed road edge with intact riparian vegetation dominated by *Calopsis paniculata, Carpha glomerata, Ehrharta* sp*., Othonna parviflora, Pelargonium glutinosum, Psoralea affinis, Searsia lucida* and *Eragrostis* sp*.* Additional species include *Brachylaena neriifolia, Osteospermum moniliferum* and *Zantedeschia aethiopica.* LHS: Previously disturbed road edge with lower vegetation cover and several large boulders on the south side of the crossing. Dominant species include *Buddleja salvifolia, Calopsis paniculata, Juncus effusus* and *Ehrharta ramosa* Additional species include *Erica caffra, Morella serrata, Searsia lucida* and *Salix mucronata*. Note: previous disturbance is due to past flood damage and piling of flood alluvium along the road edge. Disturbance has led to the invasive feather top grass (*Pennisetum setaceum*) colonizing the road edge.

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Figure 9.9. RHS (looking downstream).


Figure 9.10. LHS (looking downstream).
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KM44.7
Crossing

RHS: The north side of the crossing is disturbed within 2-3m of the road edge. Dominant species include Cliffortia strobilifera, Eragrostis chloromelas, Juncus lomatophyllus, Mentha longifolia, Pelargonium crispum, Pennisetum macrourum and Othonna parviflora. Additional species include Anthospermum aethiopicum, Carpha glomerata and Pelargonium glutinosum. Large shrubs and trees, including Salix mucronata and Dodonaea angustifolia occur on the south side of the crossing.

LHS: Dominant species include Buddleja salvifolia, Eragrostis sp., Eragrostis chloromelas, Juncus effusus, Osteospermum moniliferum and Carpha glomerata. Additional species include Dodonaea angustifolia, Othonna parviflora and mature Cape willow (Salix mucronata) at waypoint 023 (33°23'8.13"S; 21°24'22.00"E). Large plants of Diospyros dichrophylla and Aloe ferox occur at waypoint 026 (33°23'8.50"S; 21°24'22.53"E).
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Figure 9.11. RHS (looking downstream).

Figure 9.12. LHS (looking downstream).</td><td>KM445.05
Crossing

RHS: Dominant species include Anthospermum aethiopicum, Calopsis paniculata, Cliffortia strobilifera, Morella serrata, Phylica sp. and Stoebe sp. The instream communities include Gunnera perpensa (DECLINING), Phragmites australis and Isolepis sp.

LHS: Dominant species include Cliffortia strobilifera Eragrostis sp., Morella serrata, Osteospermum moniliferum, Psoralea affinis and Phragmites australis. Additional species include Diospyros dichrophylla, Othonna parviflora and Searsia lucida.</td></tr>
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<tr><td>
Figure 9.13. RHS (looking north).

Figure 9.14. LHS (looking downstream).</td><td>KM45.1
Crossing

RHS: The habitat is characterized by high numbers of Brachylaena neriifolia on the south and north sides of the crossing (Figure 9.13). Other dominants include Anthospermum aethiopicum, Calopsis paniculata, Othonna parviflora and Searsia lucida.

LHS: Dominant species include Osteospermum moniliferum, Othonna parviflora Phragmites australis and Searsia lucida.</td></tr>
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<tr><th>Illustrations</th><th>Affected area</th></tr>
<tr><td>


Figure 9.15. RHS (looking downstream).

Figure 9.16. LHS (looking downstream).
</td><td>
KM45.5
Crossing

RHS: Crossing at side tributary previously disturbed and dominated by Cyperus textilis, Diospyros dichrophylla, Othonna parviflora, Osteospermum moniliferum, Nemesia fruticans and Searsia lucida. The invasive common thorn apple (Datura stramonium) occurs along the road edge.

LHS: Dominant species include Eragrostis sp., Othonna parviflora and Searsia lucida. Several large Aloe ferox trees occur at waypoint 047 (33°23'24.32"S; 21°24'38.39"E). A large rock candlewood (Maytenus oleoides) occurs at waypoint 048 (33°23'24.67"S; 21°24'38.27"E). Piles of flood alluvium occur on the north side of the crossing within the vegetation. Several plants of Anginon difforme occur in these rocky areas.
</td></tr>
</table>

Illustrations	**Affected area**
 **Figure 9.17.** RHS (looking downstream).  **Figure 9.18.** LHS (looking downstream).	**KM45.97** **Crossing** RHS: Intact riverine vegetation dominated by *Gunnera perpensa* (DECLINING)*, Juncus capensis, Juncus cephalotes* and *Isolepis* sp. The road edge is disturbed and dominated by *Eragrostis* sp., *Cirsium vulgare* (invasive weed), *Othonna parviflora*, *Rubus* sp. (invasive weed) and *Stoebe* sp. Additional species include *Artotheca calendula*, *Carpobrotus* sp. and *Lobostemon stachydeus.* LHS: The same instream species occur on the LHS of the crossing with the addition of a single *Salix mucronata* tree. Dominant terrestrial species include *Elytropappus rhinocerotis, Othonna parviflora*, *Searsia lucida* and *Stoebe* sp. Additional species include *Oedera squarrosa* and *Osteospermum moniliferum*.

