FRESHWATER ASSESSMENT FOR THE PROPOSED FLOOD DAMAGE REPAIRS TO STRUCTURES ON MR309 IN SEWEWEEKSPOORT PASS

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EXECUTIVE SUMMARY

The Seweweekspoort Pass, located on MR309, is a gravel road that meanders through the narrow gorge of the Seweweekspoort, linking the towns of Laingsburg and Ladismith. Structures have been constructed over many years consisting mostly of one or two pipes. The result is that even small rain events cause the road to be overtopped with ensuing damage to the road that requires repair work to be done. The Western Cape Government Roads Network Branch proposed to upgrade the road. This freshwater assessment report is intended to inform the freshwater ecosystem aspects of the project.

The main freshwater features in the study area are the Seweweekspoort River, a tributary of the Kobus Tributary (J25B) in the Gouritz River System. There are some tributaries and valley bottom wetland areas associated with the river in the area where the road will be upgraded. The present ecological state of the river system within the pass is largely natural. The ecological importance and sensitivity of the river is high and for the wetland areas is moderate to high.

The Seweweekspoort River and tributaries is mapped as a Fish Support Area. Most of the study area is located within the formally protected Towerkop Nature Reserve, with the southern portion also forming part of a Mountain Catchment Area. The portions of the study area immediately north and south of the protected areas are mapped as Critical Biodiversity Areas that should be protected.

The roadway and associated structures are already in existence adjacent to or within the Seweweekspoort River System. The road, together with some other physical modifications to the freshwater features in the upper catchment, has resulted in the current ecological condition of the river and its associated wetland areas. Therefore it can be expected that the likely impacts of the proposed upgrade of the road crossings are of a limited extent and of a short term nature, occurring mostly during the construction phase.

Longer term impacts that are likely to occur relate to how the maintenance work is undertaken for the road as well as the potential encroachment of invasive alien vegetation into the freshwater features where they have been disturbed by the construction activities. However, the proposed upgrades will also result in an overall positive impact as the capacity of the crossing structures will be increased which will reduce the impact of the structures on the hydraulics of the river and the likelihood that the structures will become blocked. This will result in a reduced need to repair flood damage to the road and structures or remove sediment and debris at the structures on an ongoing basis.

The following general mitigation measures are recommended:

- *Work within the river channel or wetland areas should be limited as far as possible and the disturbed areas rehabilitated immediately afterwards.*
- *Construction within the river channel should as far as possible take place during the drier months of the year.*
- *To minimise the impact of the temporary bypass, the bypass route should be selected to avoid larger riparian trees as far as possible. Larger plants should be trimmed back to leave their stems and roots*

intact rather than removing the entire trees unless absolutely necessary. Bidem should be placed over the existing topsoil and vegetation before placing the fill material in the channel, that the fill material can all be removed after completion of the road crossing structure. Pipe culverts should be temporarily placed within the channel to ensure the low flow in the river is not impeded. Sandbags should be placed on the outer edge of the bypass to prevent the sashing of sediment into the channel.

- *Rubble and debris from existing structures and construction activities, as well as the temporary bypass structure, should be removed after construction is complete so as not to impede flow in the stream.*
- *Once construction is complete, the area should be rehabilitated to resemble that of the surrounding bed and banks and where necessary vegetated with suitable local indigenous plants as occur at the site.*
- *The channel upstream of the crossing should be kept free of debris and sediment build-up, particularly at the culvert where it might impede flows.*
- *Any invasive alien plants from the road reserve should be monitored and removed on an ongoing basis according to methods as provided by the Working for Water Programme.*

Specific mitigation measures for each road crossing are provided within the report. With mitigation, the significance of the cumulative impacts of the proposed activities are deemed to be a very low negative for the construction phase and a low positive for the operation phase. The no-go alternative implies that no upgrades for the road crossings will be undertaken and that the current 'ad hoc' repair of flood damaged structures would continue. The structures would also remain with many of the existing culverts becoming increasingly blocked by sediment and impeding the lower flow in the river system. The significance of the no-go alternative is deemed to be a low negative for the operation phase.

The Breede-Gouritz Catchment Management Agency should be approached for comment on the requirement that the water use aspects of the proposed activities may need to be authorised. The proposed works within the river system in the pass are deemed to be changing the characteristics of the associated freshwater ecosystems and would therefore require authorization. In terms of the risk assessment for the proposed works, the level of the proposed water use activities is such that they would need to be authorised by means of a water use licence.

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1. BACKGROUND

The Seweweekspoort Pass, located on MR309 approximately between km 40.9 to 58.1, is a gravel road that meanders through the narrow gorge of the Seweweekspoort, linking the towns of Laingsburg and Ladismith. Structures have been constructed over many years consisting mostly of one or two pipes. The result is that even small rain events cause the road to be overtopped with ensuing damage to the road that requires repair work to be done by the Eden District Municipality and the Central Karoo District Municipality since the border is half way through the Seweweekspoort.

Hatch was appointed by the Western Cape Government Roads Network Branch to assess, design and monitor the repair work to roads, drainage and protection works for the road. This freshwater assessment report is intended to inform the freshwater ecosystem aspects of the project.

The Seweweekspoort River is a tributary of the Kobus River which is a tributary of the Gamka River in the Gouritz River System. The pass was used by earlier farmers to access the Great Karoo from the south. It is approximately 17km long and in many places is only broad enough for the stream to pass through. In 1859 it was decided that a pass should be built through the poort. The early part of the work was done by 108 convicts, without the presence of a road engineer. In 1860 A G de Smidt, brother-in-law of Thomas Bain, continued and 11 of the 17km was completed. The road was s finally completed in November 1962. The road crosses the river 23 times

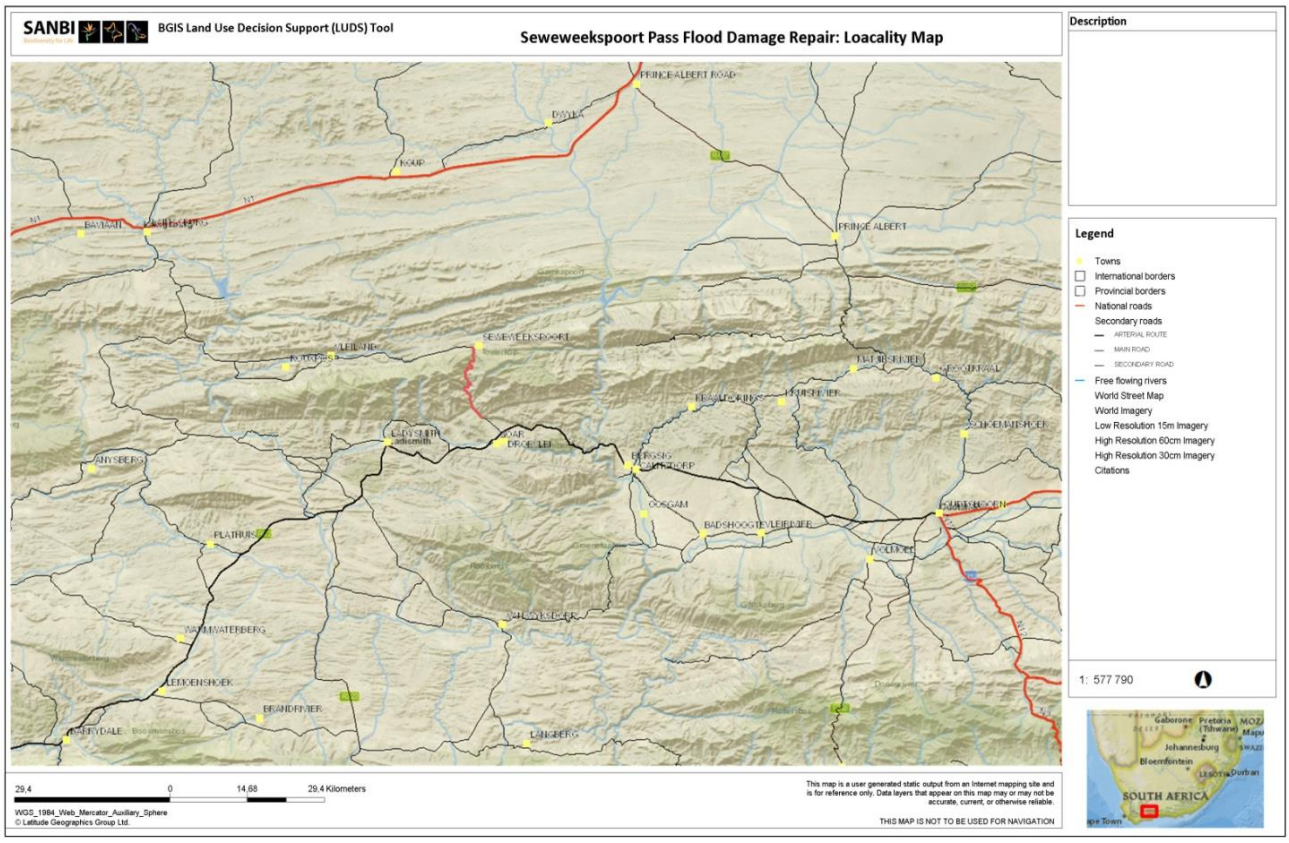


Figure 1. Locality map for the proposed road upgrade (SANBI Biodiversity GIS, 2016)

Table 1: Summary of key information related to the water resource in the study area

Descriptor	Name / details	Notes
Water Management Area	Breede-Gouritz	
Catchment Area	Seweweekspoort River, a tributary of the Kobus River in the Gourits River	
Quaternary Catchment	J25B	
Present Ecological state	D	DWS PES and EI&ES national rapid assessments (2012) for the adjacent Kobus River
Ecological Importance and Ecological Sensitivity	High; Very High	
Water resource component potentially impacted	Seweweekspoort River, as well as its tributaries and associated wetland areas	
Latitude	33°21'41.3"S	Start of Road Upgrade (km 40.9)
Longitude	21°24'35.4"E	
Latitude	33°27'35.0"S	End of Road Upgrade (km 58.1)
Longitude	21°25'43.2"E	

2. TERMS OF REFERENCE

The agreed upon scope of work for this project is as follows:

TASK 1: FRESHWATER ASSESSMENT

1.1. Literature survey and initialisation;

1.2. Site assessment and meetings;

1.2.1. Meeting with client and project team;

1.2.2. Group site visit;

1.3. Freshwater impact assessment and assessment report

1.4. Department of Water and Sanitation (DWS) risk assessment

1.5. Review and liaison

TASK 2: WATER USE AUTHORISATION APPLICATION FOR SECTION 21 C AND 1

2.1. Collate relevant information

2.2. Pre-application consultation meeting with DWS

2.3. Section 21 c and i water use authorisation application, supplementary report for section 21 c and i

2.4. Submission of application

2.5. Liaison and review

3. APPROACH TO THE STUDY AND STUDY LIMITATIONS AND ASSUMPTIONS

Input into this report was informed by a combination of desktop assessments of existing aquatic ecosystem information for the study area and catchment, as well as by a more detailed assessment of the aquatic ecosystems along the road to be upgraded. During the field visit undertaken on 17 September 2016 and a follow up site visit on 26 October 2016, the characterisation and integrity assessments of the aquatic ecosystems were undertaken. The site assessments were undertaken at the end of the rainy season.

Mapping of the aquatic ecosystems was undertaken using a Garmin Colorado 300 GPS and mapped in PlanetGIS Professional. The SANBI Biodiversity GIS website was also consulted to identify any constraints in terms of fine-scale biodiversity conservation mapping as well as possible aquatic ecosystems mapped in the Freshwater Ecosystem Priority Areas maps. This information/data was used to inform the water resource protection related recommendations.

Limitations and uncertainties often exist within the various techniques adopted to assess the condition of ecosystems. The following techniques and methodologies were utilized to undertake this study:

- Analysis of the Aquatic ecosystems was undertaken at a rapid level and did not involve detailed habitat and biota assessments;
- The river health assessment was carried out using South African Department of Water and Sanitation developed methodologies. Aquatic Health assessments were carried out to provide information on the ecological condition and ecological importance and sensitivity of the river systems impacted.
- The guideline document, “A Practical Field Procedure for the Identification and Delineation of Wetlands and Riparian Areas” document, as published by DWAF (2005) was followed for the delineation of the wetland areas. According to the delineation procedure, the wetlands were delineated by considering the following wetland indicators: terrain unit indicator; Soil form indicator; Soil wetness indicator; and vegetation indicator.
- The wetlands were subsequently classified according to their hydro-geomorphic determinants based on a classification system devised by Kotze *et al* (2004) and SANBI (2009). Notes were made on the levels of degradation in the wetlands based on field experience and a general understanding of the types of systems present.
- A Present Ecological State (PES) assessment was conducted for each hydro-geomorphic wetland unit identified and delineated within the study area. For the purpose of this study, the tool WET-Health as defined in the WET Health Series developed for the Water Research Commission was used to assess the present ecological state of each wetland unit.
- The functional wetland assessment technique, WET-EcoServices, developed by Kotze *et al* (2009) was used to provide an indication of the ecological benefits and services provided by delineated wetland habitat. This technique consists of assessing a combination of desktop and infield criteria in order to identify the importance and level of functioning of the wetland units within the landscape.
- The ecological importance and sensitivity assessment was conducted according to the guidelines as developed by DWAF (1999).

- Recommendations are made with respect to the adoption of buffer zones within the development site, based on the wetlands/river's functioning and site characteristics.

The level of aquatic assessment and environmental water requirement determination undertaken was considered to be adequate for this study.

4. USE OF THIS REPORT

This report reflects the professional judgment of its author. The full and unedited content of this should be presented to the client. Any summary of these findings should only be produced in consultation with the author.

5. OVERVIEW OF THE PROPOSAL

5.1. OVERVIEW OF THE STUDY AREA

Seweweekspoort is located in the Klein Swartberg mountain range in the Klein Karoo. Main Road 309 is linked between the R62 south of the mountain rand and R323 north of the mountains. Within the pass, the Cape Fold mountains on both sides reach heights of 1 500 to 2 000m. The mountain chain is surrounded to the south by an extensive farming area for the production of apricots, peaches, plums, nectarines, and grapes. The nearest towns are Ladismith to the west, Calitzdorp to the east, Vanwyksdorp and Riversdale to the south and Laingsburg to the north. The communities of Zoar and Seweweekspoort are located to the south and north of the pass respectively. Vegetation within the pass and mountain range is still largely natural.

The Seweweekspoort is located within the Cape Nature Towerkop Reserve. The river system within the pass is sensitive and unique. The pass is situated in a World Heritage site and is a tourist destination.

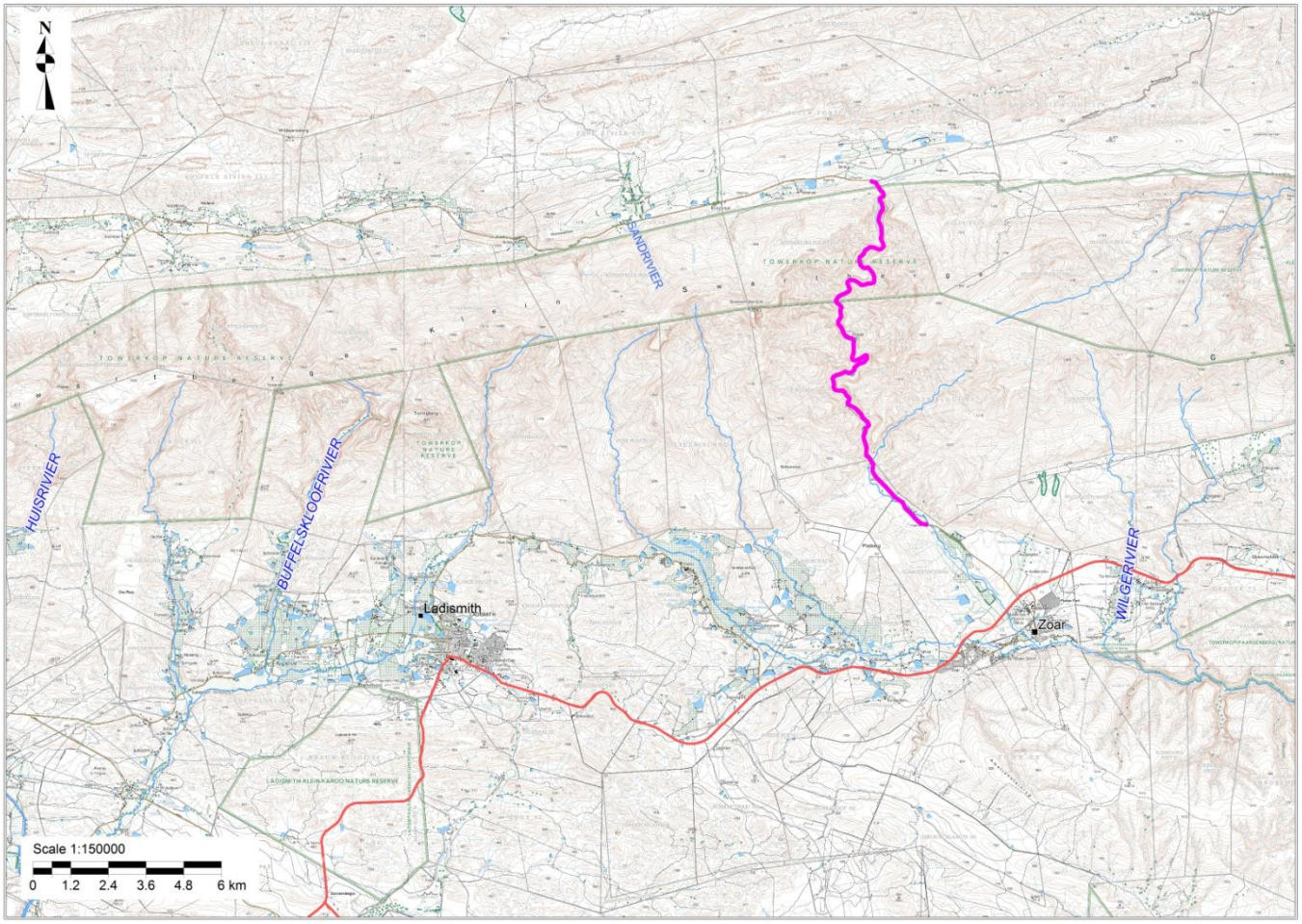


Figure 2. Topographical map (3321AC/DA/CA/CB) of the location and extent of the proposed flood repair work in the Seweweekspoort Pass

5.2. ACTIVITY DESCRIPTION

The flood damage repairs included in this project occur on Major Road MR306 in the Seweweekspoort Area. There are 27 structures proposed for repair work or replacement. Table 2 each structure. The design width of the structures are to be 6m clear width between guideblocks and not materially wider than the gravel road which is narrower in many parts of the pass. Typical sizes for the structures will be 4m to 6m wide perpendicular to the flow of the river and structures will be aligned with the direction of the river. Rectangular causeways with larger clear spans (few piers) are preferred to pipe causeways as the risk of blockage is much reduced. The sizing of openings will be to allow floods with a 2 year return period to pass through drainage openings under the deck slab. Concrete approach slabs are to be omitted as far as possible due to under scour risks and expensive repairs. The pass cannot be closed for traffic during construction. Temporary deviation roads would need to be used but will be revegetated. A site visit was attended between the environmental impact assessment team, the project engineers and the client to determine the bypass routing that would have the least environmental impact.