Illustrations	Affected area
 **Figure 9.19.** RHS (looking downstream).	**KM46.35** **Crossing** RHS: The river crossing is concrete and clear of riverine vegetation along the edges. A large *Maytenus oleoides* tree occurs on the south side of the road and may need to be removed for the proposed structure upgrade. An effort should, however, be made to protect the tree. The dominant terrestrial species on either side of the crossing include *Diospyros dichrophylla, Othonna parviflora* and *Searsia lucida.* Additional species include *Crassula rupestris* and *Crassula* cf. *arborescens.* LHS: Narrow crossing will dense terrestrial vegetation along the road edge on either side of the crossing. Dominant species include *Diospyros dichrophylla* and *Searsia lucida*. Additional species include *Asparagus* sp., *Elytropappus rhinocerotis, Eragrostis* cf. *namaquensis, Osteospermum moniliferum, Osyris compressa* and *Phylica* sp.

Illustrations	**Affected area**
 **Figure 9.20.** RHS (looking downstream).  **Figure 9.21.** LHS (looking downstream).	**KM46.5** **Crossing** RHS: Paved area with a large Cape willow (*Salix mucronata*) tree on the south side of the crossing. The terrestrial habitat on either side of the crossing is dominated by dense vegetation with *Diospyros dichrophylla, Eragrostis* sp., *Othonna parviflora, Osteospermum moniliferum, Osyris compressa, Phylica* sp. and *Searsia lucida*. Additional species include *Brachylaena neriifolia, Dodonaea angustifolia, Juncus effusus* and *Pelargonium* sp. The instream communities are dominated by *Erica caffra, Gunnera perpensa, Juncus capensis, Juncus cephalotes, Isolepis* sp. and *Mentha longifolia.* LHS: The same instream species occur on the LHS of the crossing. Dominant riparian species include *Diospyros dichrophylla, Dodonaea angustifolia, Osyris compressa, Calopsis paniculata* and *Searsia lucida*.

<table>
<tr><th>Illustrations</th><th>Affected area</th></tr>
<tr><td>
Figure 9.22. RHS (looking downstream).


Figure 9.23. LHS (looking downstream).</td><td>KM46.7
Crossing

RHS: Previously disturbed riparian habitat with a young Cape willow (Salix mucronata) tree occurring in the river channel. Dominant dryland species on either side of the crossing include Diospyros dichrophylla, Eragrostis sp., Psoralea affinis, Searsia lucida and Stoebe sp.

LHS: Previously disturbed 2.5m high cut-away occurs on the north side of the crossing. Dominant species occurring on either side of the crossing include Diospyros dichrophylla, Othonna parviflora, Osteospermum moniliferum and Searsia lucida. Additional species include Brachylaena neriifolia, Dodonaea angustifolia, Maytenus oleoides, Oedera squarrosa. The riparian and instream communities are characterized by Brachylaena neriifolia, Juncus cephalotes, Isolepis sp., Psoralea affinis and Phragmites australis.</td></tr>
</table>

Illustrations	**Affected area**
 **Figure 9.24.** RHS.  **Figure 9.25.** LHS (looking downstream).	**KM48** **Crossing** RHS: Dense vegetation occurs along the edge of the road (terrestrial habitat) whereas the side tributary does not support any riparian vegetation on the steep banks. Dominant shrubs along the road occurring on either side of the crossing include *Anthospermum aethiopicum, Dodonaea angustifolia, Osteospermum moniliferum, Othonna parviflora* and *Searsia lucida.* Additional species include *Diospyros glabra* and *Maytenus oleoides*. LHS: The side tributary and steep river bank does not support any riparian vegetation. The roadside vegetation is dominated by *Diospyros glabra, Phylica* sp., *Pteridium aquilinum* and *Searsia lucida.* Additional species include *Aloe ferox, Osyris compressa* and *Osteospermum moniliferum*.

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Figure 9.26. RHS (looking downstream).

Figure 9.27. LHS (looking upstream).
</td><td>
KM50.1
Crossing

RHS: Narrow section of the poort supporting several Cape willow (Salix mucronata) trees within 2-4 m of the existing crossing. The river supports a number of established riverine trees including Cape holly (Ilex mitis) and Brachylaena neriifolia, with terrestrial trees including Aloe ferox and Cussonia paniculata. Several large bergkiepersol (Cussonia paniculata) occur on the north side of the crossing close to the road.

LHS: Dense riparian vegetation occurs within about 4m from the road edge, with a large Cape holly (Ilex mitis) occurring about 6m upstream (i.e. from the crossing). The dominant species along the stream is Calopsis paniculata. Dominant species associated with the dryland habitats include Aloe ferox, Buddleja salvifolia, Calopsis paniculata, Diospyros glabra, Diospyros dichrophylla, Eragrostis cf. namaquensis, Othonna parviflora, Pelargonium glutinosum, Phylica sp. and Searsia lucida.
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<tr><th>Illustrations</th><th>Affected area</th></tr>
<tr><td>
Figure 9.28. RHS (looking downstream).

Figure 9.29. LHS (looking downstream).</td><td>KM50.3
Crossing

RHS: Dense, tall vegetation occurs on along the road edge, with the riparian habitat dominated by Buddleja salvifolia, Calopsis paniculata and Searsia lucida. The dominant terrestrial species include Diospyros dichrophylla, Dodonaea angustifolia, Eragrostis cf. namaquensis, Gymnosporia buxifolia and several large bergkiepersol (Cussonia paniculata) trees.

LHS: The terrestrial habitat along the road on either side of the crossing includes dominants such as Aloe ferox, Cussonia paniculata, Dodonaea angustifolia, Pelargonium glutinosum and Searsia lucida. The riparian habitat is dominated by Calopsis paniculata, with instream species including Isolepis sp. and Juncus cephalotes.</td></tr>
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<tr><th>Illustrations</th><th>Affected area</th></tr>
<tr><td>
Figure 9.30. RHS (looking downstream).

Figure 9.31. LHS (looking downstream).</td><td>KM50.8
Crossing

RHS: Intact riparian vegetation dominated by Brachylaena neriifolia, Diospyros dichrophylla, Pelargonium glutinosum, and Searsia lucida. Additional cover includes Cliffortia ruscifolia, Halleria lucida and Peucedanum sp. Mature bergkiepersol (Cussonia paniculata) trees occurs close to the road edge on the north side of the crossing.

LHS: A small stream runs parallel to the road where a narrow band of dense riparian vegetation occurs between the road and stream on the north side of the crossing. The habitat on the opposite side of the stream also comprise dense riparian vegetation. Dominant species include in the riparian and terrestrial mosaic on both sides of the crossing include Aloe ferox, Buddleja salvifolia, Calopsis paniculata, Cliffortia strobilifera, Diospyros dichrophylla, Othonna parviflora, Virgilia divaricata. A mature bergkiepersol (Cussonia paniculata) tree occurs at waypoint 114. Groups of Aloe ferox occur at waypoint 111, 112 and 113. Plants of black wattle (Acacia mearnsii) were recorded on the south side of the crossing.</td></tr>
</table>

Illustrations	**Affected area**
 **Figure 9.32.** RHS (looking downstream).  **Figure 9.33.** LHS (looking downstream).	**KM51.10** **Crossing** RHS: Previously disturbed roadside on either side of the road crossing with intact riparian vegetation. Dominant species include *Artotheca calendula, Brachylaena neriifolia, Calopsis paniculata, Diospyros dichrophylla, Eragrostis sp., Freylinia lanceolata, Hyparhenia hirta, Psoralea affinis* and *Searsia lucida.* Additional species include *Buddleja salvifolia, Cliffortia ruscifolia, Othonna parviflora* and *Pelargonium glutinosum.* LHS: The road side is heavily disturbed on the south side of the crossing next to the road where rocks have been piled. The road edge supports dominants such as *Anginon difforme, Calopsis paniculata, Brachylaena neriifolia, Hyparrhenia hirta, Pelargonium glutinosum, Phylica* sp. and *Stoebe* sp. The dominant instream species include *Isolepis* sp. and *Mentha longifolia.*

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<tr><th>Illustrations</th><th>Affected area</th></tr>
<tr><td>
Figure 9.34. RHS (looking downstream).


Figure 9.35. LHS (looking downstream).</td><td>KM51.6
Crossing

RHS: Intact, dense riparian thicket with keurboom (Virgilia divaricata), Calopsis paniculata Diospyros dichrophylla, Diospyros glabra and Pelargonium glutinosum. On the south side of the crossing approximately ten mature Aloe ferox plants occur in the terrestrial habitat. Additional species include Othonna parviflora, Pelargonium cf. zonale and Zantedeschia aethiopica.

LHS: A side stream that runs parallel to the road, is line with mature Cape willow (Salix mucronata) trees, forming the dominant cover. Additional species include Diospyros dichrophylla, Lobostemon stachydeus, Pelargonium cf. zonale and Nemesia fruticans (along the road edge).

Sensitivity rating = High</td></tr>
</table>

Illustrations	**Affected area**
 **Figure 9.36.** RHS (looking downstream).  **Figure 9.37.** LHS (looking downstream).	**KM52.0** **Crossing** RHS: The roadside is previously disturbed but the riparian habitat is intact and comprises of dense vegetation. The intact terrestrial habitat is several metres from the road edge. Dominant species include, *Freylinia lanceolata, Pelargonium zonale*, *Salix mucronata* and *Virgilia divaricata*. The instream species include *Isolepis* sp. and *Mentha longifolia*. LHS: Intact, dense riparian and terrestrial vegetation thicket vegetation dominated by *Brachylaena neriifolia, Buddleja salvifolia, Calopsis paniculata, Diospyros dichrophylla, Gymnosporia buxifolia, Phylica* sp.*, Psoralea affinis* and *Searsia lucida.* Approximately 20 mature *Aloe ferox* plants occur in the terrestrial habitat on the south side of the crossing. Sensitivity rating = High

Illustrations	**Affected area**
 **Figure 9.38.** RHS (looking upstream).  **Figure 9.39.** LHS (looking downstream).	**KM53.2** **Crossing** RHS: Intact, dense riparian and terrestrial mosaic vegetation dominated by *Calopsis paniculata, Diospyros dichrophylla and Searsia lucida*. A mature Cape holly (*Ilex mitis*) tree occurs near waypoint 156 (33°25'35.52"S; 21°24'15.50"E). LHS: Intact, dense riparian and terrestrial mosaic vegetation dominated by *Calopsis paniculata, Freylinia lanceolata, Maytenus oleoides* and *Searsia lucida.* A mature Cape holly tree occurs on the north side of the crossing near waypoint 151 (33°25'35.75"S; 21°24'16.80"E). The south side of the crossings is disturbed next to the road. Sensitivity rating = High

Illustrations	Affected area
 **Figure 9.40.** RHS (looking downstream).  **Figure 9.41.** LHS (looking downstream).	**KM53.4** **Crossing** RHS: Disturbed and cleared vegetation occurs within 4 to 6m of the road edge and crossing. Intact vegetation occurs beyond this distance and occurs closer to the road with increasing distance away from the crossing on either direction (south and north). Dominant species in the intact vegetation include *Freylinia lanceolata, Maytenus oleoides, Pterocelastrus tricuspidatus, Searsia* sp. and *Searsia lucida.* LHS: A similar disturbance distance to the RHS, with cleared area spanning 2 to 4 m near the crossing and narrowing with distance form the form the crossing on either side of the river. Dominant species include *Buddleja salvifolia, Diospyros dichrophylla, Eragrostis* sp*., Freylinia lanceolata, Psoralea affinis, Searsia* sp. and *Virgilia divaricata.*

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<tr><td>


Figure 9.42. RHS (looking downstream).