Table 2. Description of the structures on MR306 proposed for repair or replacement

Structure No.	Km	Co-ordinates	Description of Existing Structure	Description Of Proposed Structure
1	40.90	33°21’41.30’’S 21°24’35.42’’E	3x600mm pipes with gabions upstream, ponding occurs at inlet and outlet	6m wide causeway
2	44.10	33°22'51.38"S 21°24'31.32"E	2x600mm encased pipes, large skew angle	4m wide causeway
3	44.30	33°22'55.45"S 21°24'26.95"E	2x600mm encased pipes, with wing walls, apron slabs, gabions downstream damaged	6m wide causeway
4	44.50	33°23'1.12"S 21°24'21.51"E	2x600mm encased pipes, grouted stone head walls, base scoured and water running under structure	4m wide causeway
5	44.70	33°23'8.56"S 21°24'22.03"E	2x600mm encased pipes, heavy siltation, low level	6m wide causeway
6	45.05	33°23'11.26"S 21°24'31.42"E	2x600mm encased pipes, grouted stone head walls, mostly damaged, slight siltation	4m wide causeway
7	45.10	33°23'13.16"S 21°24'34.38"E	2x600mm encased pipes, with stone and concrete head walls upstream	4m wide causeway
8	45.50	33°23'24.84"S 21°24'37.91"E	1x600mm pipe only for side stream	3m wide causeway
9	45.97	33°23'27.84"S 21°24'22.06"E	2x600mm encased pipes with concrete and stone head walls at inlet and outlet, heavy siltation, structure completely buried	4m wide causeway
10	46.35	33°23'23.57"S 21°24'7.61"E	1x600mm pipe with stone head wall	2m wide causeway
11	46.50	33°23'26.04"S 21°24'5.27"E	2x600mm pipes; concrete and stone head walls at inlet and outlet, stone pitching aprons, siltation, structure buried	6m wide causeway
12	48.00	33°24'3.53"S 21°23'55.81"E	1x900mm pipe, stone head and wing walls, damaged apron slabs both sides, river channel is deep	6m wide causeway
13	50.10	33°24'42.25"S 21°24'31.50"E	3x600mm pipes with stone head walls up and down stream, stone pitching aprons severely damaged	2 x 3m Wide Cell causeway
14	50.30	33°24'46.14"S 21°24'29.91"E	2x900mm pipes with stone head and return wall downstream, severely damaged and siltation issue	4m Wide Cell causeway
15	50.80	33°24'56.08"S 21°24'14.54"E	3x600mm pipes with stone head and return walls up and down stream, severely damaged and siltation prevalent	4m Wide Cell
16	51.10	33°24'59.11"S 21°24'7.50"E	2x900mm pipes with stone head wall up and down stream, severely damaged, large boulders abundant in river bed	4m Wide Cell causeway
17	51.60	33°25'1.52"S 21°23'51.22"E	River blocked by fallen tree and erodes bank and under scours road when flood comes through	30m Long Wall
18	52.00	33°25'16.31"S 21°23'50.59"E	2x900mm pipes with stone head wall up and down stream, severely damaged, boulders abundant in river bed	4m Wide Cell causeway
19	53.20	33°25'35.88"S 21°24'16.53"E	2x900mm pipes with concrete protection works up and down stream, scouring severe	4m Wide Cell causeway
20	53.40	33°25'39.94"S 21°24'20.83"E	2x600mm pipes with stone head walls at and outlet, mostly buried, nearly completely destroyed	4m Wide Cell causeway
21	53.50	33°25'43.76"S 21°24'23.71"E	2x900mm pipes with concrete protection works up and down stream, scouring severe	4m Wide Cell causeway
22	53.80	33°25'52.34"S 21°24'31.94"E	Road way gets flooded by river and washes material away completely during floods	100m Long Wall
23	54.10	33°25'56.48"S 21°24'26.57"E	2x900mm pipes with stone head wall up and down stream, mostly damaged, large boulders in river	4m Wide Cell causeway
24	54.30	33°26'0.20"S 21°24'24.55"E	2x900mm pipes with stone head wall up and down stream, mostly damaged, large boulders in river bed, siltation high	4m Wide Cell causeway
25	54.40	33°26'3.00"S 21°24'24.34"E	Road way gets flooded by river and washes material away completely during floods	350m Long Wall
26	57.10	33°27'14.40"S 21°25'15.08"E	57m causeway with 6x2.4m openings, 500mm slab, aprons and wing walls, 4 openings blocked with rocks only 2 openings clear	Drop inlet on existing structure
27	58.10	33°27'34.98"S 21°25'43.17"E	1x1.9m W causeway with 750mm pipe down steam, broken apron slabs and downstream return walls	6m Wide Cell causeway

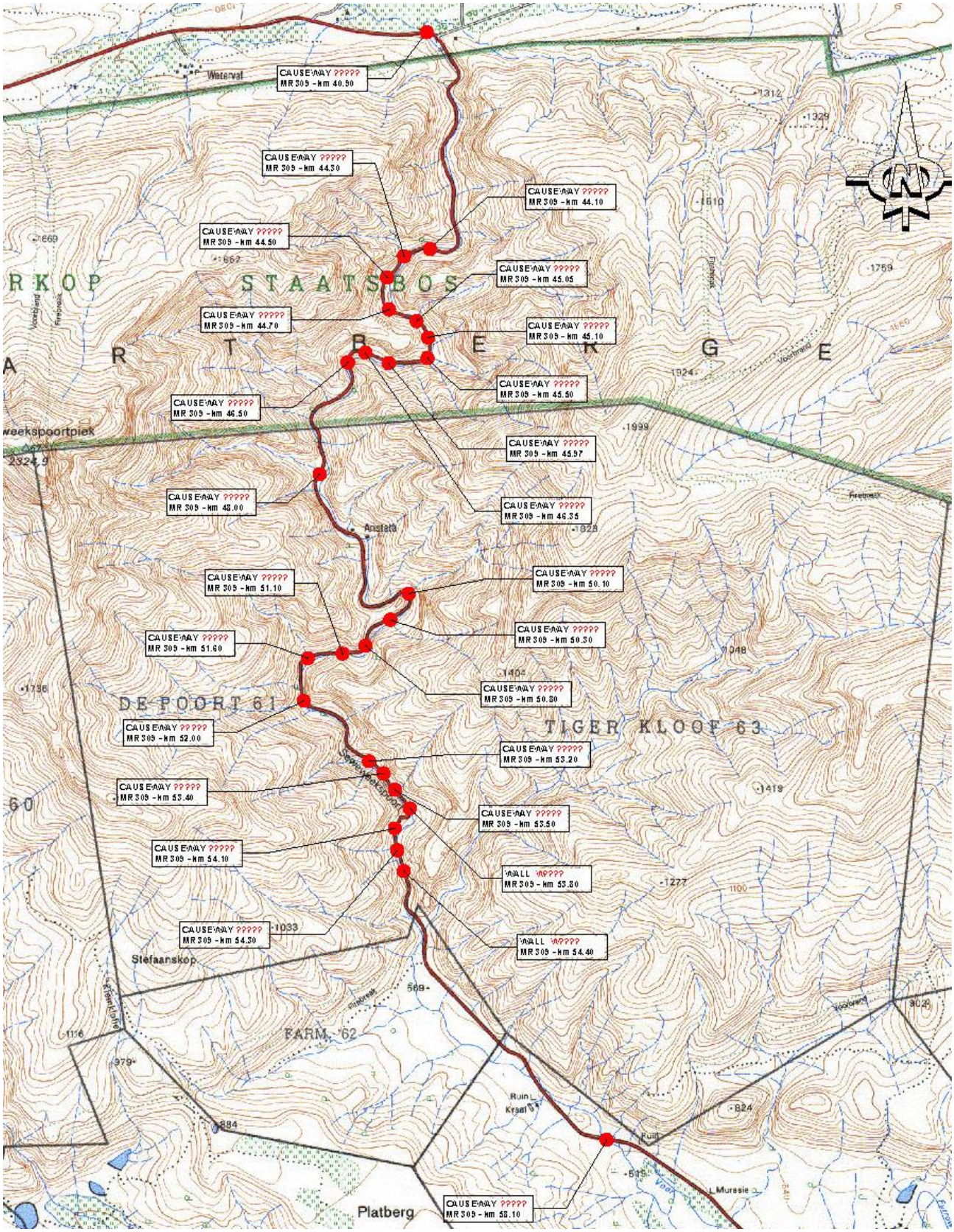


Figure 3. Location of the structure that require repair or replacing

6. LEGAL REQUIREMENTS

The following Acts, regulations and ordinances (over and above the EIA regulations already mentioned) are applicable to the freshwater aspects of the proposed project:

6.1. NATIONAL WATER ACT, 1998 (ACT NO. 36 OF 1998)

The purpose of the National Water Act is to provide a framework for the equitable allocation and sustainable management of water resources. Both surface and groundwater sources are redefined by the Act as national resources which cannot be owned by any individual, and rights to which are not automatically coupled to land rights, but for which prospective users must apply for authorisation and register as users. The National Water Act also provides for measures to prevent, control and remedy the pollution of surface and groundwater sources.

REGULATIONS REQUIRING THAT A WATER USER BE REGISTERED, GN R.1352 (1999)

Regulations requiring the registration of water users were promulgated by the Minister of the Department of Water Affairs (DWA) in terms of provision made in section 26(1)(c), read together with section 69 of the National Water Act, 1998. Section 26(1)(c) of the Act allows for registration of all water uses including existing lawful water use in terms of section 34(2). Section 29(1)(b)(vi) also states that in the case of a general authorisation, the responsible authority may attach a condition requiring the registration of such water use. The Regulations (Art. 3) oblige any water user as defined under section 21 of the Act to register such use with the responsible authority and effectively to apply for a Registration Certificate as contemplated under Art.7(1) of the Regulations.

GENERAL AUTHORISATION IN TERMS OF S. 39 OF THE NATIONAL WATER ACT

According to the preamble to Part 6 of the NWA, "*This Part established a procedure to enable a responsible authority, after public consultation, to permit the use of water by publishing general authorisations in the Gazette…*" *"The use of water under a general authorisation does not require a licence until the general authorisation is revoked, in which case licensing will be necessary…"*

The General Authorisations for Section 21 (c) and (i) water uses (impeding or diverting flow or changing the bed, banks or characteristics of a watercourse) as defined under the NWA have recently been revised (Government Notice R509 of 2016). The proposed works within or adjacent to river channel or its associated wetland areas are likely to change the characteristics of the associated freshwater ecosystems and may therefore require authorization. Determining if a water use licence is required for these water uses is now determined based on the risk of the proposed activities degrading the ecological status of a watercourse. A low risk of impact could be authorised in terms of a General Authorisations (GA). A risk assessment for the proposed project is included in the report.

6.2. THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT (ACT NO. 107 OF 1998)

Chapter Seven of the NEMA states that:

"Every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment".

The Act also clearly states that the landowner, or the person using or controlling the land, is responsible for taking measures to control and rectify any degradation. These may include measures to:

"(a) investigate, assess and evaluate the impact on the environment;

(b) inform and educate employees about the environmental risks of their work and the manner in which their tasks must be performed in order to avoid causing significant pollution or degradation of the environment:

(c) cease, modify or control any act, activity or process causing the pollution or degradation:

(d) contain or prevent the movement of pollutants or degradation: or

(e) eliminate any source of pollution or degradation: or

(f) remedy the effects of the pollution or degradation."

NEMA ENVIRONMENTAL IMPACT ASSESSMENT REGULATIONS

NEMA provides for the identification of activities which will impact the environment, in terms of Section 24. These activities were promulgated in terms of Government Notice No. R. 983, 984 and 985, dated 4 December 2014 and require environmental authorisation. The impacts of the listed activities must be investigated, assessed and reported to the competent authority before authorisation to commence with such listed activities can be granted.

7. DESCRIPTION OF THE STUDY AREA

7.1. PHYSICAL CHARACTERISTICS

The study area is largely located within a narrow valley in the Klein Swartberg Mountains between the Klein Karoo and the Great Karoo.

The Klein Karoo is an east-west orientated valley bounded in the north by the Swartberg and Witteberg Mountains and in the south by the Langeberg and Outeniqua mountains. Three biomes meet in the Klein Karoo, the Fynbos, Succulent Karoo and Thicket biomes.

The topography along the road drops from about 1005m down to 467m over a distance of 16.5km with an average slope 3.5%. The valley sites within the pass are very steep with a number of small tributaries draining downs these steep slopes into the Seweweekspoort River. Significant runoff of a high intensity can thus be expected to occur within the pass following large rainfall events on the mountain range.

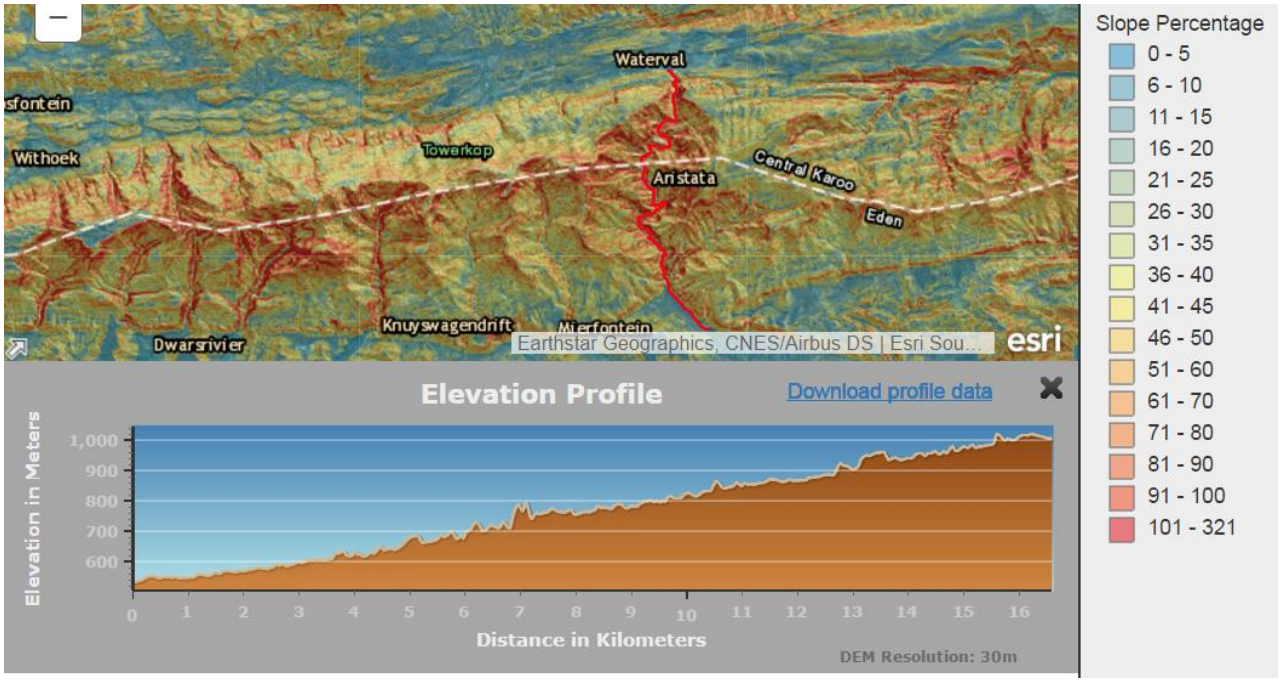


Figure 4. Elevation profile and Slope for the study area (CapeFarmMapper, 2016)

7.2. CLIMATE

The pass receives about 270mm to 320mm of rain per year on average. The area has a bimodal rainfall pattern with rain occurring throughout the year. The lowest rainfall (12mm) occurs in January and the highest (25mm) in March. The average midday temperatures for the area range from 9°C in July to 19°C in January.

Climate change indications for the area are that the variability of flows might increase with a tendency for more erratic flows and more frequent flooding. This justifies the project's primary purpose of undertaking flood protection measures.

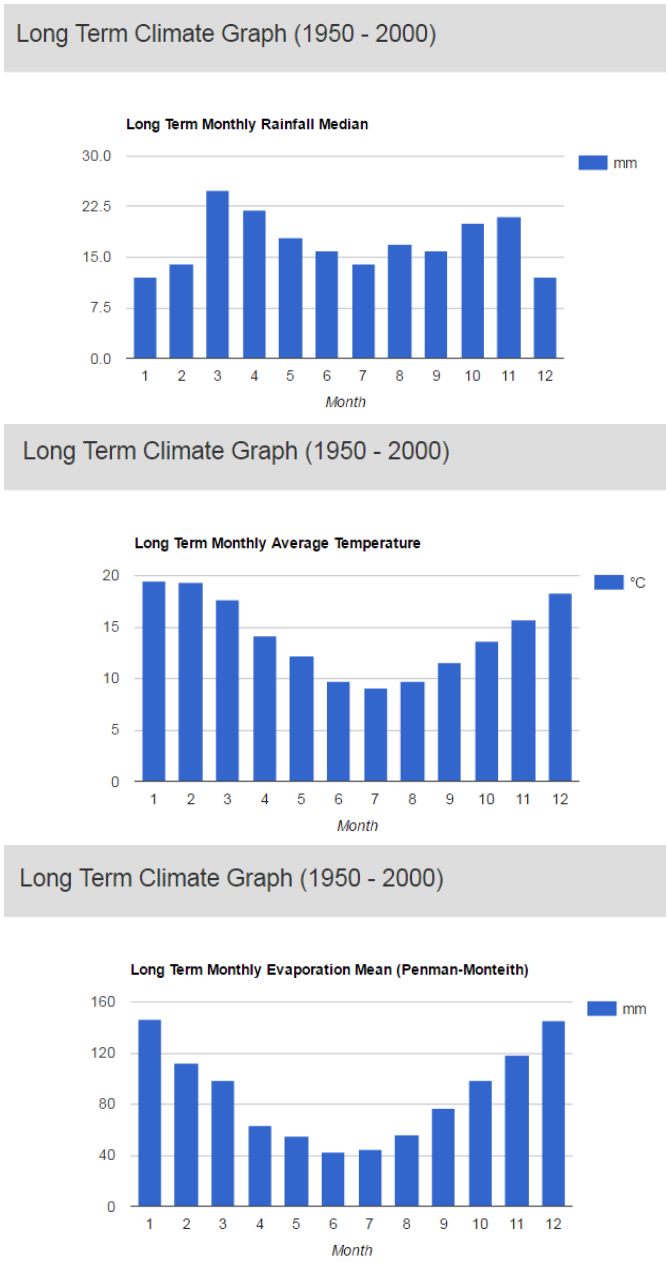


Figure 5. Average monthly rainfall (top), temperature (middle) and evaporation (bottom) for the area (CapeFarmMapper, 2016)

7.3. GEOLOGY AND SOIL

The dominant geology in the study area is quartzitic sandstone, conglomerate, grit, shale, siltstone, feldspathic sand- stone and sandstone of the Table Mountain Group which form the bulk of the mountains while shale, siltstone, sand- stone and mudstone of the Bokkeveld Group form the valleys.