Figure 9.43. LHS (looking downstream).
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KM53.5
Crossing

RHS: intact, dense riparian and terrestrial vegetation dominated by Buddleja salvifolia, Diospyros dichrophylla, Freylinia lanceolata, Osyris compress, Pelargonium zonale, Searsia lucida and Searsia sp..

Sensitivity rating = High

LHS: Disturbed roadside with riparian vegetation occurring within 5m of the crossing. Dominant species in the riparian habitat include Calopsis paniculata, Eragrostis sp., Freylinia lanceolata, Pelargonium glutinosum, Searsia lucida and Virgilia divaricata. Additional species include Othonna parviflora, Psoralea affinis and Scirpoides thunbergii.

Sensitivity rating = High
</td></tr>
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<tr><td>


Figure 9.44. RHS (looking downstream).

Figure 9.45. LHS (looking downstream).
</td><td>
KM53.8
Proposed retaining wall

The proposed retaining wall would be aligned next to the left-hand-side road edge. The area within about 6 m of the road edge is mostly disturbed along the 100 m length of the proposed structure. Recently burnt riparian vegetation occurs along the parallel river channel further than 6m from the road edge. A large Cape willow that was killed by fire occurs within 3m of the road edge at waypoint 174 (33°25'50.37"S; 21°24'31.77"E).

The riparian vegetation is dominated by Cape willow and Freylinia lanceolata whereas the disturbed areas are covered with grasses and pioneer species such as Eragrostis sp., Hyparrhenia hirta, Stoebe sp., Nemesia fruticosa and Pelargonium glutinosum.
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</table>

Illustrations	Affected area
 **Figure 9.46.** RHS (looking downstream).  **Figure 9.47.** LHS (looking downstream).	**KM54.1** **Crossing** RHS: The crossing is located next to a picnic site access road. The riparian terrestrial vegetation on either side of the access road comprises thicket dominated by *Diospyros dichrophylla, Gymnosporia buxifolia, Osyris compressa, Maytenus oleoides* and *Searsia* sp.. Additional species include *Aloe ferox.* The riparian vegetation is intact and dominated by *Brachylaena neriifolia, Calopsis paniculata, Cliffortia strobilifera, Cussonia paniculata* and *Maytenus oleoides.* Sensitivity rating = High RHS: Dense terrestrial and riparian vegetation occur on the north side of the crossing, dominated by *Aloe ferox, Calopsis paniculata, Cussonia paniculata, Dodonaea angustifolia, Freylinia lanceolata* and *Maytenus oleoides.* Sensitivity rating = High

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<tr><th>Illustrations</th><th>Affected area</th></tr>
<tr><td>
Figure 9.48. RHS (looking downstream).

Figure 9.49. LHS (looking downstream).</td><td>KM54.3
Crossing

RHS: Dominated by Calopsis paniculata, Dodonaea angustifolia, Freylinia lanceolata, Searsia lucida, Searsia sp. and Virgilia divaricata. A mature rock candlewood (Maytenus oleoides) occurs on the south side of the crossing in the terrestrial habitat.

Sensitivity rating = High

RHS: Riparian and terrestrial habitat mosaic dominated by Brachylaena neriifolia, Calopsis paniculata, Conyza sp., Diospyros dichrophylla, Pteridium aquilinum, Psoralea sp., Freylinia lanceolata, Searsia lucida and Virgilia divaricata.

Sensitivity rating = High</td></tr>
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<tr><th>Illustrations</th><th>Affected area</th></tr>
<tr><td>


Figure 9.50. LHS (looking downstream).

Figure 9.51. LHS (looking downstream).

Figure 9.52. LHS (looking downstream).
</td><td>
KM54.4

Proposed 350m retaining wall

The proposed retaining wall is on the LHS of the road in close proximity to the road between the road and river channel that runs parallel to the road. The river channel supports intact riverine thicket with dominants including Brachylaena neriifolia, Buddleja salvifolia, Calopsis paniculata, Cliffortia strobilifera, Cussonia paniculata, Diospyros dichrophylla, Dodonaea angustifolia, Freylinia lanceolata, Gymnosporia buxifolia, Osyris compressa, Pelargonium glutinosum, Pelargonium zonale, Psoralea affinis, Pterocelastrus tricuspidatus, Searsia lucida, Searsia sp. and Virgilia divaricata.

A mature Cape holy (Ilex mitis) tree occurs close to the road at waypoint 201 (33°26'5.44"S; 21°24'25.35"E).

Sensitivity rating = Very High
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<tr><td>


Figure 9.52. LHS (looking downstream).

Figure 9.53. LHS (looking downstream).
</td><td>
KM57.1
Crossing

LHS: Disturbed roadside vegetation dominated by weeds and disturbance-associated indigenous grasses, annuals and perennials, with high number of juvenile sweet thorn (Acacia karoo) indicating that the area is naturally recovering but subjected to flooding events. Clumps of shrubs with Acacia karoo, Gymnosporia buxifolia, Searsia sp. and Searsia lucida occur at waypoint 207 (33°27'13.66"S; 21°25'15.46"E). A well-defined patch of river grass (Pennisetum macrourum) occur at waypoint 208 (33°27'13.50"S; 21°25'15.90"E) in the lower floodplain.

RHS: The same disturbance regime and array of species occur occurs on the LHS, with tall terrestrial thicket occurring on the south side of the crossing. The thicket is dominated by large trees/shrubs of Acacia karoo, Olea europaea subsp. africana, Freylinia lanceolata, Gymnosporia buxifolia and Searsia sp.

Sensitivity rating = High
</td></tr>
</table>

Illustrations	**Affected area**
 **Figure 9.54.** RHS (looking downstream).  **Figure 9.55.** LHS (looking upstream).	**KM58.1** **Crossing** RHS: Highly degraded roadside vegetation dominated by weeds and disturbance-associated indigenous species. The riparian vegetation is intact and dominated by a dense cover of *Freylinia lanceolata* and *Salix mucronata*. LHS: The same disturbance regime as the RHS is found on this side. Riparian vegetation includes dense cover of *Freylinia lanceolata* and *Gymnosporia buxifolia*. Sensitivity rating = High

7. Impact Assessment

The impact assessment is a measure of the impacts likely to occur on the affected environment, specifically the vegetation, ecological processes, important species and habitats. They are considered for the following:

Alternative 1: The ‘No Go’ scenario, where the *status quo* remains.

Alternative 2: The preferred alternative of undertaking the structure upgrades. The assessment includes Deviation Route Alternative A (preferred deviation route) and Deviation Route Alternative B (the least preferred deviation). The direct, indirect and cumulative impacts are considered for Alternative 1 and Alternative 2.

7.1. 'No Go' or No Development Scenario

The 'No Go' scenario, or Alternative 1, takes into consideration the impacts associated with the no construction option (Table 2). It is a prediction of the future state of the affected area in the event of no construction upgrades taking place and is based on the current *ad hoc* repair works that result from irregular flooding. The current maintenance practice is to repair damage caused by flooding at the low level crossings and on the road surface. The following known impacts and/or potential impacts are identified:

- Damage to natural vegetation along the flood path, mainly the overflow points at blocked underpasses.
- Clearing of sensitive natural riverine vegetation by contractors, either out of necessity or irresponsibly (Figure 10).
- Introduction of weed seed from imported fill material. Problem species identified within the study area include feather top grass (*Pennisetum setaceum*), black wattle (*Acacia mearnsii*), Australian blackwood (*Acacia melanoxylon*) and common thorn apple (*Datura stramonium*).

Since the 'No Go' option is a long-term scenario the above impacts would have a cumulative impact. Note, however, that the road has been maintained using the current *ad hoc* approach since its construction over 150 years ago. The continuation of the *status quo* is expected to result in a **Low Negative Impact.**

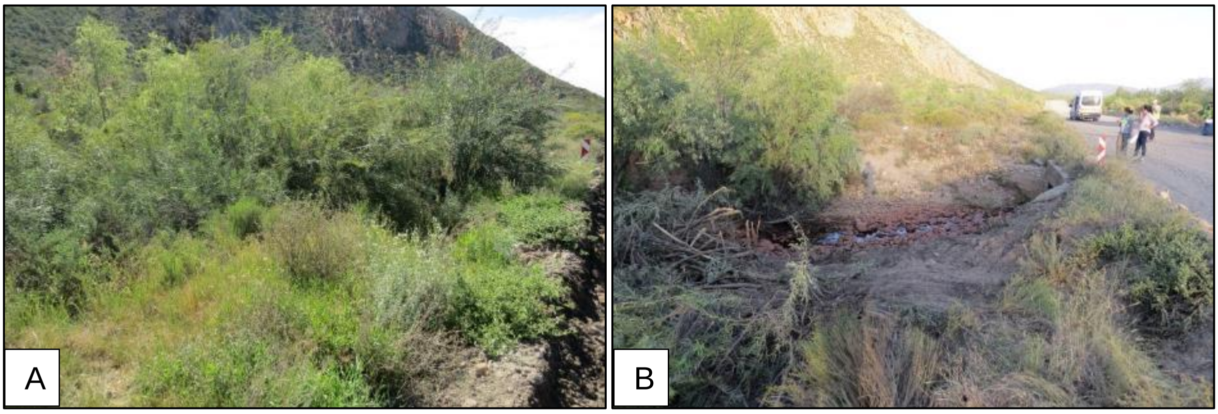

Figure 10A. Crossing at KM58.1 showing the site photographed 20 September 2016 with thicket cover of Cape willow (*Salix mucronata*) and sweet thorn (*Acacia karoo*). **Figure 10B.** The same site photographed on 26 October 2016 showing the vegetation having been cleared. The road side was recently graded but it is not clear why the clearing was carried out. This is an example of impacts that would occur under the 'No Go' option.

7.2. Direct impacts

Direct impacts are those that would occur as a direct result of undertaking the structure upgrades (Alternative 2). Direct impacts are assessed under Alternative 2 for Deviation Route Alternative A (preferred deviation route) and Deviation Route Alternative B (the least preferred deviation) in Table 3 according to the following interrelated components:

- Loss of vegetation type – including intact vegetation, ecologically important species and species of conservation concern.
- Loss of ecological processes – associated with the loss of intact vegetation, ecologically important species and species of conservation concern.