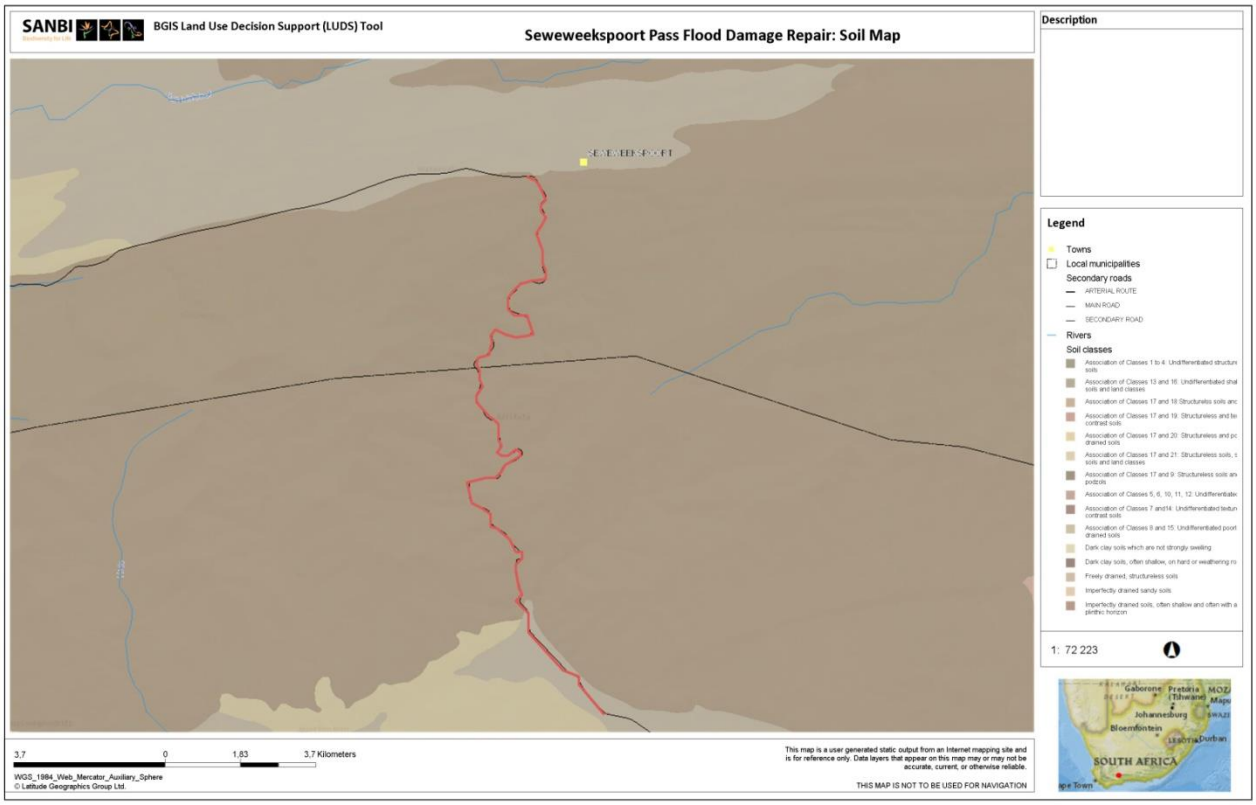


Figure 6. Soil map for the area (Biodiversity GIS, 2009)

The types of soils discernible from Figure 6 comprise largely of limited soils in the mountainous areas (dark brown area in Figure 6) with shallow soils on rock for much of the area within the valley (lighter brown and grey areas in Figure 6). The soils within the pass consist largely of weathered sandstones. Soils within the valley are with or without intermittent diverse soils and generally contain lime.

7.4. FLORA

The study area is located largely in the Fynbos biome with the Succulent Karoo biome occurring immediately north of the mountain range. The natural vegetation type that is dominant in the valley is South Swartland Sandstone Fynbos (FFs 24 - purple in Figure 7) and North Swartberg Sandstone Fynbos (FFs23 -lilac in Figure 7). Matjiesfontein Shale Renosterveld (FRs6 – medium blue in Figure 7) occurs north of the mountain range while Montagu Shale Renosterveld occurs south of the mountains (FRs7 – light blue in Figure 7). A band of Central Inland Shale Band (FFb3 - burgundy in Figure 7) is orientated west-east in the centre of the site that is associated with a shale band within the sandstone mountain range. Swartberg Altimontaine Sandstone Fynbos (FFs31 – orange in Figure 7) is located on the higher lying slopes in the mountain range.

The vegetation within the pass is still largely natural however with the valley floor the vegetation has largely been modified by agricultural activities. Vegetation within the river channel is also still largely natural with a low density of invasive alien plants. The vegetation of the river consists of two different habitats, the upper

portion is influenced by the sediments and salts of the Great Karoo and comprises largely of Sweet thorn (*Acacia karroo*) and Karee (*Searsia lancea*) with Tamarisk (*Tamarix usneoides*) on the banks and the common reed (*Phragmites australis*) dominating the instream habitat. Further downstream, the seepage from the mountain slopes within the pass result in fresher and more permanent flow. Typical species within this stretch of the river are Cape willow (*Salix mucronata*), honey bells (*Freylinia lanceolata*), blinktaaibos (*Searsia lucida*), vleibos (*Cliffortia strobilifera*), fountain bush (*Psoralea affinis*), broom restio (*Calopsis paniculata*), soft rush (*Juncus effuses*), river pumpkin (*Gunnera perpensa*) and arum lilies (*Zanthedeschia aethiopica*).

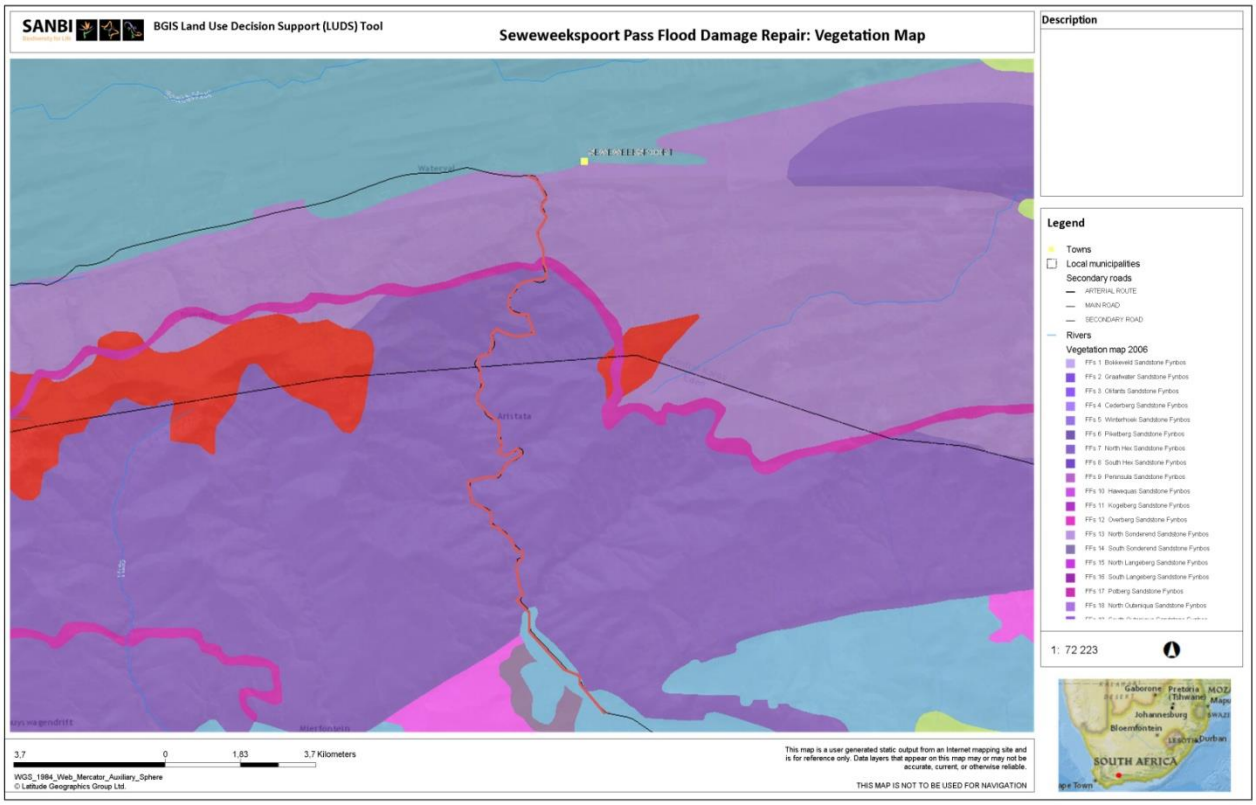


Figure 7. Vegetation map for the area (SANBI Biodiversity GIS)

7.5. AQUATIC FEATURES AND FAUNA

The main freshwater features in the study area consist of the Seweweekspoort River, its tributaries with the pass and its associated valley bottom wetland area. The Seweweekspoort River is a tributary of the Kobus River, as tributary of the Gamka River in the Gouritz River System. The Seweweekspoort River is largely contained within the Klein Swartberg Mountains and is still in a largely natural ecological state. Only once the river exits the pass does it become modified by the surrounding agricultural activities.

These aquatic ecosystems are discussed in more detail in the following section.

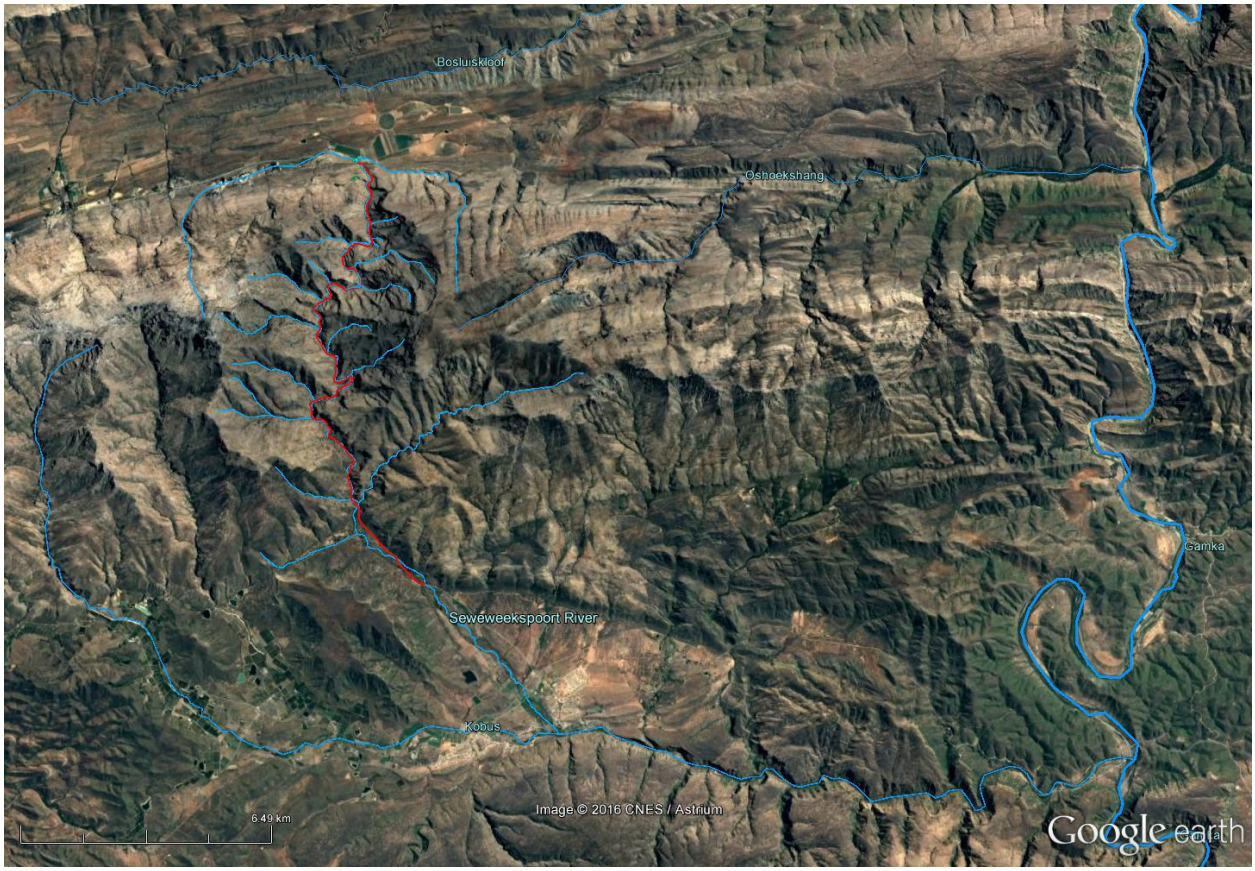


Figure 8. Google Earth image of the study area with the mapped freshwater features

7.6. LAND USE

The landcover within the study area and its surroundings is mapped as comprising largely of natural areas (pale green in Figure 9). The area is also mapped as largely being located within the CapeNature Towerkop Nature Reserve which is a formally protected area.

The road to be upgraded lies across the boundary between the Laingburg Local Municipality (Central Karoo District Municipality) and the Kanneland Local Municipality (Eden District Municipality). The closest urban areas are Ladismith to the west, Calitzdorp to the east, Vanwyksdorp and Riversdale to the south and Laingsburg to the north. The communities of Zoar and Seweweekspoort are located to the south and north of the pass respectively. Some cultivated areas occur immediately to the north and to the south of the area (yellow in Figure 9). The blue areas in Figure 9 that are mapped as wetland areas consist largely of small farm dams that have been constructed to irrigate the cultivated areas. The pass provides an important access route between the little Karoo to the south and the Great Karoo to the north.

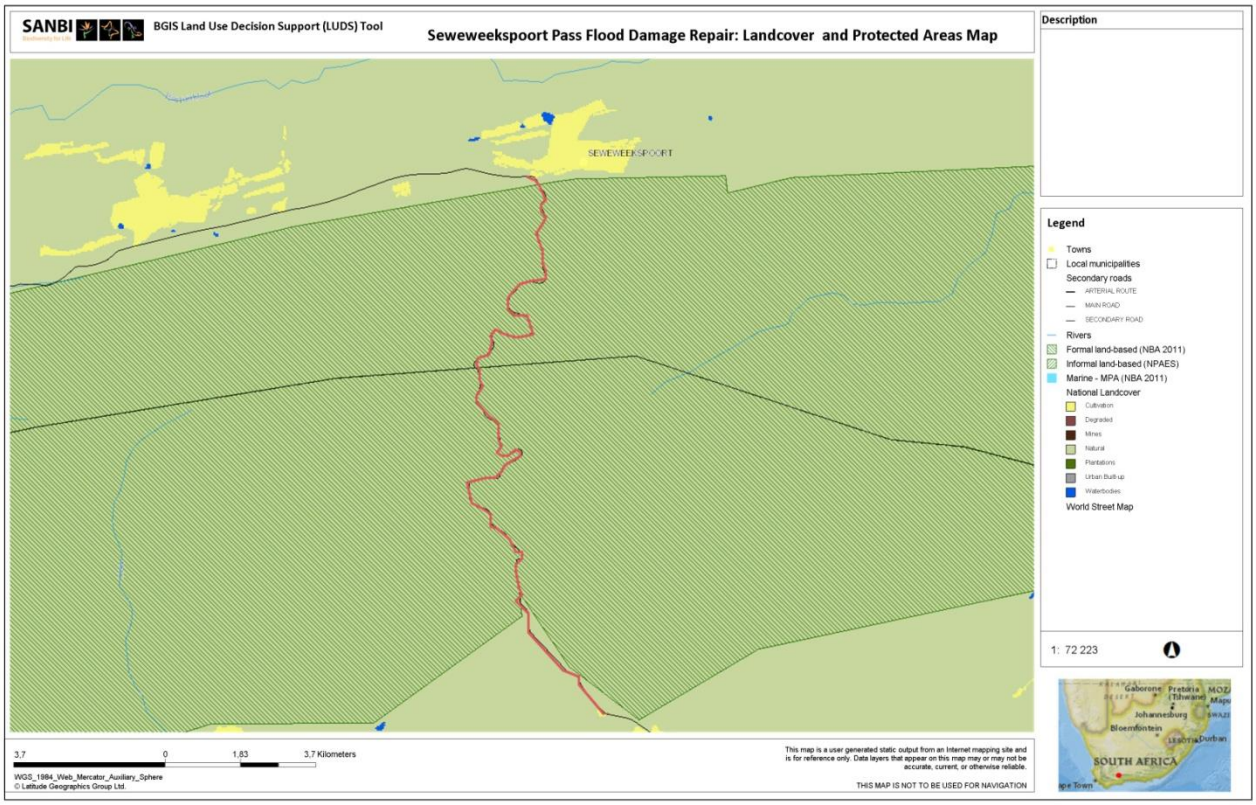


Figure 9: Land cover for the surrounding area (SANBI BiodiversityGIS, 2016)

7.7. BIODIVERSITY CONSERVATION IMPORTANCE

There are two biodiversity mapping initiatives of relevance to the site, the Western Cape Biodiversity Framework (WCBF) for the Central Karoo and Kannaland that contains fine-scale mapping and the national Freshwater Ecosystem Priority Areas (FEPA) map. The WCBF or Critical Biodiversity Areas (CBA) map aims to guide sustainable development by providing a synthesis of biodiversity information to decision makers. It serves as the common reference for all multi-sectorial planning procedures, advising which areas can be lost to development, and which areas of critical biodiversity value and their support zones should be protected against any impacts. The CBA map indicates areas of land as well as aquatic features which must be safeguarded in their natural state if biodiversity is to persist and ecosystems are to continue functioning.

Most of the study area is located within the formally protected Towerkop Nature Reserve (hatched green area in Figure 10), with the southern portion also forming part of a Mountain Catchment Area (yellow area in Figure 10). The portions of the study area immediately north and south of the protected areas are mapped as CBAs that should be protected.

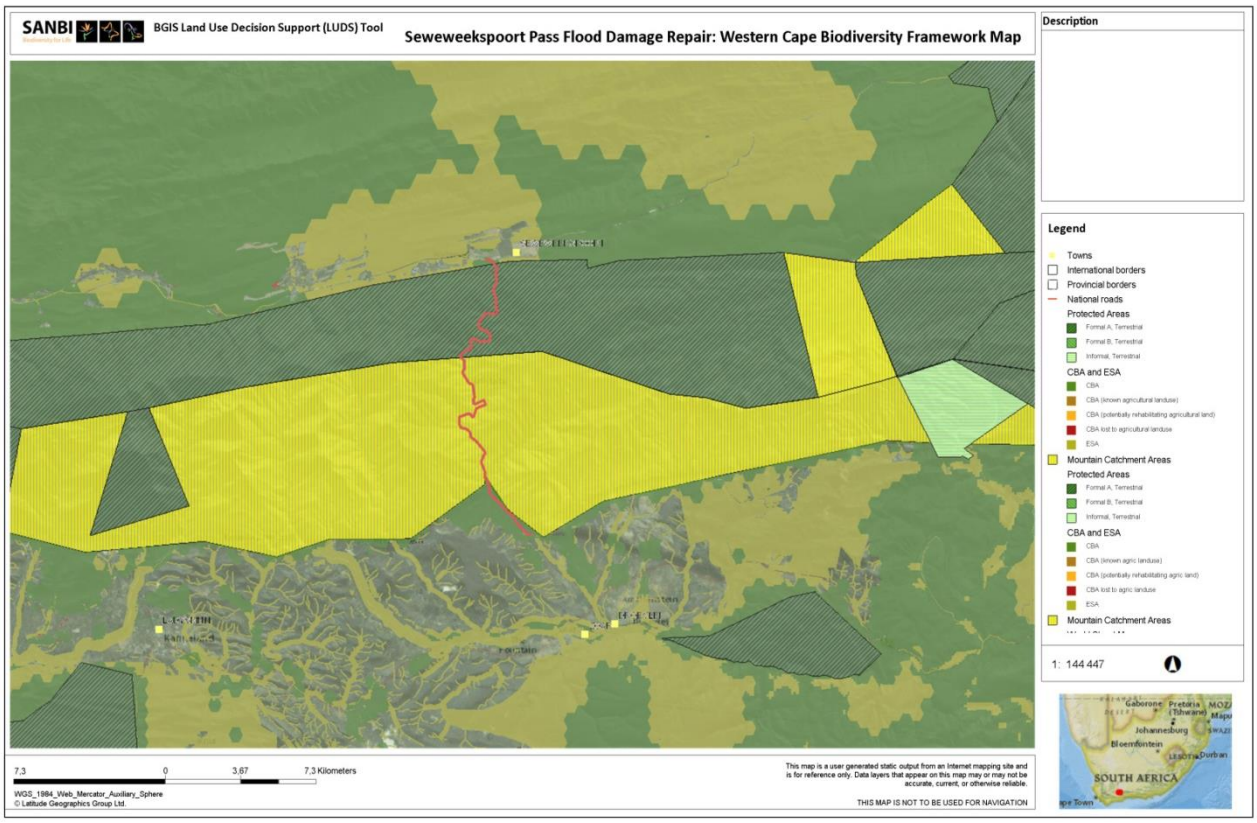


Figure 10. Western Cape Biodiversity Framework map for the area (SANBI Biodiversity GIS, 2016)

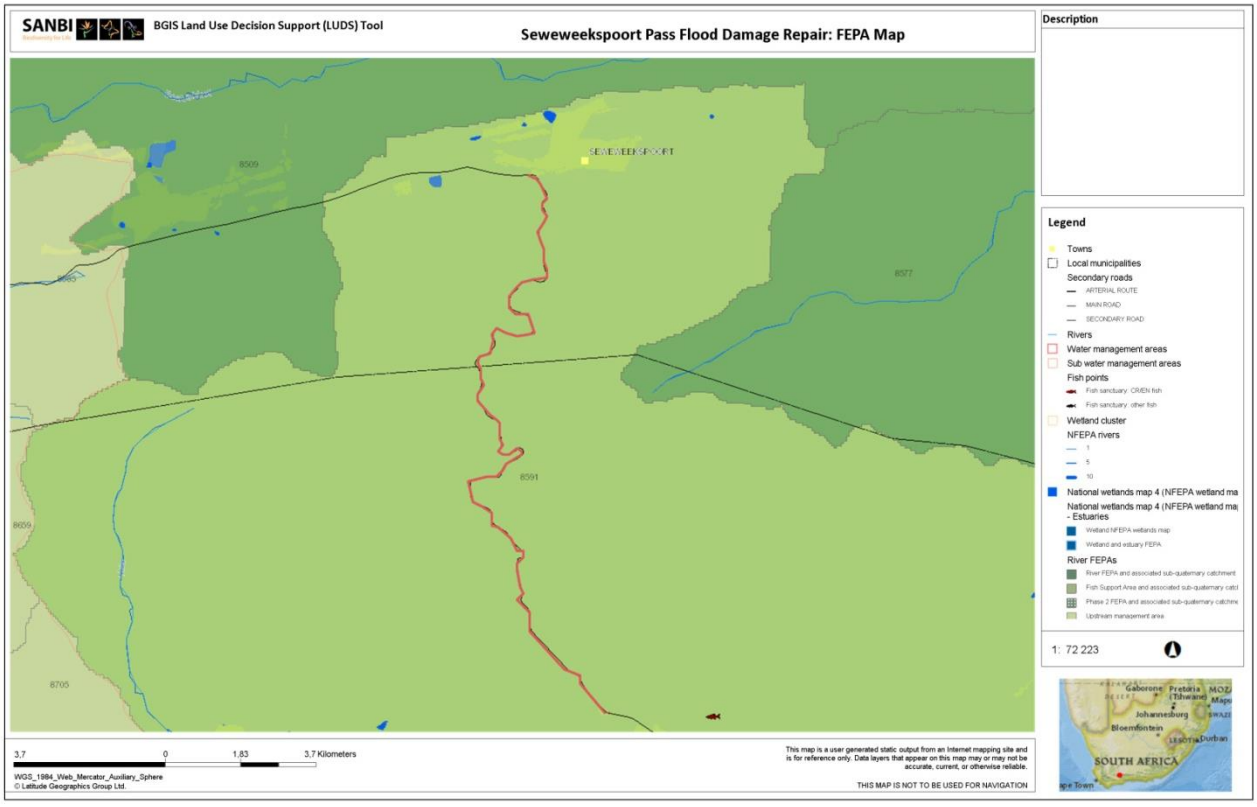


Figure 11. Freshwater Ecosystem Protected Areas (FEPA) map for the area

The Seweweekspoort River is considered to be an important fish support area for indigenous fish such as the Slender redfin (*Pseudobarbus tenius*) and Smallscale redfin (*P. asper*) and as such is mapped as a FEPA Fish Support Area (pale green area in Figure 11). FEPAs are strategic spatial priorities for conserving freshwater ecosystems and associated biodiversity. FEPAs were determined through a process of systematic biodiversity planning and were identified using a range of criteria for serving ecosystems and associated biodiversity of rivers, wetlands and estuaries. Fish support areas are important for the migration of indigenous fish species. The condition of these rivers should be improved in order to sustain the fish populations that they contain.

8. FRESHWATER ASSESSMENT

The Present Ecological Status and Site Characterisations were used to provide information on the ecological condition of the river and wetland areas assessed in this report.

8.1. SEWEWEEKSPOORT RIVER

RIVER CLASSIFICATION

In order to assess the condition and ecological importance and sensitivity of the Seweweekspoort River, it is important to classify the river according to its ecological characteristics, in order that it can be compared to ecologically similar rivers. River typing or classification involves the hierarchical grouping of rivers into ecologically similar units so that inter- and intra-river variation in factors that influence water chemistry, channel type, substratum composition and hydrology are best accounted for. Any comparative assessment of river condition should only be done between rivers that share similar physical and biological characteristics under natural conditions. Thus, the classification of rivers provides the basis for assessing river condition to allow comparison between similar river types. The primary classification of rivers is a division into Ecoregions. Rivers within an ecoregion are further divided into sub-regions.

Ecoregions are groups of rivers within South Africa, which share similar physiography, climate, geology, soils and potential natural vegetation. For the purposes of this study, the ecoregional classification presented by Department of Water which divides the country's rivers into 30 ecoregions, was used. The river assessed lies within the Southern Folded Mountains Ecoregion, with the characteristics as described in Table 3.

Sub-regions (or geomorphological zones) are groups of rivers, or segments of rivers, within an ecoregion, which share similar geomorphological features, of which gradient is the most important. The use of geomorphological features is based on the assumption that these are a major factor in the determination of the distribution of the biota. Table 4 provides the geomorphological features of the streams assessed.

Table 3. Characteristics of the Southern Folded Mountains Ecoregion

Main Attributes	Characteristics
Terrain Morphology	Lowlands; Hills and Mountains; Moderate and High Relief; Open Hills; Lowlands; Mountains; Moderate to High Relief; Closed Hills; Mountains; Moderate and High Relief
Vegetation types	Patches Afromontane Forest; Spekboom Succulent Thicket; Grassy Fynbos; Mountain Fynbos; South and South West Coast Renosterveld; Central Mountain Renosterveld; Eastern Mixed Nama Karoo; Central Nama Karoo; Great Nama Karoo; Little Succulent Karoo
Altitude (m a.m.s.l)	0-300 limited; 300-1900
MAP (mm)	200 to 1500
Rainfall seasonality	Very late summer to winter to all year
Mean annual temp. (°C)	10 to 20
Median annual simulated runoff (mm)	<5 to >250 for quaternary catchment

DESCRIPTION OF RIVERS AND SITE CHARACTERISATION

The Seweweekspoort River is a southward flowing tributary of the Kobus River. The river is largely natural for much of its middle to upper reaches where it has carved a ravine through the Klein Swartberg Mountains. Only in its lower reaches have been impacted by agricultural activities.

Figure 12. Seweweekspoort River as it enters the pass

Figure 13. View of the Seweweekspoort River within the pass

Figure 14. Seweweekspoort River immediately downstream of the pass

From the Site Characterisation assessment, the geomorphological and physical characteristics of the river can be classified as shown in Table 4.

Table 4. Geomorphological and Physical features of the river

River	Seweweekspoort
Geomorphological Zone	Lower foothill river
Lateral mobility	Largely confined
Channel form	Simple
Channel pattern	Single thread: low sinuosity
Channel type	Cobble bed
Channel modification	Largely natural
Hydrological type	Perennial
Ecoregion	Southern Folded Mountains
DWA catchment	J25B
Vegetation type	Montague Shale Renosterveld
Rainfall region	Throughout the year

INDEX OF HABITAT INTEGRITY

The evaluation of Index of Habitat Integrity (IHI) provides a measure of the degree to which a river or stream has been modified from its natural state. The methodology (DWAF, 1999) involves a qualitative assessment of the number and severity of anthropogenic perturbations on a river and the damage they potentially inflict upon the system (Table 5). These disturbances include both abiotic and biotic factors, which are regarded as the primary causes of degradation of a river. The severity of each impact is ranked using a six-point scale from 0 (no impact) to 25 (critical impact).

The IHI assessment is based on an evaluation of the impacts of two components of the river, the riparian zone and the instream habitat. The total scores for the instream and riparian zone components are then used to place the habitat integrity of both in a specific habitat category (Table 6). The assessment of habitat integrity was undertaken for the Seweweekspoort River within the study area.

Table 5: Index of Habitat Integrity Assessment results and criteria assessed

Instream Habitat Integrity	Score	Riparian Zone Habitat Integrity	Score
Water Abstraction	7	Vegetation Removal	6
Flow Modification	5	Exotic Vegetation	4
Bed Modification	4	Bank Erosion	5
Channel Modification	3	Channel Modification	3
Water Quality	4	Water Abstraction	7
Inundation	4	Inundation	4
Exotic Macrophytes	1	Flow Modification	5
Exotic Fauna	1	Water Quality	4
Rubbish Dumping	2		
Instream Habitat Integrity Score	85	Riparian Zone Habitat Integrity Score	82
Integrity Class	**B**	**Integrity Class**	**B**

Table 6: Habitat Integrity categories (From DWAF, 1999)

Category	Description	Score (% of Total)
A	Unmodified, natural.	90-100
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	80-90
C	Moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged.	60-79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota.	0

The Seweweekspoort River is in a largely natural state within the pass. Impacts to the river consist of the direct impact on the existing road and its associated activities on the riparian habitat of the river as well as the light invasion of alien plants within the disturbed riparian habitat. The upstream agricultural activities have also modified the flow and water quality of the water entering the pass.

ECOLOGICAL IMPORTANCE AND SENSITIVITY (EIS)

EIS (Table 9) considers a number of biotic and habitat determinants surmised to indicate either importance or sensitivity. The determinants are rated according to a four-point scale (Table 8). The median of the resultant score is calculated to derive the EIS category (Table 9).

Table 7. Results of the EIS assessment

Biotic Determinants	Seweweekspoort
Rare and endangered biota	3
Unique biota	3
Intolerant biota	3
Species/taxon richness	3
Aquatic Habitat Determinants	
Diversity of aquatic habitat types/features	3
Refuge value of habitat type	3
Sensitivity of habitat to flow changes	3
Sensitivity of flow related water quality changes	3
Migration route/corridor for instream and riparian biota	3.5
National parks, wilderness areas, Nature Reserves, Natural Heritage sites, Natural areas, PNEs	3.5
EIS CATEGORY	High

Table 8. Scale used to assess biotic and habitat determinants either importance or sensitivity

Scale	Definition
1	One species/taxon judged as rare or endangered at a local scale.
2	More than one species/taxon judged to be rare or endangered on a local scale.
3	One or more species/taxon judged to be rare or endangered on a Provincial/regional scale.
4	One or more species/taxon judged as rare or endangered on a National scale (i.e. SA Red Data Books)

Table 9. Ecological importance and sensitivity categories (DWAF, 1999)

EISC	General description	Range of median
Very high	Quaternaries/delineations considered unique on a national and international level based on unique biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually very sensitive to flow modifications and have no or only a small capacity for use.	>3-4
High	Quaternaries/delineations considered unique on a national scale based on their biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) may be sensitive to flow modifications but in some cases may have substantial capacity for use.	>2-≤3
Moderate	Quaternaries/delineations considered unique on a provincial or local scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are not usually very sensitive to flow modifications and often have substantial capacity for use.	>1-≤2
Low/ marginal	Quaternaries/delineations that are not unique on any scale. These rivers (in terms of biota and habitat) are generally not very sensitive to flow modifications and usually have substantial capacity for use.	≤1

The Seweweekspoort Rivers is considered to be of a high ecological importance and sensitivity. The river is home to many localised and endemic plant species as well as aquatic biota such as redfin minnows (*Psuedobarbus* spp.), ghost frogs (*Helephryne* sp.) and Victorin's warbler (*Bradypterus victorini*).

8.2. WETLAND ASSESSMENT

In terms of the Ramsar Convention on Wetlands (Iran 1971), to which South Africa is a contracting party, "… *wetlands include a wide variety of habitats such as marshes, peatlands, floodplains, rivers and lakes, and coastal areas such as salt marshes, mangroves, and sea grass beds, but also coral reefs and other marine areas no deeper than six meters at low tide, as well as human-made wetlands such as waste-water treatment ponds and reservoirs*" (Ramsar Convention Secretariat 2007).

In South Africa, wetlands are defined as "…*land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil*" (National Water Act, Act No. 36 of 1998), (NWA). Wetlands are also included in the definition of a watercourse within the NWA, which implies that whatever legislation refers to watercourses will also be applicable to wetlands.

The wetland areas within the site have been classified (Table 9) and delineated according to nationally developed guidelines. WET-EcoServices and WET-Health were utilised to assess the benefits and services supplied by the wetlands within the study area as well as to determine the integrity of the ecological processes for the wetland areas. An Ecological Importance and Sensitivity assessment was also undertaken of the wetland areas.

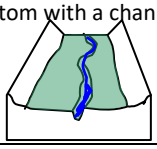
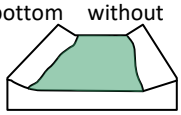
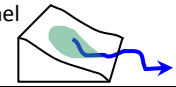
WETLAND CLASSIFICATION

The wetland areas at the site can largely be classified as a mosaic of valley bottom wetland and riparian zones that are associated with the river. The valley bottom wetland areas are closely associated with the riparian zones of the streams and as such have also been assessed as part of the river/stream assessment. The wetland features receive their flow from both groundwater and surface water. According to Table 11 the wetland areas within the study area can be classified as follows:

Table 10: Classification of wetland areas within study area

Name	**Channelled Valley bottom wetlands**
System	Inland
Ecoregion	Southern Folded Mountains Ecoregion
Landscape setting	Valley floor
Longitudinal zonation	foothills
Drainage	Associated with river and its tributaries
Seasonality	Seasonally to permanently inundated
Anthropogenic influence	Largely Natural
Geology	Sandstone
Terrestrial Vegetation	North and South Swartberg Sandstone Fynbos
Dominant wetland vegetation	*Phragmites australis* reeds in the upstream section and sedges and rushes such *Juncus effuses* and *Isolepis* sp. in the southern section
Substrate	alluvial sands
Salinity	Fresh

Table 11: Wetland hydro-geomorphic types typically supporting inland wetlands in South Africa

Hydro-geomorphic types	Description	Source of water [1]	
		Surface	Sub-surface
Floodplain 	Valley bottom areas with a well-defined channel, gently sloped, characterized by floodplain features and alluvial transport or sediment deposition, usually lead to net sediment accumulation. Water input from channel and adjacent slopes.	***	*
Valley bottom with a channel 	Valley bottom areas with a well-defined channel but lacking characteristic floodplain features. May be gently sloped, characterized by net accumulation of alluvial deposits or may have steeper slopes, characterized by a net loss of sediment. Water inputs from main channel and from adjacent slopes.	***	*/ ***
Valley bottom without a channel 	Valley bottom areas with no clear channel, gently sloped and characterized by alluvial sediment deposition, generally leading to a net accumulation of sediment. Water inputs mainly from channel entering the wetland and also from adjacent slopes.	***	*/ ***
Hillslope seepage linked to a stream channel 	Slopes on hillsides, which are characterized by the colluvial movement of materials. Water inputs are mainly from sub-surface flow and outflow is usually via a well-defined stream channel connecting the area directly to a stream channel.	*	***
Isolated Hillslope seepage 	Slopes on hillsides, characterized by colluvial material movement. Water input mainly sub-surface flow and very limited outflow or through diffuse sub-surface / surface flow with no direct surface water connection to a stream channel.	*	***
Depression (includes Pans) 	A basin shaped area with a closed elevation contour that allows for the accumulation of surface water . It may also receive sub-surface water. An outlet is usually absent, and therefore this type is usually isolated from the stream channel network.	*/ ***	*/ ***

[1] Precipitation is an important water source and evapotranspiration an important

Water source: * Contribution usually small or *** Contribution usually large

*/ *** Contribution may be small or important depending on the local circumstances


Wetland

The valley bottom wetland areas within the study area as closely associated with the Seweweekspoort and occur along the length of the river where the valley is slightly wider and flatter and where flow in the river is slightly impeded by natural rock barriers. In the upper portion the wetland areas tend to be dominated by the common reed, *Phragmites australis,* as a result of the more brakish water quality and finer sediments that are influenced by the Great Karoo while the wetland areas in the lower section consist of rushes, sedges and restios such as *Isolepis* sp., broom restio (*Calopsis paniculata*), soft rush (*Juncus effuses*) as a result of the low conductivity and coarser sediments within the pass.

Figure 15. Valley bottom wetland in the upper (top) and lower (bottom) sections of the Seweweekspoort

WETLAND HABITAT INTEGRITY

The Present Ecological Status (PES) Method (DWAF 2005) was used to establish the integrity of the wetlands in the study area and was based on the modified Habitat Integrity approach developed by Kleynhans (DWAF, 1999; Dickens *et al*, 2003). The Table below displays the criteria and results from the assessment of the habitat integrity of the wetlands. These criteria were selected based on the assumption that anthropogenic modification of the criteria and attributes listed under each selected criterion can generally be regarded as the primary causes of the ecological integrity of a wetland.

Table 12. Habitat integrity assessment criteria for palustrine wetlands (Dickens *et al*, 2003)

Criteria & Attributes	Relevance
Hydrologic	
Flow Modification	Changes in flow regime, volumes, velocity which affect inundation of habitats resulting in floralistic changes or incorrect cues to biota. Abstraction of groundwater flows to wetland.
Inundation	Impoundment resulting in destruction of natural wetland habitat and cues for wetland biota.
Water Quality	
Water Quality Modification	From point or diffuse sources such as from upstream agricultural activities, human settlements and industrial activities. Aggravated by volumetric decrease in flow delivered to the wetland.
Sediment Load Modification	Reduction due to entrapment by impoundments or increase due to land use practices. Cause of unnatural rates of erosion, accretion, infilling of wetlands and habitat change.
Hydraulic/Geomorphic	
Canalisation	Desiccation or change to inundation of wetland and habitat change. River diversions or drainage.
Topographic Alteration	Consequence of infilling, ploughing, trampling, bridges, roads, railway lines and other substrate disruptive activities that reduce or change wetland habitat directly in inundation patterns.
Biota	
Terrestrial Encroachment	Desiccation of wetland and encroachment of terrestrial plant species due to changes in hydrology or geomorphology. Change from wetland to terrestrial habitat and loss of wetland functions.
Indigenous Vegetation Removal	Direct destruction of habitat through farming, grazing or firewood collection affecting wildlife habitat and flow attenuation functions, organic matter inputs and increases potential for erosion.
Invasive Plants	Affects habitat through changes in community structure and water quality changes.
Alien Fauna	Presence of alien fauna affecting faunal community structure.
Over utilization	Overgrazing, over fishing, etc.