Table 2. Alternative 1 (No Go): Impact and Significance – Loss of vegetation & ecological processes

(a) **Impacts that may result from the operational phase (note that the planning, design and construction phase and decommissioning and closure phase are <u>not applicable</u> under the 'No Go' option).**

Potential impact on biological aspects:	**Loss of vegetation & ecological processes**
Nature of impact:	**Loss of vegetation**
Extent of impact:	**Local**
Duration of impact:	**Permanent**
Intensity of impact:	**Low Negative**
Probability of occurrence:	**Definite**
Degree to which the impact can be reversed:	**Very Low**
Degree to which the impact may cause irreplaceable loss of resources:	**Low**
Cumulative impact prior to mitigation:	**Low**
Significance rating of impact prior to mitigation (Low, Medium, Medium-High, High, or Very-High)	**Very Low Negative**
Degree to which the impact can be mitigated:	**Very Low**
Proposed mitigation:	**Unblock underpasses regularly; Strict control of foreign material to reduce risk of introducing weed seed; Control of weeds and IAP's.**
Cumulative impact post mitigation:	**Low Negative**
Significance rating of impact after mitigation (Low, Medium, Medium-High, High, or Very-High)	**Very Low Negative**

Table 3. Alternative 2: Deviation Route Alternative A (preferred deviation route): Impact and Significance – Loss of vegetation & ecological processes

(a) **Impacts that may result from the planning, design and construction phase (briefly describe and compare the potential impacts (as appropriate), significance rating of impacts, proposed mitigation and significance rating of impacts after mitigation that are likely to occur as a result of the planning, design and construction phase.**

Potential impact on biological aspects:	**Loss of vegetation & ecological processes**
Nature of impact:	**Loss of vegetation**
Extent of impact:	**Local**

Duration of impact:	**Medium Term**
Intensity of impact:	**Medium Negative**
Probability of occurrence:	**Definite**
Degree to which the impact can be reversed:	**Very Low**
Degree to which the impact may cause irreplaceable loss of resources:	**Medium**
Cumulative impact prior to mitigation:	**High Negative**
Significance rating of impact prior to mitigation (Low, Medium, Medium-High, High, or Very-High)	**High Negative**
Degree to which the impact can be mitigated:	**Low**
Proposed mitigation:	**Alternative includes careful selection of the least severe side of structure to carry out construction works i.e. avoidance of vegetation as far as possible – at a micro-site level. Rehabilitation of vegetation. Reduce overall working width of bypasses and structures.**
Cumulative impact post mitigation:	**High Negative**
Significance rating of impact after mitigation (Low, Medium, Medium-High, High, or Very-High)	**Medium**

(b) **Impacts that may result from the operational phase (briefly describe and compare the potential impacts (as appropriate), significance rating of impacts, proposed mitigation and significance rating of impacts after mitigation that are likely to occur as a result of the operational phase.**

Potential impact biological aspects:	**Loss of vegetation & ecological processes**
Nature of impact:	**Loss of vegetation**
Extent of impact:	**Local**
Duration of impact:	**Permanent**
Intensity of impact:	**Low Positive**
Probability of occurrence:	**Definite**
Degree to which the impact can be reversed:	**Very Low**
Degree to which the impact may cause irreplaceable loss of resources:	**Low**
Cumulative impact prior to mitigation:	**Low Positive**
Significance rating of impact prior to mitigation (Low, Medium, Medium-High, High, or Very-High)	**Low Positive**
Degree to which the impact can be mitigated:	**N/A**
Proposed mitigation:	**N/A**
Cumulative impact post mitigation:	**N/A**
Significance rating of impact after mitigation (Low, Medium, Medium-High, High, or Very-High)	**Low Positive**

(c) **Impacts that may result from the decommissioning and closure phase**

Potential impact biological aspects:	**Loss of vegetation & ecological processes**
Nature of impact:	**Loss of vegetation**
Extent and duration of impact:	**Local**
	Permanent
Intensity of impact:	**Low Positive**
Probability of occurrence:	**Definite**
Degree to which the impact can be reversed:	**Very Low**

Degree to which the impact may cause irreplaceable loss of resources:	**Low**
Cumulative impact prior to mitigation:	**Low Negative**
Significance rating of impact prior to mitigation (Low, Medium, Medium-High, High, or Very-High)	**Low Negative**
Degree to which the impact can be mitigated:	**N/A**
Proposed mitigation:	**N/A**
Cumulative impact post mitigation:	**N/A**
Significance rating of impact after mitigation (Low, Medium, Medium-High, High, or Very-High)	**Low Negative**

Table 3 continued. Alternative 2: Deviation Route Alternative B (the least preferred deviation): Impact and Significance – Loss of vegetation & ecological processes

(e) **Impacts that may result from the planning, design and construction phase (briefly describe and compare the potential impacts (as appropriate), significance rating of impacts, proposed mitigation and significance rating of impacts after mitigation that are likely to occur as a result of the planning, design and construction phase.**

Potential impact on biological aspects:	**Loss of vegetation & ecological processes**
Nature of impact:	**Loss of vegetation**
Extent of impact:	**Local**
Duration of impact:	**Medium Term**
Intensity of impact:	**Medium Negative**
Probability of occurrence:	**Definite**
Degree to which the impact can be reversed:	**Very Low**
Degree to which the impact may cause irreplaceable loss of resources:	**Medium**
Cumulative impact prior to mitigation:	**High Negative**
Significance rating of impact prior to mitigation (Low, Medium, Medium-High, High, or Very-High)	**High Negative**
Degree to which the impact can be mitigated:	**Low**
Proposed mitigation:	**Avoidance of vegetation as far as possible – at a micro-site level. Rehabilitation of vegetation. Reduce overall working width of bypasses and structures.**
Cumulative impact post mitigation:	**High**
Significance rating of impact after mitigation (Low, Medium, Medium-High, High, or Very-High)	**Medium Negative**