Table 13. Wetland habitat integrity assessment (score of 0=critically modified to 5=unmodified)

Criteria & Attributes	**Valley bottom wetlands**
Hydrological	
Flow Modification	4.1
Permanent Inundation	4.3
Water Quality	
Water Quality Modification	4.0
Sediment Load Modification	3.7
Hydraulic/Geomorphic	
Canalisation	4.0
Topographic Alteration	4.2
Biota	
Terrestrial Encroachment	4.1
Indigenous Vegetation Removal	3.9
Invasive Plant Encroachment	4.1
Alien Fauna	4.6
Over utilization of Biota	4.5
Category	**A/B**

Table 13. Relation between scores given and ecological categories

Scoring Guidelines	Interpretation of Scores for all Attributes: Rating of Present Ecological Status Category (PESC)
Natural, unmodified – score=5.	CATEGORY A >4; Unmodified, or approximates natural condition.
Largely natural – score=4.	CATEGORY B >3 and ≤4; Largely natural with few modifications, but with some loss of natural habitats.
Moderately modified-score=3.	CATEGORY C >2 and ≤3; moderately modified, but with some loss of natural habitats.
Largely modified – score=2.	CATEGORY D ≤2; largely modified. Large loss of natural habitat & basic ecosystem function has occurred.
	OUTSIDE GENERALLY ACCEPTABLE RANGE
Seriously modified – rating=1.	CATEGORY E >0 and <2; seriously modified. Extensive loss of natural habitat & basic ecosystem function.
Critically modified – rating=0.	CLASS F 0; critically modified. Modification reached critical levels with system completely modified.

The WET-Health method was then used to determine that overall Present Ecological Status (PES) for the wetlands. PES scores were determined for geomorphology, hydrology, water quality and vegetation to generate the overall score and ecological category (Table 14).

Table 14: WET-Health assessment of wetland areas in the study area

Components	Method used for assessment	Valley bottom wetlands	
		PES% Score	Ecological Category
Hydrology PES	WET-Health Hydro Module	90 %	**A/B**
Geomorphology PES	WET-Health Geomorph Module	97 %	**A**
Water quality PES	Landuse-WQ Model	99 %	**A**
Vegetation PES	WET-Health Veg Module	80 %	**B/C**
Overall Wetland PES	WET-Health default weightings	89 %	**A/B**

The valley bottom wetlands are considered to be largely natural with the only impacts are the direct habitat and aquatic vegetation impacts associated with the existing road, as well as flow modification as a result of the upstream agricultural activities (Table 14). There is also a low density invasion of alien plants as a result of the disturbance activities.

ECOSYSTEM GOODS AND SERVICES

The assessment of the ecosystem services supplied by the wetland areas was conducted according to the guidelines as described by Kotze *et* al (2005). An assessment was undertaken that examines and rates the services listed in Table 15. The characteristics were scored according to the general levels of services provided.

Table 15: Goods and services assessment results for wetlands (low=0 and high=4)

Goods and services	Valley bottom
Flood attenuation	3.0
Stream flow regulation	3.2
Sediment trapping	3.4
Phosphate trapping	2.0
Nitrate removal	2.3
Toxicant removal	1.5
Erosion control	2.9
Carbon storage	1.8
Biodiversity Maintenance	3.3
Water supply	2.8
Natural resources	0
Cultivated foods	0
Cultural significance	0.5
Tourism and recreation	3.0
Education and research	0.8

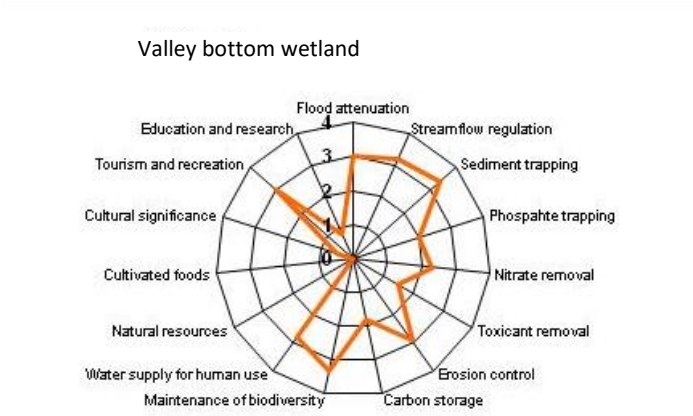


Figure 16: Ecosystem services provided by the wetland areas

The valley bottom wetlands provides important goods and services such as flood attenuation, flow regulation, erosion control and sediment trapping for the Seweweekspoort River (Figure 16). The wetland areas are important for providing habitat for biodiversity.

ECOLOGICAL IMPORTANCE AND SENSITIVITY

The EIS Assessment for the wetland areas is undertaken in the same manner as that for the river and considers a number of biotic and habitat determinants surmised to indicate either importance or sensitivity. The main ecological importance of the valley bottom wetland areas are their link to the river system.

Table 16: Results of the EIS assessment for the wetland areas

Biotic Determinants	**Valley bottom**
Rare and endangered biota	3
Unique biota	3
Intolerant biota	3
Species/taxon richness	2
Aquatic Habitat Determinants	
Diversity of aquatic habitat types or features	2
Refuge value of habitat type	3
Sensitivity of habitat to flow changes	3
Sensitivity of flow related water quality changes	3
Migration route/corridor for instream and riparian biota	2
National parks, wilderness areas, Nature Reserves, Natural Heritage sites, PNEs	3
EIS CATEGORY	Moderate to High

The valley bottom wetlands are of a moderate to high ecological importance and sensitivity due to their link with the Seweweekspoort River.

9. ASSESSMENT OF IMPACTS

9.1. DESCRIPTION AND ASSESSMENT OF IMPACTS OF PROPOSED ACTIVITIES

This section provides an assessment of the potential aquatic ecosystem impacts that are likely to be associated with the proposed road improvement activities. The impact assessment and recommended mitigation measures are per site as outlined in Table 17.

The roadway and associated structures are already in existence adjacent to or within the freshwater features described in the previous section. The road, together with some other physical modifications to the freshwater features in the upper catchment, has resulted in the current ecological condition of the river and its associated wetland areas. Therefore it can be expected that the likely impacts of the proposed upgrade of the road crossings are of a limited extent and of a short term nature, occurring mostly during the construction phase.

Longer term impacts that are likely to occur as a result of the proposed activities relate to how the maintenance work is undertaken for the road as well as the potential encroachment of invasive alien vegetation into the freshwater features where they have been disturbed by the construction activities.

The proposed upgrades will also result in a positive impact as the capacity of the crossing structures will be increased which will reduce the impact of the structures on the hydraulics of the river and the likelihood that the structures will become blocked. This will result in a reduced need to repair flood damage to the road and structures or remove sediment and debris at the structures on an ongoing basis.

A description of each site, the proposed activity, and specific mitigation measures are included in the following table. General mitigation measures are:

- Work within the river channel or wetland areas should be limited as far as possible and the disturbed areas rehabilitated immediately afterwards.
- Construction within the river channel should as far as possible take place during the drier months of the year.
- To minimise the impact of the temporary bypass, the bypass route should be selected to avoid larger riparian trees as far as possible. Larger plants should be trimmed back to leave their stems and roots intact rather than removing the entire trees unless absolutely necessary. Bidem should be placed over the existing topsoil and vegetation before placing the fill material in the channel, that the fill material can all be removed after completion of the road crossing structure. Pipe culverts should be temporarily placed within the channel to ensure the low flow in the river is not impeded. Sandbags should be placed on the outer edge of the bypass to prevent the sashing of sediment into the channel.
- Rubble and debris from existing structures and construction activities, as well as the temporary bypass structure, should be removed after construction is complete so as not to impede flow in the stream.
- Once construction is complete, the area should be rehabilitated to resemble that of the surrounding bed and banks and where necessary vegetated with suitable local indigenous plants as occur at the site.

- The channel upstream of the crossing should be kept free of debris and sediment build-up, particularly at the culvert where it might impede flows.
- Any invasive alien plants from the road reserve should be monitored and removed on an ongoing basis according to methods as provided by the Working for Water Programme.

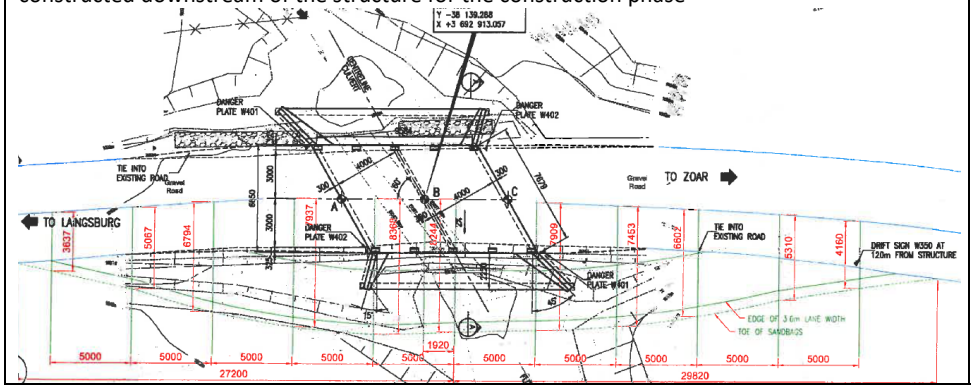
The DEADP Maintenance Management Plan guidelines (2013) provide the following set of guiding principles for maintenance work in water courses that are of relevance to this project:

- Minimise the spatial extent of disturbance and maximise physical diversity.
- Minimise the frequency of, or requirement for, maintenance activities.
- Minimise upstream/downstream impacts on the reach in which the sites are located.
- Do not impede the movement of aquatic and riparian biota.
- Minimise alterations to flow- and sediment-capacity.
- Rehabilitate and re-vegetate after construction.
- Clear alien plant species.
- Minimise impact on the structural integrity of the water course and maintain a minimum base flow at all times.
- Maintenance activities are best done during the dry season.
- All reasonable measures should be undertaken to ensure that river maintenance activities minimise erosion.
- Whenever possible existing access routes should be used. All potential pollutants should be kept away from rivers.
- Spoil material should be removed to approved dumping sites.
- After construction, any areas within the maintenance footprint that have been degraded from their condition prior to construction and as a result of the construction activities must be restored to their former condition.
- Channelization or canalization is actively discouraged as it tends to result in bigger problems than those it was intended to solve.
- Valuable biophysical or aesthetic areas, including meanders, and in-channel and floodplain habitat, should be retained.
- Cleared woody material must be removed from the riparian area to prevent it being washed into the river channel during the wet season.

Table 17. Assessment of river crossings on MR 309

Km 40.9

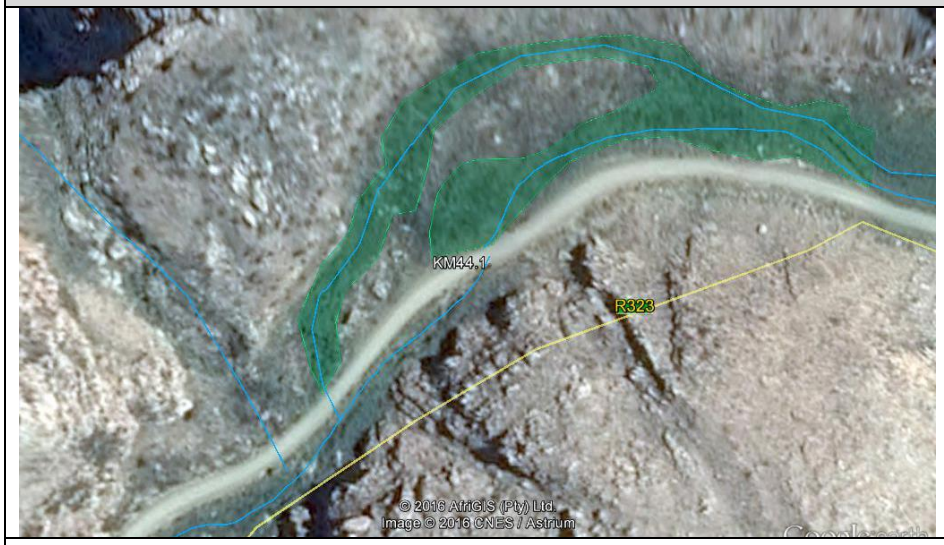
Proposed Activity: The existing culvert structure consists of 3x600mm pipes with gabions upstream. Ponding occurs at the inlet and outlet to the structure. It is proposed to replace the structure with a 8m wide causeway of 2 x 4m Wide Cells. A 3.5m wide by-pass will be constructed downstream of the structure for the construction phase



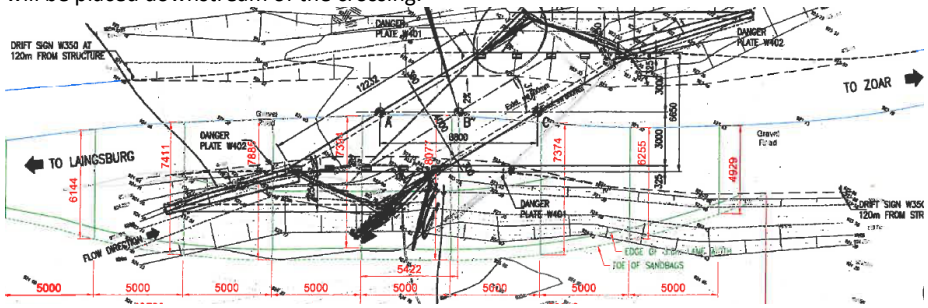
Site description: The river at the road crossing flows through a relatively flat landscape. Upstream of the crossing the riparian zone is invaded with invasive alien trees such as poplars and black wattle trees that surround a *Phragmites* reedbed. Downstream of the river channel is consists of a large *Phragmites* reedbed. The upstream inlet has been stabilised by a low gabion wall.

Specific Mitigation measures:
Remove invasive alien vegetation (black wattle trees) within or immediately adjacent to the road reserve at the road crossing
This site is specifically susceptible to the build up of sediment. The height and size o the culvert structure should ensure that the culverts do not become blocked with sediment on a regular basis. *Phragmites* reeds may need to be managed to ensure that the structure does not become blocked.

Km 44.1



Proposed Activity: The existing culvert structure consists of 2x600mm encased pipes that are orientated at an acute angle to the road. It is proposed to straighten the crossing by 7m and to replace the culvert structure with a 4m wide causeway. The upstream and downstream wingwalls will need to be extended to protect the banks from erosion. The temporary bypass will be placed downstream of the crossing.

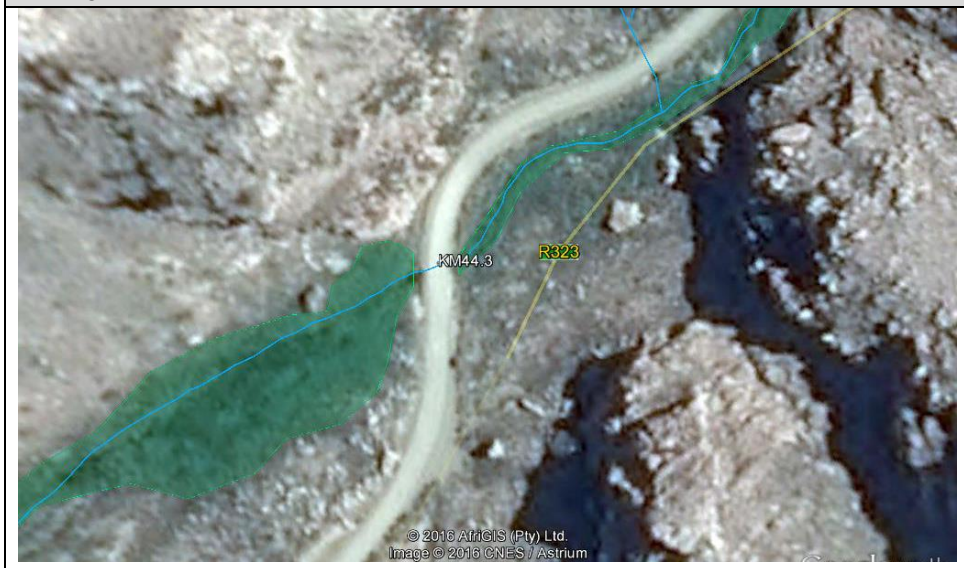


Temporary bypass to be moved to downstream site as the side with the least potential impact

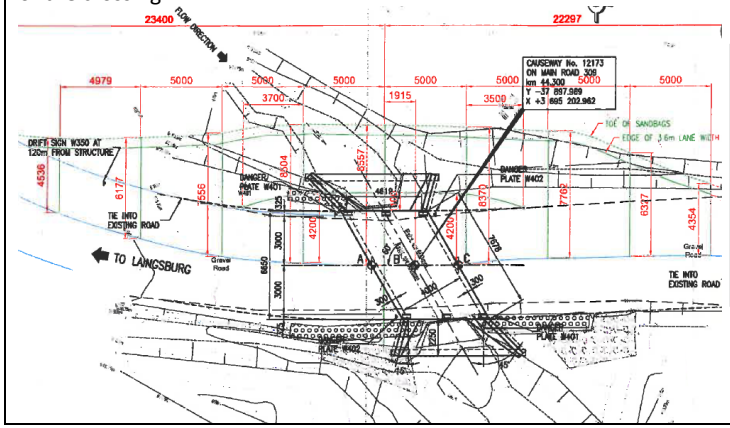
Site description: Upstream of the road crossing the channel is located along the road and consists of wetland vegetation such as broom restio (*Calopsis paniculata*), river pumpkin (*Gunnera perpensa*) and arum lilies (*Zanthedeschia aethiopica*) together with Cape willows (*Salix mucronata*). Downstream of the crossing the river is contained within a narrow channel with grassed banks. This upper section of the river channel within the pass has recently burnt, with most of the larger riparian trees being significantly burnt.

Specific mitigation measures:
The sizing, level of the culvert in relation to the channel bed and the alignment of the river channel at the road crossing are important factors in trying to reduce the potential for sedimentation and erosion taking place at the road crossing. The new culvert structures should not be placed higher than the base level of the river channel to ensure that low flows are not impeded.

Km 44.3



Proposed Activity: The existing culvert structure consists of 2x600mm encased pipes, with wing walls and apron slabs. The gabions downstream have been damaged. It is proposed to replace the structure with a 6m wide causeway and to remove the gabions. The new structure will be aligned slightly upstream of its current location. A temporary bypass will be placed downstream of the crossing.



Temporary bypass to be moved to downstream site as the side with the least potential impact

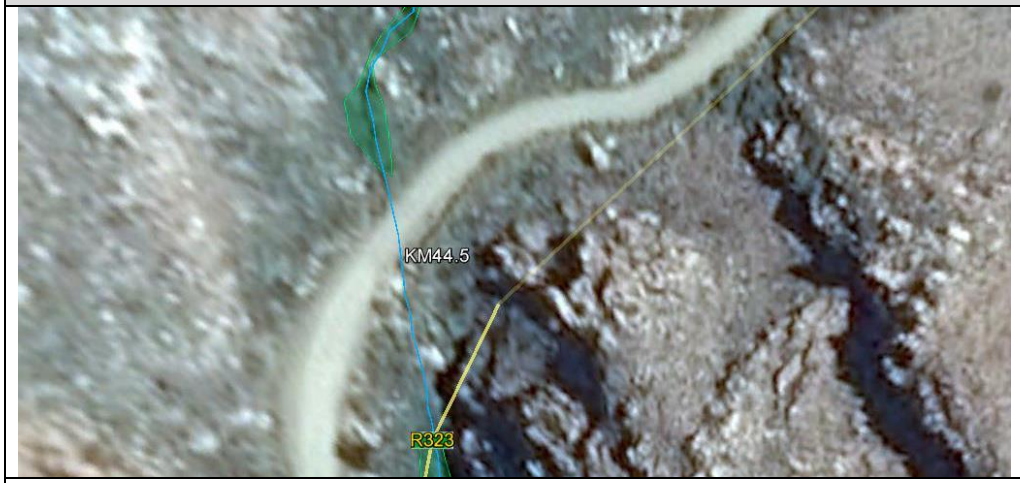
Site description: Upstream of the road crossing, the river channel is dominated by *Phragmites* reeds Downstream of the structure, wetland vegetation such as vleibos (*Cliffortia strobilifera*), fountain bush (*Psoralea affinis*), broom restio (*Calopsis paniculata*), creeping rush (*Juncus lomotophyllus*), vlei sedge *Carpha glomerata,* river pumpkin (*Gunnera perpensa*), taaiblaarmalva (*Pelargonium glutinosum*) and arum lilies (*Zanthedeschia aethiopica*).

Specific Mitigation measures:

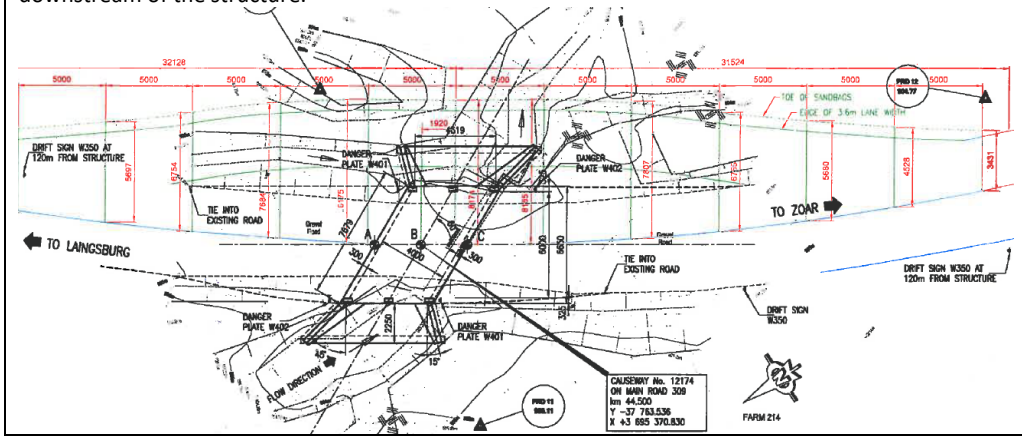
The material from the removed gabion structures and any rock that needs to be broken should be removed from the river channel and utilised for reshaping of the river banks or elsewhere in the construction works.

The baselevel of the river channel should not be significantly altered.

Km 44.5



Proposed Activity: The existing causeway structure consists of 2x600mm encased pipes, grouted stone head walls, The base of the structure is scoured and water is running under the structure. It is proposed to replace the structure with a 4m wide causeway. The temporary bypass will be placed downstream of the structure.

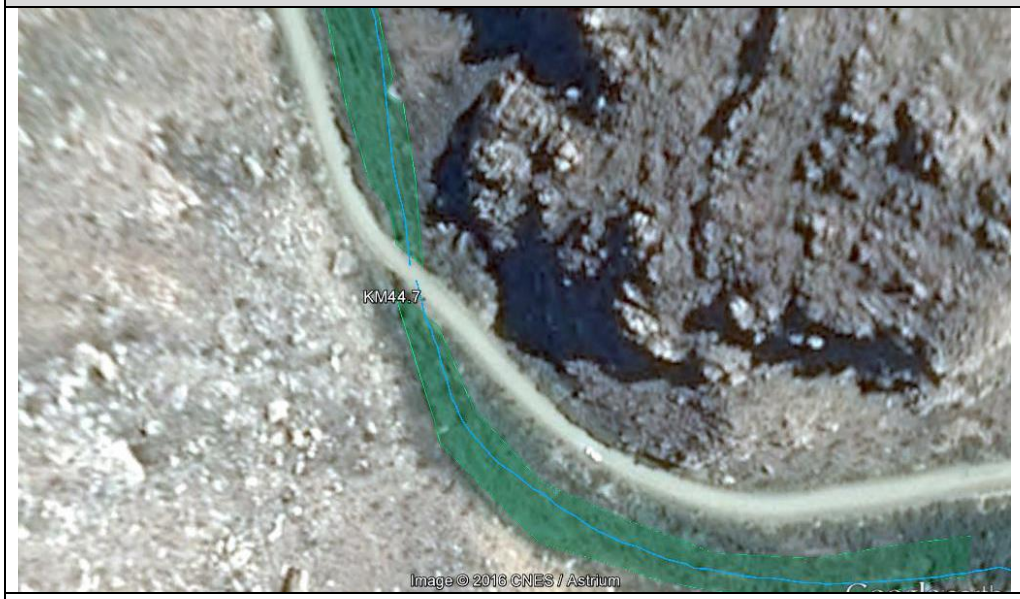


Site description: The stream is largely confined to a narrow channel at the crossing, consisting mostly of boulders. Indigenous vegetation includes Cape willow (*Salix mucronata*), blinktaaibos (*Searsia lucida*), sand olive (*Dodonaea angustifolia*), fountain grass (*Pennisetum setaceum*), broom restio (*Calopsis paniculata*). Material from past road repair works has been deposited on the upstream bank.

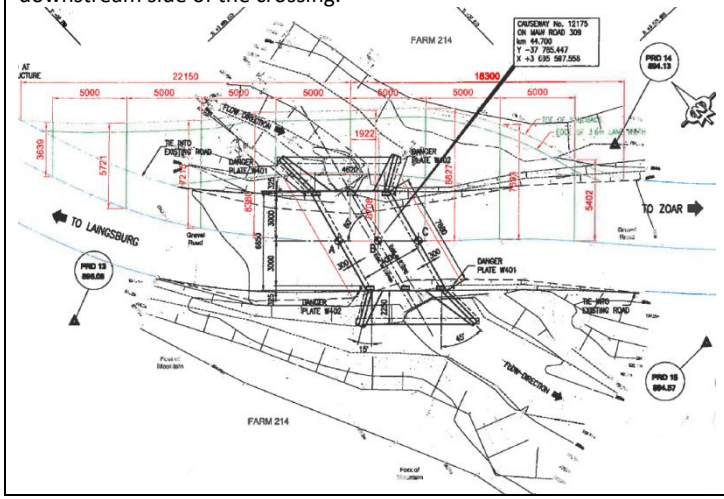
Specific Mitigation measures:

The dumped material from previous road repair works should be utilised was far as possible for the construction of the new crossing and the banks shaped to resemble that of the surrounding unimpacted banks.

Km 44.7



Proposed Activity: The existing culvert structure consists of 2x600mm encased pipes that have been placed at a low level and been subjected to heavy siltation. The structure has also been placed at a low level. It is to be replaced with a 6m wide causeway. The temporary bypass is to be located on the downstream side of the crossing.



Temporary bypass to be moved to downstream site as the side with the least potential impact

Site description: The river is largely confined to a relatively narrow channel at the crossing. Indigenous vegetation includes Cape willow (*Salix mucronata*), vleibos (*Cliffortia strobilifera*), sand olive (*Dodonaea angustifolia*), blinktaaibos (*Searsia lucida*), fountain grass (*Pennisetum setaceum*) and broom restio (*Calopsis paniculata*). Material from past road repair works has been deposited on the downstream bank.

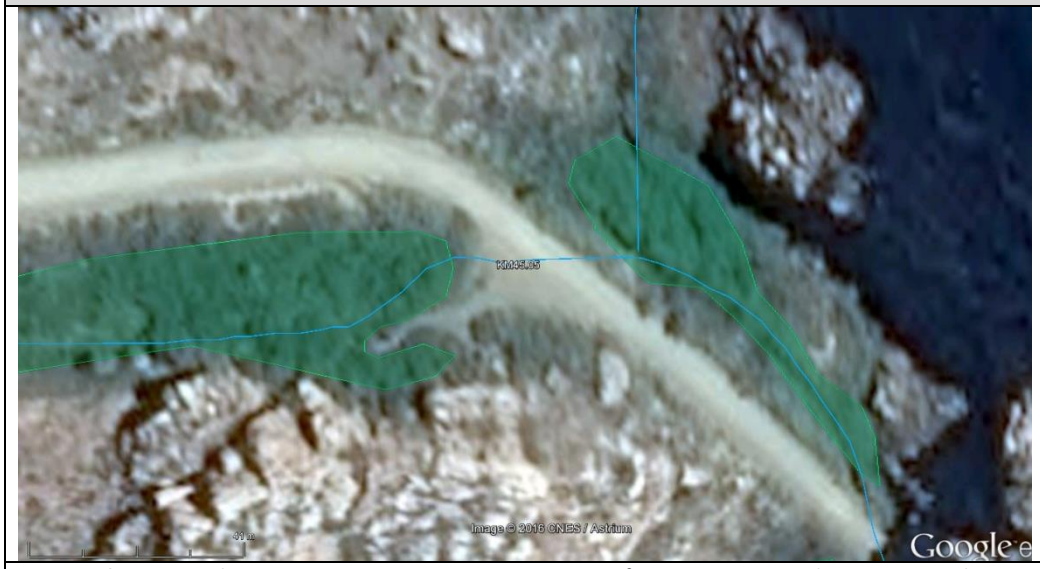
Mitigation of the proposed embankment repair:

The dumped material from previous road repair works should be utilised was far as possible for the construction of the new crossing and the banks shaped to resemble that of the surrounding unimpacted banks.

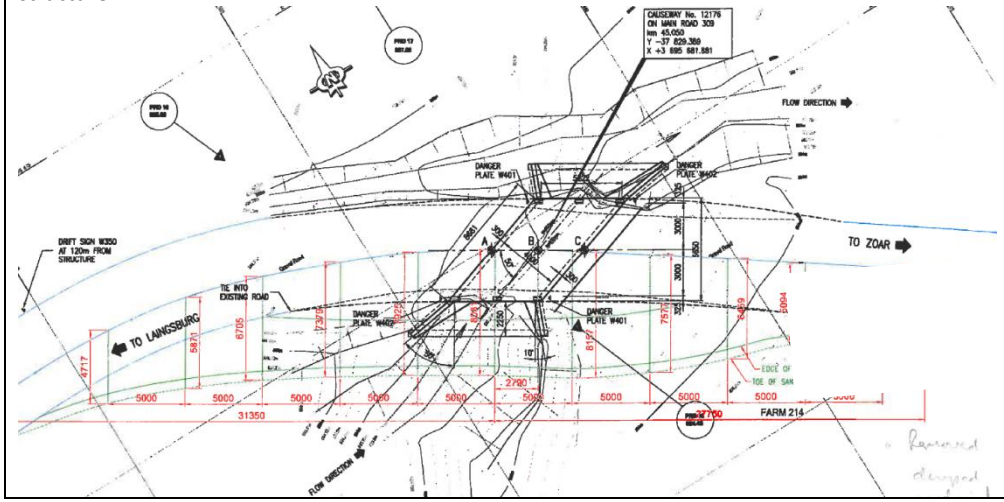
The mature Cape willow trees adjacent to the crossing should be avoided. Ongoing monitoring and clearing of any invasive alien plants within the disturbed areas should take place.

Cape willow tree

Km 45.05



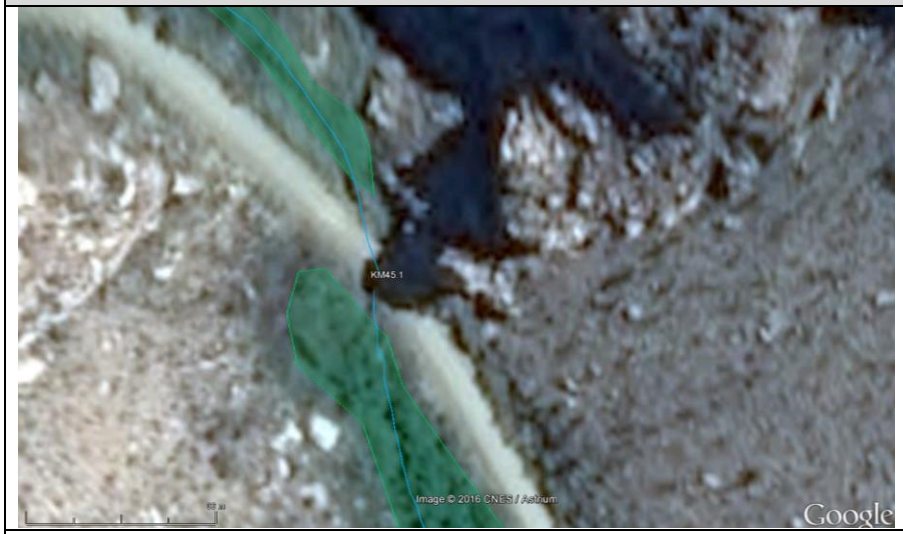
Proposed Activity: The existing causeway structure consists of 2x600mm encased pipes, grouted stone head walls that have been damaged and the structure has become partially silted up. The structure is to be replaced with a 4m wide causeway. The temporary bypass will be placed upstream of the structure.



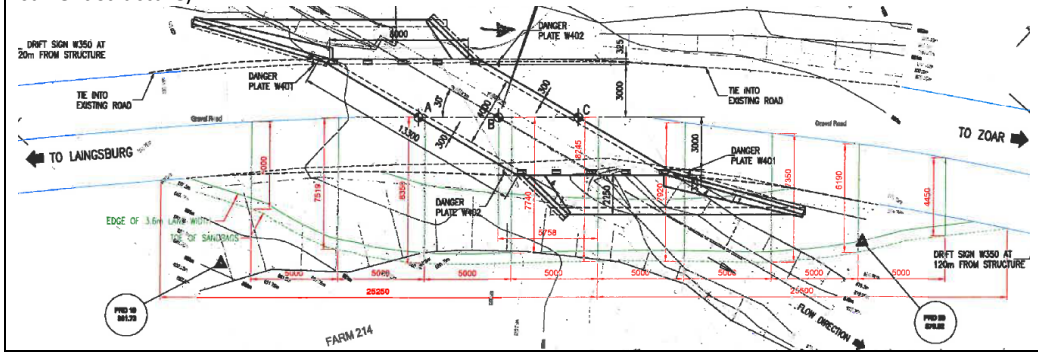
Site description: The river channel upstream and downstream of the crossing comprises wetland area with a berm on the upstream side that is the result of past road maintenance activities that was intended to protect the crossing form stormwater runoff. Indigenous vegetation includes Cape willow (*Salix mucronata*), blinktaaibos (*Searsia lucida*), sand olive (*Dodonaea angustifolia*), creeping rush (*Juncus lomotophyllus), Isolepis polifera*, broom restio (*Calopsis paniculata*), common reeds (*Phragmites australis*) and the everlasting *Helichrysum cymosum*. Material from past road repair works has been deposited on the upstream bank.

Specific Mitigation measures:
The dumped material berm should be removed and utilised was far as possible for the construction of the new crossing and the banks shaped to resemble that of the surrounding unimpacted banks.

Km 45.1



Proposed Activity: The existing causeway structure consists of 2x600mm encased pipes with stone and concrete head walls upstream. The structure is to be replaced with a 4m wide causeway. The road will be realigned such that it crosses the river approximately 7m upstream of its current location and the temporary bypass will then be placed downstream of the new structure (largely in the location of the current structure).



Site description: The river channel contains many large riparian trees as well as some wetland vegetation. A sand and stone berm is located on the upstream side that is the result of past road maintenance activities. Indigenous vegetation includes honey bells (*Freylinia lanceolata*), blinktaaibos (*Searsia lucida*) broom restio (*Calopsis paniculata*), fountain bush (*Psoralea affinis*) and river pumpkin (*Gunnera perpensa*). Material from past road repair works has been deposited on the upstream bank.

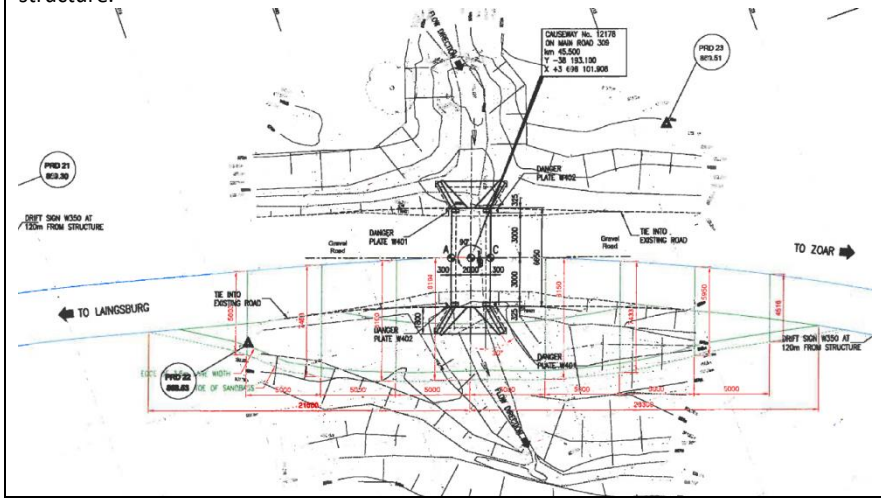
Specific Mitigation measures:

The dumped material berm should be removed and utilised was far as possible for the construction of the new crossing and the banks shaped to resemble that of the surrounding unimpacted banks.

Avoid cutting down larger riparian trees as far as possible. The larger plants should be trimmed back to leave their stems and roots intact rather than removing the entire trees unless absolutely necessary.

Km 45.5

Proposed Activity: The existing causeway structure consists of 1x600mm pipe. The structure is to be replaced with a 3m wide causeway. A temporary bypass will be placed downstream of the new structure.



Site description: The site consists of the crossing of a tributary of the river that flows down a steep catchment. The vegetation has been burnt and is currently dominated by weedy shrubs the larger riparian shrubs and trees such as the waterwitels (*Brachylaena neriifolia*), blinktaaibos (*Searsia lucida*) and Bitou bush (*Chrysanthemoides monilifera* subsp. *rotundata*) are starting to resprout.

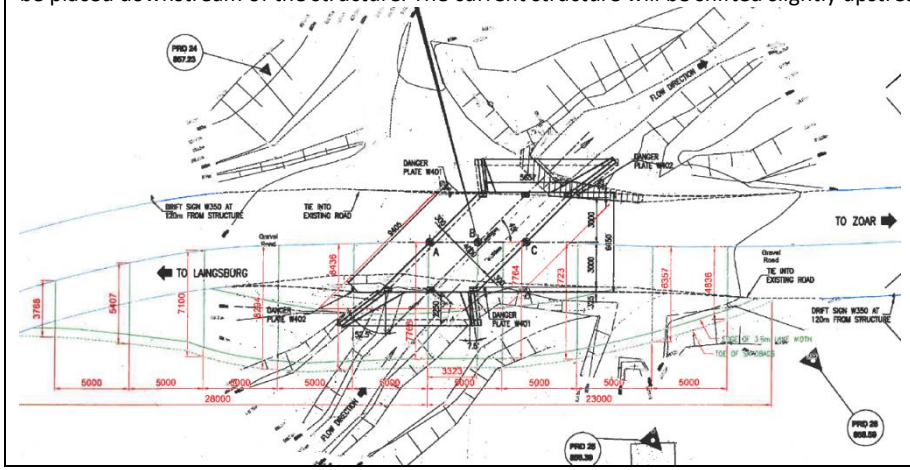
Specific Mitigation measures:

As this area is relatively disturbed as a result of the recent fire, it will need to be monitored and managed for invasive alien plant growth and has the potential for increased for sedimentation downstream.

Although the large riparian shrubs have been burnt they are resprouting and should be avoided as far as possible when establishing the bypass road. The shrubs that cannot be avoided should be cut back that they can resprout after the construction activities are complete.