(f) **Impacts that may result from the operational phase (briefly describe and compare the potential impacts (as appropriate), significance rating of impacts, proposed mitigation and significance rating of impacts after mitigation that are likely to occur as a result of the operational phase.**

Potential impact biological aspects:	**Loss of vegetation & ecological processes**
Nature of impact:	**Loss of vegetation**
Extent of impact:	**Local**
Duration of impact:	**Permanent**
Intensity of impact:	**Low Positive**
Probability of occurrence:	**Definite**
Degree to which the impact can be reversed:	**Very Low**

Degree to which the impact may cause irreplaceable loss of resources:	**Low**
Cumulative impact prior to mitigation:	**Low Positive**
Significance rating of impact prior to mitigation (Low, Medium, Medium-High, High, or Very-High)	**Low Negative**
Degree to which the impact can be mitigated:	**N/A**
Proposed mitigation:	**N/A**
Cumulative impact post mitigation:	**N/A**
Significance rating of impact after mitigation (Low, Medium, Medium-High, High, or Very-High)	**Low Positive**

(d) **Impacts that may result from the decommissioning and closure phase**

Potential impact biological aspects:	**Loss of vegetation & ecological processes**
Nature of impact:	**Loss of vegetation**
Extent and duration of impact:	**Local**
Duration of impact:	**Permanent**
Intensity of impact:	**Low Positive**
Probability of occurrence:	**Definite**
Degree to which the impact can be reversed:	**Very Low**
Degree to which the impact may cause irreplaceable loss of resources:	**Low**
Cumulative impact prior to mitigation:	**Low**
Significance rating of impact prior to mitigation (Low, Medium, Medium-High, High, or Very-High)	**Low**
Degree to which the impact can be mitigated:	**N/A**
Proposed mitigation:	**N/A**
Cumulative impact post mitigation:	**N/A**
Significance rating of impact after mitigation (Low, Medium, Medium-High, High, or Very-High)	**Low**

7.3 Loss of vegetation & ecological processes

Loss of vegetation is assessed under Alternative 1 in relation to the vegetation type occurring within the affected areas for each of the sub-alternatives:

Deviation Route Alternative A (preferred deviation route): Loss of vegetation is assessed as having **High Negative Impact** prior to mitigation. However, the loss of vegetation would be less severe compared with Deviation Route Alternative B. The collective loss of vegetation, including riverine thicket and dryland vegetation is considered in terms of overall impacts.

Deviation Route Alternative B (the least preferred deviation): Loss of vegetation is assessed as having **High Negative Impact** prior to mitigation. The collective loss of vegetation, including riverine thicket and dryland vegetation is considered in terms of overall impacts.

7.4. Mitigation

Mitigation options are generally considered in terms of the following hierarchy: (1) avoidance, (2) minimization, (3) restoration and (4) offsets. Mitigation would reduce the overall impact significance rating for Deviation Route Alternative A (preferred deviation route) to **Medium Negative Impact.** This was determined on the basis of a detailed site assessment with the project engineers. During the site visit the actual footprint (i.e. extent in terms of length, width and loss of vegetation), was determined. The outcome resulted in the determination of a preferred *versus* least preferred deviation, or Deviation Route Alternative A (preferred) and Deviation Route Alternative B (least preferred). Impacts for Deviation Route Alternative B could be reduced to Medium-High Negative with mitigation. In addition to determine a preferred, least severe deviation, the following mitigation options must be applied:

- An Environmental Control Officer (ECO) must be present during the during the construction phase, in particular when vegetation clearing is required for the temporary bypasses.
- Sensitive patches of vegetation, including trees identified as sensitive and requiring protection must be marked with danger tape to prevent them from being removed or damaged.
- Pruning of trees must be carried out with care to prevent unnecessary damage to the overall health of each tree.
- All bypasses must be rehabilitated with the following in place:
    - A vegetation rehabilitation specialist contractor must be hired to assist with the planning and implementation of the rehabilitation.
    - A detailed vegetation rehabilitation plan must be compiled along with an easy to follow method statement.
    - All fill material must be removed to expose the original soil surface and to preserve the soil integrity.
    - Bypasses must be blocked to avoid motorists and pedestrians from accessing and disturbing these areas.
    - Seed must be collected from vegetation at each construction site prior to the construction phase by a qualified practitioner.

- Collected seed should be cleaned and stored until the rehabilitation phase. The areas must then be rehabilitated by careful sowing of seed under supervision of a qualified horticulturalist.
- Areas must be irrigated regularly using a vehicle-based irrigation hose. Areas should be watered twice weekly for 2-months and weekly thereafter for 3 months.
- Monitoring of each site must be carried out to ensure that disturbed areas are successfully rehabilitated to an acceptable level.

Table 4. Key micro-siting mitigation measures established during site visit meeting. Establishment of Alternative 2: Deviation Route Alternative A (preferred).