Km 45.97

Proposed Activity: The existing causeway structure consists of 2x600mm encased pipes with stone and concrete head walls at inlet and outlet. The structure is almost completely buried as a result of heavy siltation. The structure is to be replaced with a 4m wide causeway. The temporary bypass will be placed downstream of the structure. The current structure will be shifted slightly upstream.



Site description: The site shows evidence of disturbance and contains weedy shrubs and a berm of material from past road works. Indigenous vegetation includes Cape willow (*Salix mucronata*), bitter aloe (*Aloe ferox*), the sedge *Ficinia nigrescence*, creeping rush (*Juncus lomotophyllus),* broom restio (*Calopsis paniculata*), fountain bush (*Psoralea affinis*), river pumpkin (*Gunnera perpensa*) and wittamarak (*Albuca Canadensis*). Redfin minnow fry and tadpoles were also observed at the site.

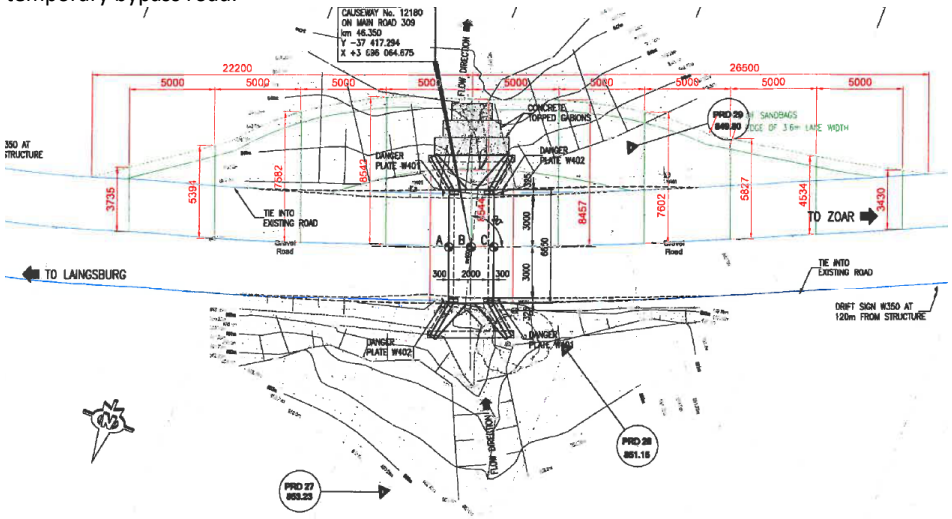
Specific Mitigation measures:

As this area is relatively disturbed as a result of the recent fire, it will need to be monitored and managed for invasive alien plant growth and has the potential for increased for sedimentation downstream.

Although the large riparian shrubs have been burnt they are resprouting and should be avoided as far as possible when establishing the bypass road. The shrubs that cannot be avoided should be cut back that they can resprout after the construction activities are complete.

Km 46.35

Proposed Activity: The existing causeway structure consists of 1x600mm encased pipes with a stone head wall upstream. The new proposed structure will consist of a 2m wide causeway with 2x900mm pipe culverts with additional strengthening. The structure will also be stepped to accommodate the drop at the site. The works at the road will be undertaken in half roadwidths as there is no space for a temporary bypass road.

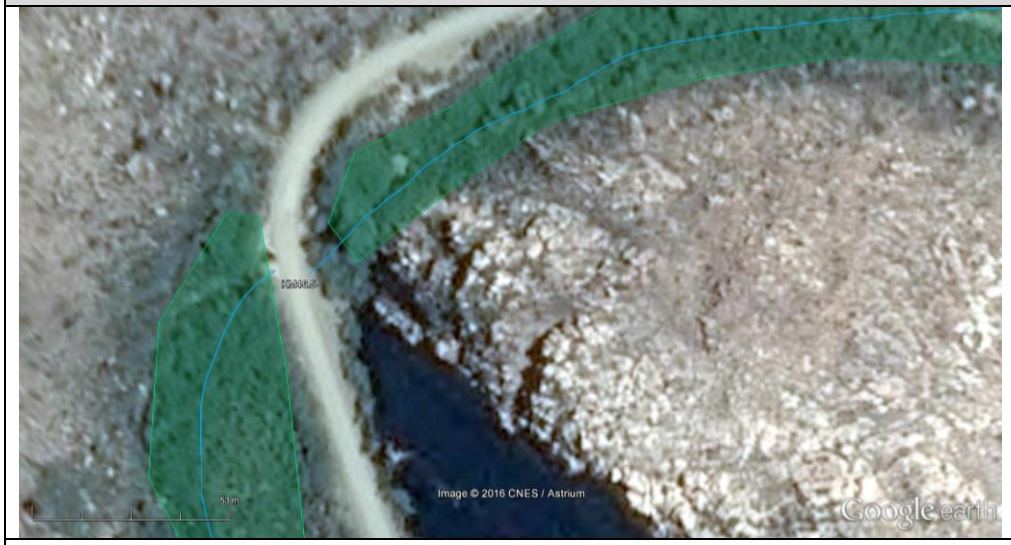


Site description: The site consists of the crossing of a tributary of the river that flows down a steep catchment and drops steeply at the crossing. The vegetation is minimal with a stream channel dominated by larger boulders.

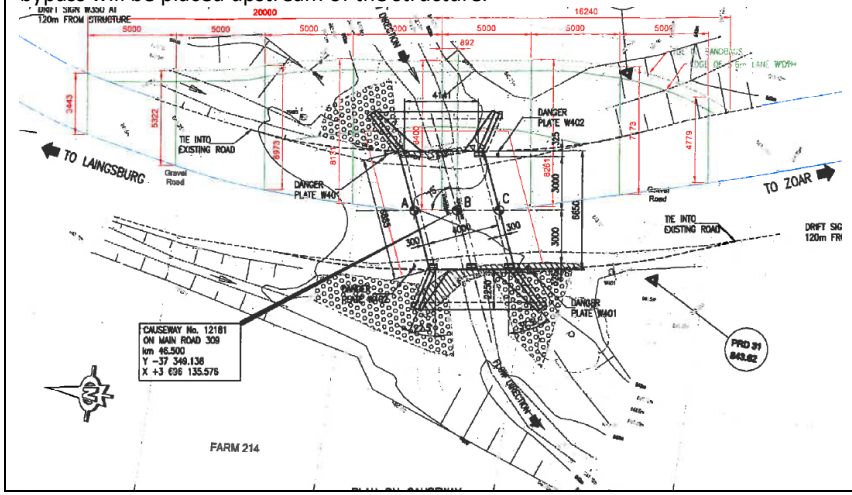
Specific Mitigation measures:

As this stream channel drops steeply at the site, the risk of erosion downstream of the crossing is high and the level at which the culverts are constructed is critical. Stormwater runoff from the road into the stream channel should also be mitigated to prevent erosion of the embankment at the crossing. Where necessary the disturbed area on the stream banks should be revegetated with at least indigenous grasses to reduce the risk of erosion.

Km 46.5



Proposed Activity: The existing causeway structure consists of 2x600mm encased pipes, with concrete and stone head walls at inlet and outlet and stone pitching aprons. As a result of siltation, the structure is completely buried. The structure is to be replaced with a 6m wide causeway. The road will be shifted slightly downstream and some bedrock will need to be removed. The temporary bypass will be placed upstream of the structure.



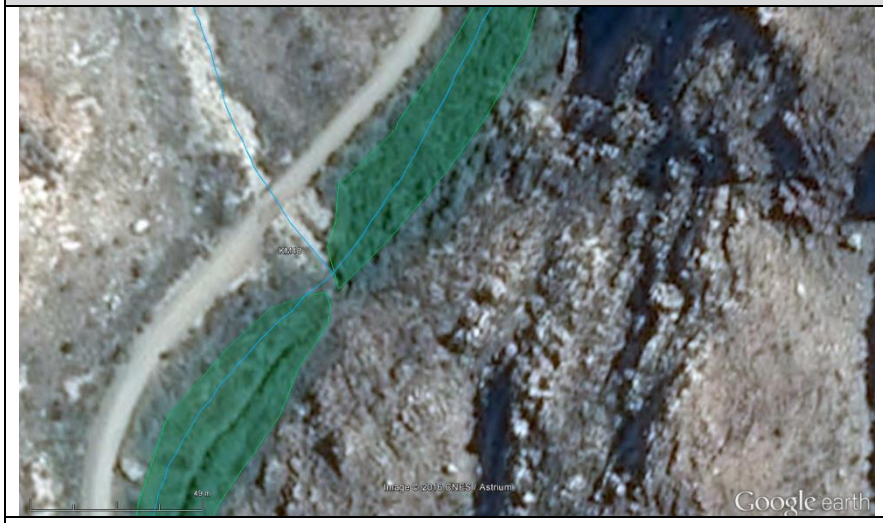
Site description: The river channel upstream and downstream of the crossing is somewhat disturbed as result of past road maintenance activities. Indigenous vegetation includes Cape willow (*Salix mucronata*), blinktaaibos (*Searsia lucida*), the sedges, *Mariscus thunbergii* and *Ficinia nigrescence*, creeping rush (*Juncus lomotophyllus),* broom restio (*Calopsis paniculata*), fountain bush (*Psoralea affinis*), taaiblaarmalva (*Pelargonium glutinosum*), river pumpkin (*Gunnera perpensa*) and Bitou bush (*Chrysanthemoides monilifera* subsp. *rotundata*). Material from past road repair works has been deposited on the upstream bank.

Specific Mitigation measures:

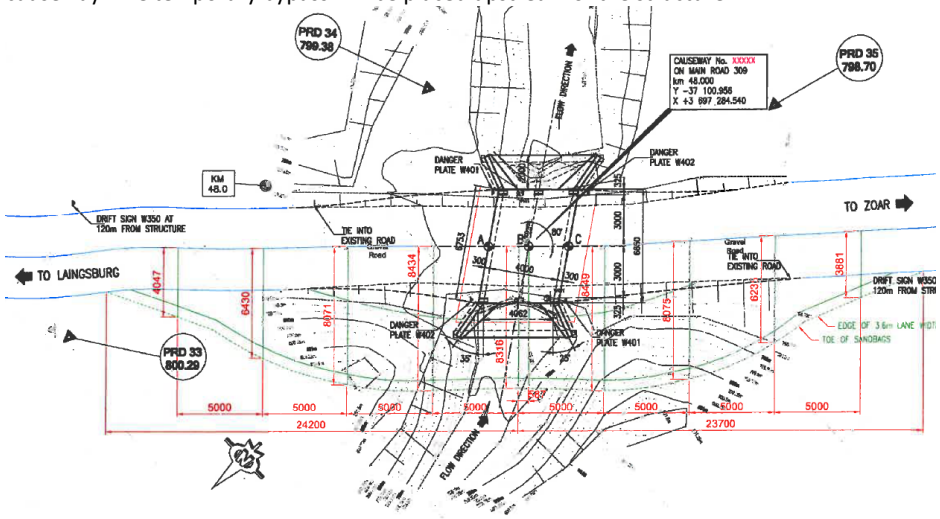
The dumped material from previous road repair works should be utilised was far as possible for the construction of the new crossing and the banks shaped to resemble that of the surrounding unimpacted banks.

The mature Cape willow tree adjacent to the crossing should be avoided. Ongoing monitoring and clearing of any invasive alien plants within the disturbed areas should take place.

Km 48.00



Proposed Activity: The existing causeway structure consists of 1x900mm pipe with stone head and wing walls and damaged apron slabs both sides. The structure is to be replaced with a 6m wide causeway. The temporary bypass will be placed upstream of the structure.



Site description: The site consists of the crossing of a tributary of the river that flows down a steep catchment and drops steeply at the crossing. The vegetation is minimal with a stream channel dominated by larger boulders. Material from past road repair works has been deposited on both the upstream and the downstream stream banks. The road is located at the point at which the hillslope flattens out.

Specific Mitigation measures:

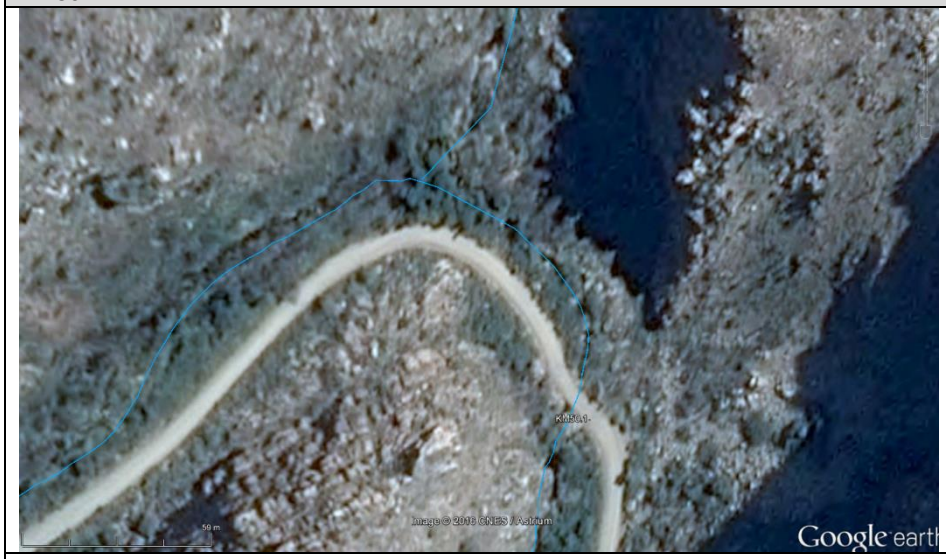
As this stream channel drops steeply at the site, the risk of erosion downstream of the crossing is high and the level at which the culverts are constructed is critical.

Stormwater runoff from the road into the stream channel should also be mitigated to prevent erosion of the embankment at the crossing.

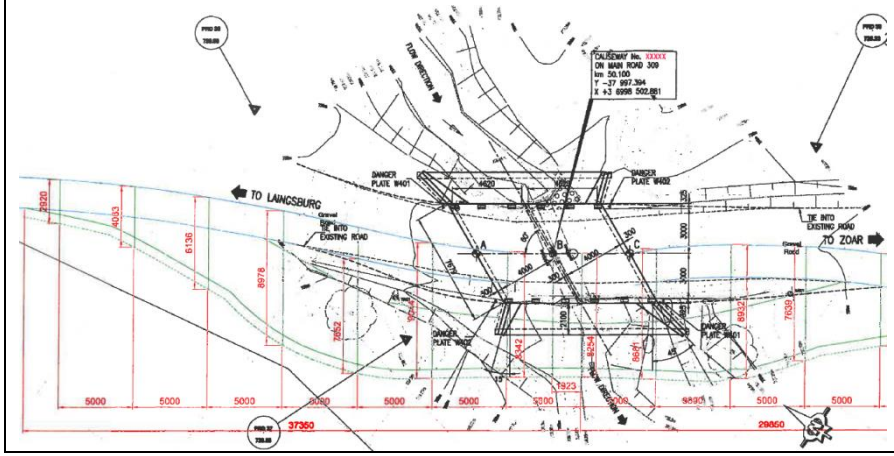
Where necessary the disturbed area on the stream banks should be revegetated with at least indigenous grasses to reduce the risk of erosion and sedimentation of the downstream channel.

The dumped material from previous road repair works should be utilised was far as possible for the construction of the new crossing and the banks shaped to resemble that of the surrounding unimpacted banks.

Km 50.1



Proposed Activity: The existing causeway structure consists of 3x600mm encased pipes, with stone head walls at inlet and outlet and stone pitching aprons that are severely damaged. The structure is to be replaced with an 8m wide causeway. Some of the existing structure will remain. The new structure will be constructed as far upstream and possible and the temporary bypass placed downstream of the structure.

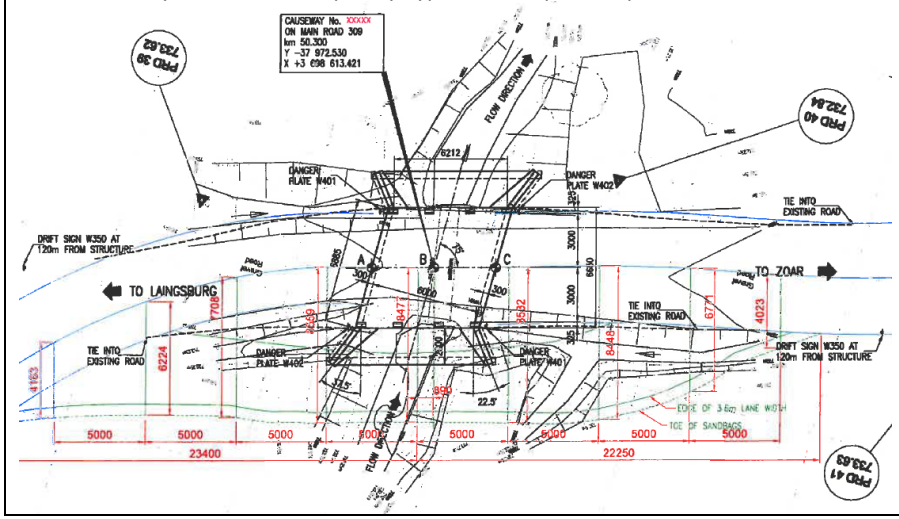


Site description: The river channel upstream and downstream of the crossing is somewhat disturbed as result of past road maintenance activities. Indigenous vegetation includes Cape willow (*Salix mucronata*), blinktaaibos (*Searsia lucida*), bostolbos (*Diospyros dichrophylla*), keurboom (*Virgilia divaricata*), kiepersol (*Cussonia spicata*), sand olive (*Dodonaea angustifolia*), broom restio (*Calopsis paniculata*) and sagewood (*Buddleja salviifolia*).

Specific Mitigation measures:
The mature trees adjacent to the crossing should rather be cut back and not removed to accommodate the temporary bypass so that they can resprout after the construction activities are complete. The bed and banks of the river upstream and downstream of the road reserve should be disturbed as little as possible. Routine monitoring of the structure should be undertaken to ensure that it does not become blocked with larger boulders. Ongoing monitoring and clearing of any invasive alien plants within the disturbed areas should also take place.

Km 50.3

Proposed Activity: The existing causeway structure consists of 2x900mm encased pipes, with stone head and return walls downstream that have been severely damaged and area silted up. The structure is to be replaced with a 5m wide causeway. The road will be realigned slightly downstream by 2m and the temporary bypass will be placed upstream of the structure.



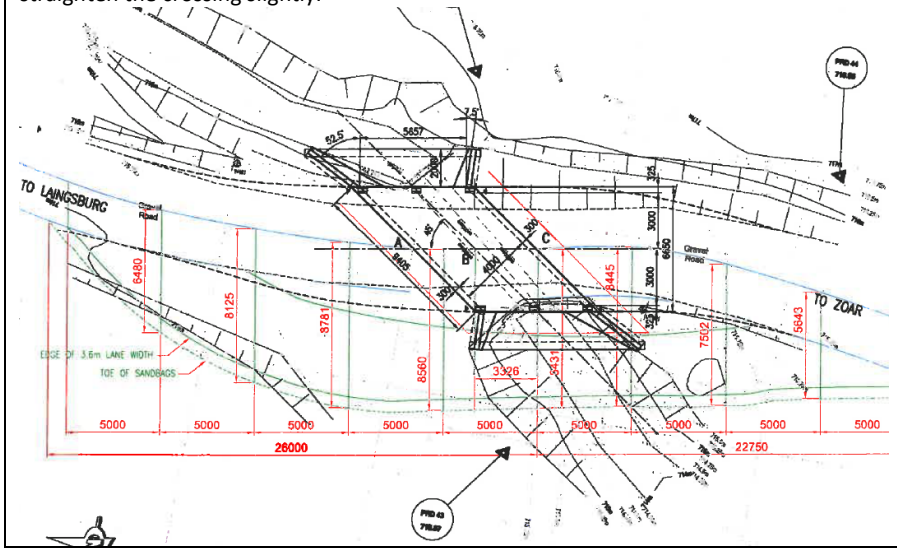
Site description: The river channel upstream and downstream of the crossing is somewhat disturbed as result of past road maintenance activities. Indigenous vegetation includes the sedge *Ficinia nigrescence*, creeping rush (*Juncus lomotophyllus),* bostolbos (*Diospyros dichrophylla*), keurboom (*Virgilia divaricata*), broom restio (*Calopsis paniculata*) and sagewood (*Buddleja salviifolia*). Material from past road repair works has been heaped within the site.