Structure	**Preferred or constrained bypass side**	**Approximate clearing width**	**Key mitigation**	**Image**
44.1	LHS	4m clearing width		
44.3	RHS	4.5m clearing width		
44.50	RHS	4m clearing width		
44.7	RHS	7m clearing width	Avoid *Salix mucronata* tree.	
45.05	LHS	4m clearing width		
45.1	RHS	4m clearing width	Move structure 5-6m south. *Brachylaena neriifolia* trees to be pruned but not removed	
45.5	RHS	4m clearing width		
45.97	LHS	4m clearing width	Avoid *Salix mucronata* tree.	
46.35	N/A	No bypass	Structure to be constructed in half widths with no bypass.	

46.5	LHS	4m clearing width	Avoidance of *Salix mucronata* tree on RHS.	
48	LHS	4m clearing width	Avoid *Aloe ferox* on north side of structure. Transplant aloe if necessary.	
50.1	RHS	2-3m		
50.3	RHS	4m clearing width	Move road alignment on LHS in by about 2m. Avoid bergkiepersol (*Cussonia paniculata*). Use topsoil form south side of structure on LHS to rehabilitate bypass.	
50.8	RHS	4m clearing width	Avoid *Cussonia paniculata* on north side of structure. Avoid *Aloe ferox* on south side of structure. Transplant aloe if necessary.	
51.1	LHS	4m clearing width		
51.6	RHS	4m clearing width	Avoid *Salix mucronata* tree.	
52	RHS		Road to be moved downstream by 2m. Prune back *Searsia* sp. trees but do not remove.	
53.4	RHS	4m clearing width	Road to be moved slightly upstream	

53.5	LHS	4m clearing width	Road to be moved upstream to avoid cutting into embankment	
54.1	RHS	4m clearing width		
54.3	LHS	4m clearing width	Structure to be moved upstream slightly.	
58.1	LHS	4m clearing width	Not applicable: area already cleared of *Salix mucronata* trees.	

7.5. Indirect impacts

Indirect impacts are those that do not occur as a direct result of the activity on site but that occur further away. No indirect impacts were identified.

7.6. Cumulative impacts

Cumulative impacts are those impacts linked to (a) increased loss of vegetation type or the ecosystems listed in the national List of Threatened Terrestrial Ecosystems (Government Gazette, 2011) and (b) consideration of other developments in the region within the same vegetation types. Cumulative impacts are assessed as the overall impact of loss of habitat in relation to loss of the same or similar habitat at a local scale due to past, present and future habitat loss. This includes activities that have permanently transformed habitats.

The actual quantity in terms of loss of vegetation is difficult to determine since this differs at each site and was not measured in terms of surface area. If the assumption is that the working area at each structure would be 15 m x 6 m or 90 m^2, the collective loss of vegetation for the 25 crossings amounts to an approximate loss of vegetation of 2250 m^2, or 0.2 ha. The equates to 0.01% of the remaining habitat of the Fynbos Riparian Vegetation if assessed collectively for the ecosystem. Note, however, that about 80% of the vegetation would be rehabilitated, which equates to a Very Low Cumulative Impact.

8. Conclusions and Recommendations

The proposed upgrading of Seweweekspoort would require road bypasses at each of the 25 crossings, which would have a destructive impact on well-established riparian and dryland vegetation. Although the bypasses are not supported from a botanical perspective, the decisions taken at a site meeting are seen as a constructive approach to minimizing the overall impacts. The option to close the pass during construction in order to negate the need for traffic bypasses would not be possible due to provincial regulations and engineering requirements. The main reason for this is to ensure that construction vehicles can move freely through the poort to allow several structures to be simultaneously upgraded. If the recommended mitigation measures are strictly adhered to, impacts could be reduced to Medium Negative for Alternative 2 [Deviation Route Alternative A (preferred)]. However, a detailed vegetation rehabilitation plan would need to be compiled and implemented so that the bypasses are re-vegetated to their original or at least near-original condition.

The quality of the vegetation is not consistent at every site. Some sites are more disturbed than others whereas other sites contain highly sensitive riverine trees and mature bergkiepersol (*Cussonia paniculata*) trees. Impacts are also not confined to botanical features. A freshwater specialist study (Belcher and Grobler, 2016) addresses impacts to the freshwater systems but these are linked to botanical features, specifically the riparian and instream plant communities.

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Report submitted: 13 December 2016

Appendix 1: Curriculum Vitae: Paul Emms

Experience

- Expertise in field work in the CFR and Succulent Karoo ecosystems – vegetation surveys, plant identification, plant collection and propagation, ecological monitoring of dryland and wetland habitats; including physiological studies
- Data management and analysis – data sets and statistical analysis
- Proficiency in Google Earth, QGIS and related GIS programs.
- Vegetation and species mapping
- Completed an MSc thesis entitled *"Long-term vegetation monitoring – a 33-year record from Table Mountain".* Graduation date: March 2014
- Experience leading teams of field assistants in remote mountainous areas
- Completed over 150 botanical survey/assessment reports

Career History

- March 2011 - present - botanical specialist - associate of Bergwind Botanical Surveys & Tours CC
- March 2008 - March 2010 - field botanist - Coastec (Coastal & Environmental Consultants)
- January 2006 – December 2007 - Kirstenbosch Scholar/horticultural research/plant identification instructor - South African National Biodiversity Institute.

Education and qualifications

- MSc (Botany) – University of the Western Cape (2014).
- BSc: Hons (Botany) – University of the Western Cape (2005)
- BSc: Biodiversity and Conservation Biology - University of the Western Cape (2002 – 2004)
- National Diploma in Horticulture - Cape Peninsula University of Technology (1998 – 2000)

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