Specific Mitigation measures:

The dumped material from previous road repair works should be utilised was far as possible for the construction of the new crossing and the banks shaped to resemble that of the surrounding unimpacted banks. The bed and banks of the river upstream and downstream of the road reserve should be disturbed as little as possible. Routine monitoring of the structure should be undertaken to ensure that it does not become blocked with larger boulders. Ongoing monitoring and clearing of any invasive alien plants within the disturbed areas should also take place.

Km 50.8

Proposed Activity: The existing causeway structure consists of 3x600mm encased pipes, with stone head and return walls at inlet and outlet that have been severely damaged and are silted up. The structure is to be replaced with a 6m wide causeway. The road will be realigned slightly upstream and the temporary bypass will be placed downstream of the structure. It is also proposed to straighten the crossing slightly.



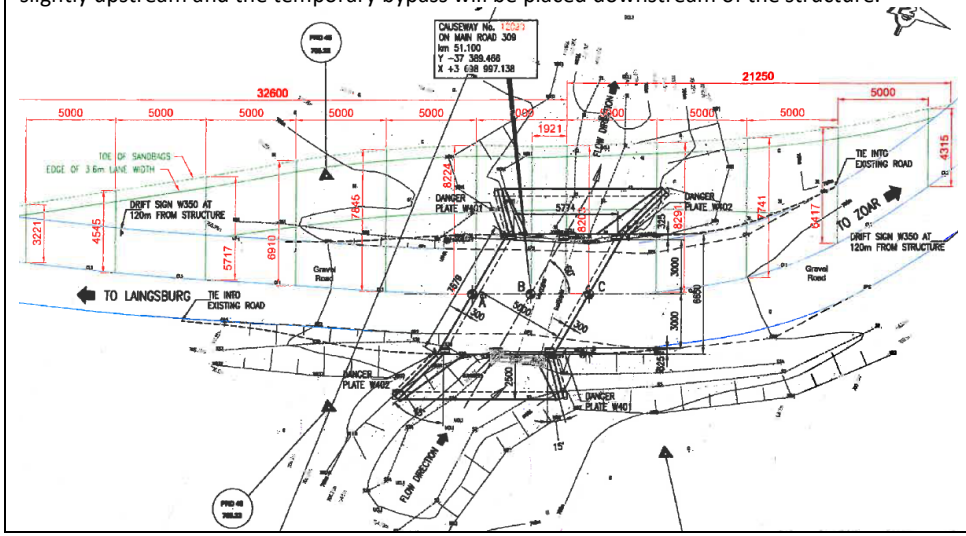
Site description: The river channel upstream and downstream of the crossing is somewhat disturbed as result of past road maintenance activities. Indigenous vegetation includes keurboom (*Virgilia divaricata*), broom restio (*Calopsis paniculata*) and sagewood (*Buddleja salviifolia*).

Specific Mitigation measures:

Additional erosion protection measures are likely to be required on the upstream east bank and downstream west bank as a result of the straightening of the channel. The bed and banks of the river upstream and downstream of the road reserve should be disturbed as little as possible. Routine monitoring of the structure should be undertaken to ensure that it does not become blocked with larger boulders. Ongoing monitoring and clearing of any invasive alien plants within the disturbed areas should also take place.

Km 51.1

Proposed Activity: The existing causeway structure consists of 2x900mm encased pipes, with stone head walls at inlet and outlet that are severely damaged by the large boulders that are abundant in the river. The structure is to be replaced with a 6m wide causeway. The structure will be realigned slightly upstream and the temporary bypass will be placed downstream of the structure.



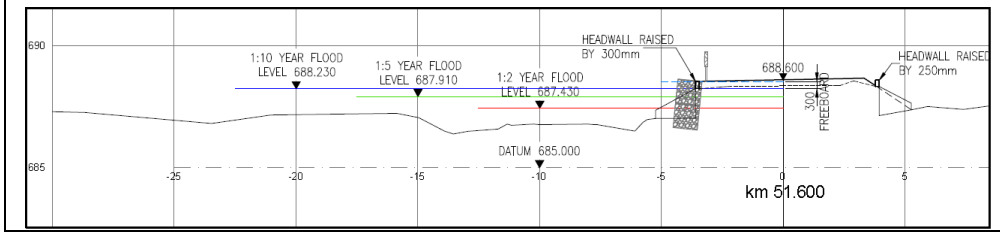
Site description: The river channel upstream and downstream of the crossing is somewhat disturbed as result of past road maintenance activities. Indigenous vegetation includes keurboom (*Virgilia divaricata*), blinktaaibos (*Searsia lucida*), the sedges, *Mariscus thunbergii* and *Isolepis prolifera*, broom restio (*Calopsis paniculata*), fountain bush (*Psoralea affinis*) and katoenbos (*Gomphocarpus fruticosus*).

Specific Mitigation measures:

The bed and banks of the river upstream and downstream of the road reserve should be disturbed as little as possible. Routine monitoring of the structure should be undertaken to ensure that it does not become blocked with larger boulders. Ongoing monitoring and clearing of any invasive alien plants within the disturbed areas should also take place.

Km 51.6

Proposed Activity: The river is blocked by a fallen tree that has resulted in an eroded bank and under-scouring of the road. A 30m concrete or gabion wall is proposed. The wall will be placed at the edge of the road reserve.

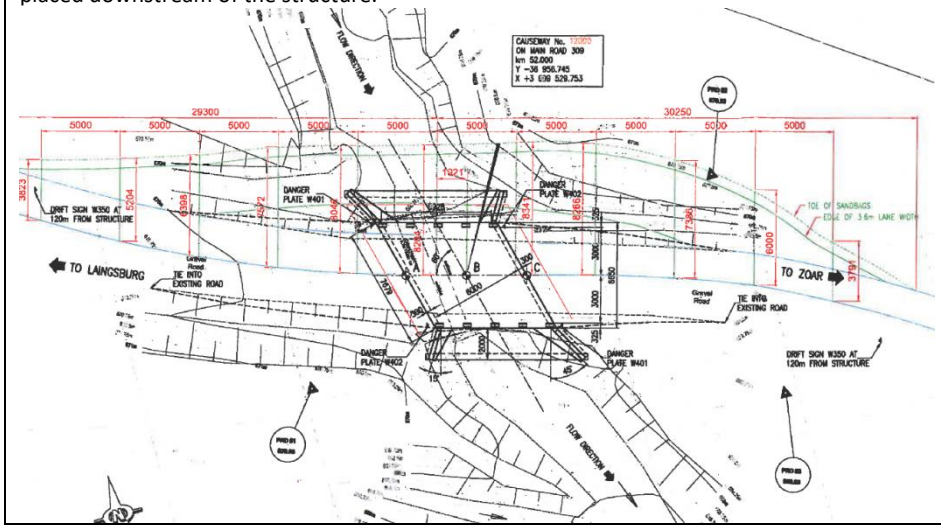


Site description: The river is located alongside the road in a relatively narrow part of the valley. The riparian zone of the river consists of large riparian trees. Indigenous vegetation includes Cape willow (*Salix mucronata*), honey bells (*Freylinia lanceolata*), keurboom (*Virgilia divaricata*), kiepersol (*Cussonia spicata*) and broom restio (*Calopsis paniculata*).

Specific Mitigation measures:
The wall should be constructed within the road reserve and should not encroach into the riparian zone of the river. It should also not significantly confine or intensify the flood flows of the river but should only protect the road from flood damage.

Km 52.0

Proposed Activity: The existing causeway structure consists of 2x900mm encased pipes, with stone head walls at inlet and outlet that are severely damaged by the large boulders that are abundant in the river. The structure is to be replaced with a 6m wide causeway. The temporary bypass will be placed downstream of the structure.



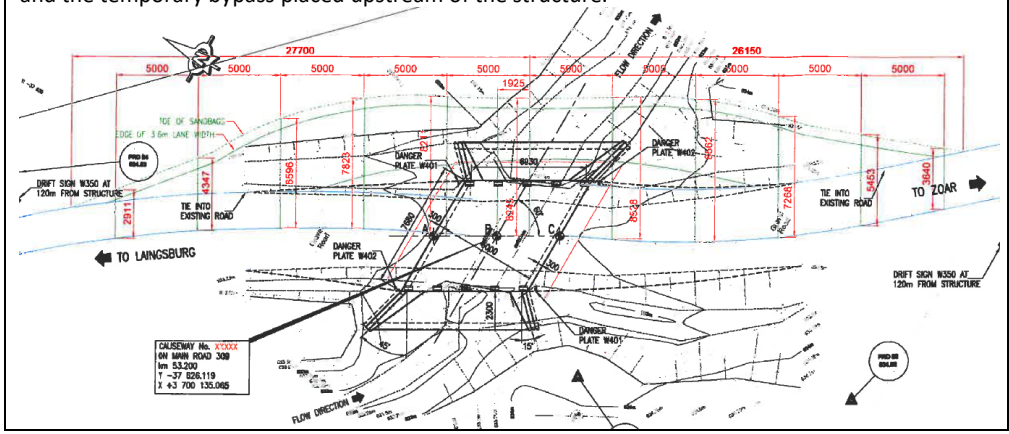
Site description: The river channel upstream and downstream of the crossing is somewhat disturbed as result of past road maintenance activities. Indigenous vegetation includes Cape willow (*Salix mucronata*), keurboom (*Virgilia divaricata*), kiepersol (*Cussonia spicata*), blinktaaibos (*Searsia lucida*), broom restio (*Calopsis paniculata*), fountain bush (*Psoralea affinis*), common reeds (*Phragmites australis*) and sagewood (*Buddleja salviifolia*). Material from past road repair works has been deposited on the upstream bank.

Specific Mitigation measures:

The dumped material from previous road repair works should be utilised was far as possible for the construction of the new crossing and the banks shaped to resemble that of the surrounding unimpacted banks. The bed and banks of the river upstream and downstream of the road reserve should be disturbed as little as possible. Routine monitoring of the structure should be undertaken to ensure that it does not become blocked with larger boulders. Ongoing monitoring and clearing of any invasive alien plants within the disturbed areas should also take place.

Km 53.2

Proposed Activity: The existing causeway structure consists of 2x900mm encased pipes, with upstream and downstream protection works. Scouring of the structure has taken place. The structure is to be replaced with a 6m wide causeway. The structure will be moved slightly upstream and the temporary bypass placed upstream of the structure.

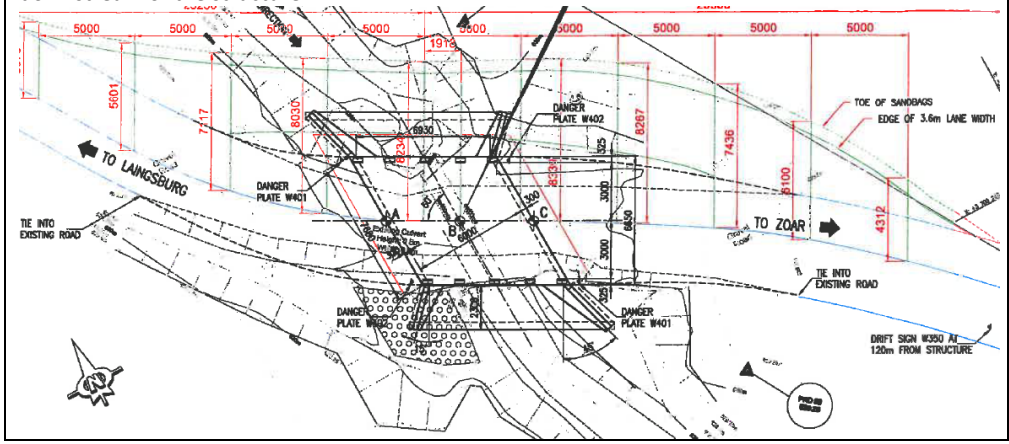


Site description: The river channel upstream and downstream of the crossing is somewhat disturbed as result of past road maintenance activities. Indigenous vegetation includes honey bells (*Freylinia lanceolata*), keurboom (*Virgilia divaricata*), Cape Holly (*Ilex mitis*), taaibos (*Searsia laevigata*), wildedagga (*Leonotis loenurus*), *Isolepis prolifera* and palmiet (*Prionium serratum*).

Specific Mitigation measures:
The mature trees adjacent to the crossing should rather be cut back and not removed to accommodate the temporary bypass so that they can resprout after the construction activities are complete. The bed and banks of the river upstream and downstream of the road reserve should be disturbed as little as possible. Routine monitoring of the structure should be undertaken to ensure that it does not become blocked with larger boulders. Ongoing monitoring and clearing of any invasive alien plants within the disturbed areas should also take place.

Km 53.4

Proposed Activity: The existing causeway structure consists of 2x600mm encased pipes, with head walls at the outlet that are mostly buried and have been almost completely destroyed. As a result of siltation, the structure is completely buried. The structure is to be replaced with a 6m wide causeway. The road will be shifted slightly upstream and the temporary bypass will be placed downstream of the structure.



Site description: The river channel upstream and downstream of the crossing is somewhat disturbed and cleared as result of past road maintenance activities. Indigenous vegetation includes keurboom (*Virgilia divaricata*), Cape honey bells (*Freylinia lanceolata*), taaibos (*Searsia laevigata*), the sedge *Isolepis prolifera*, creeping rush (*Juncus lomotophyllus),* broom restio (*Calopsis paniculata*), fountain bush (*Psoralea affinis*) and bostolbos (*Diospyros dichrophylla*). Material from past road repair works has been deposited on the river banks.

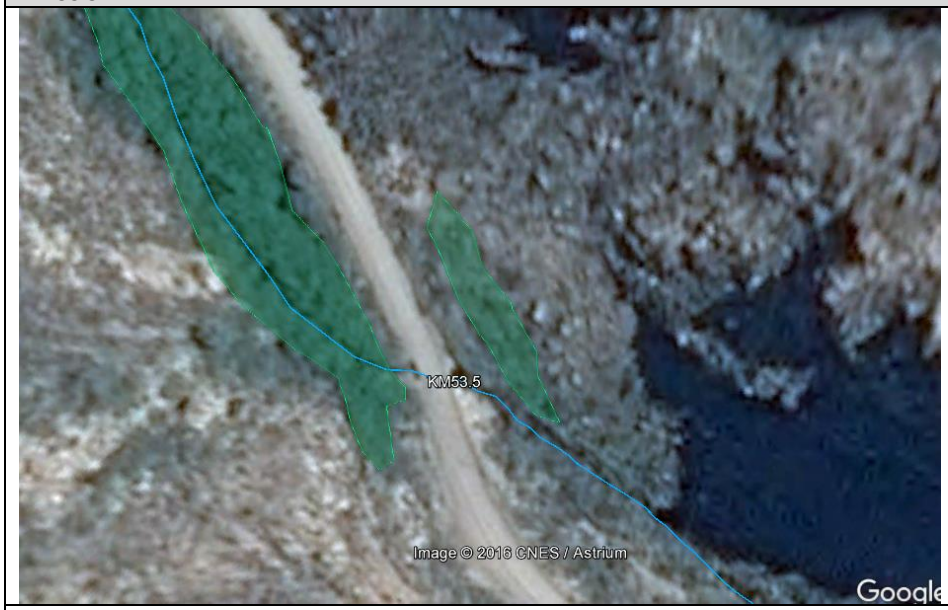
Specific Mitigation measures:

The dumped material from previous road repair works should be utilised was far as possible for the construction of the new crossing and the banks shaped to resemble that of the surrounding unimpacted banks.

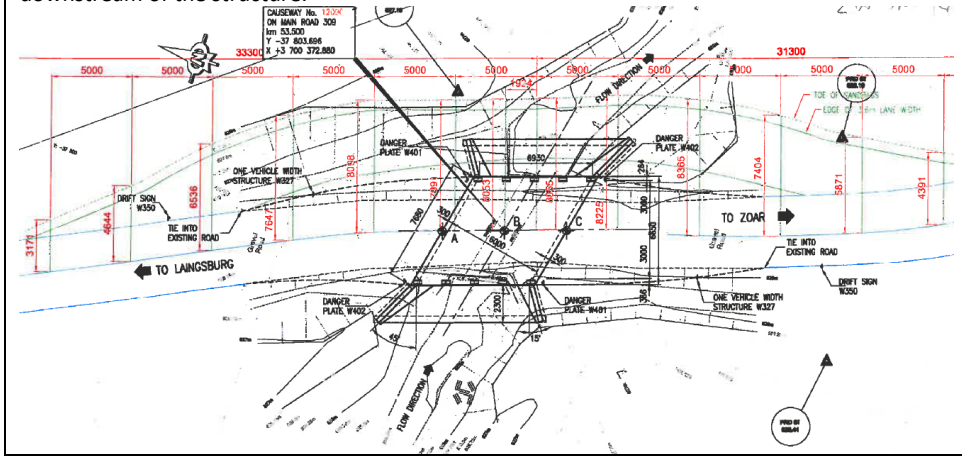
The mature trees adjacent to the crossing should be avoided and the bed and banks of the river upstream and downstream of the road reserve should be disturbed as little as possible.

Routine monitoring of the structure should be undertaken to ensure that it does not become blocked with larger boulders. Ongoing monitoring and clearing of any invasive alien plants within the disturbed areas should also take place.

Km 53.5



Proposed Activity: The existing causeway structure consists of 2x900mm encased pipes, with concrete protection works at inlet and outlet. Severely scouring has taken place at the structure. The structure is to be replaced with a 6m wide causeway. The road will be shifted slightly upstream and some of the downstream bank will need to be removed. The temporary bypass will be placed downstream of the structure.



Site description: The river channel upstream and downstream of the crossing has been disturbed as result of past road maintenance activities. Indigenous vegetation includes keurboom (*Virgilia divaricata*), Cape honey bells (*Freylinia lanceolata*), taaibos (*Searsia laevigata*), broom restio (*Calopsis paniculata*), fountain bush (*Psoralea affinis*) and bostolbos (*Diospyros dichrophylla*). Material from past road repair works has been deposited on the upstream bank.

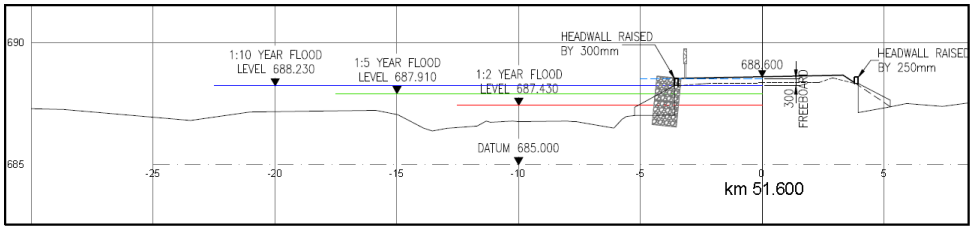
Specific Mitigation measures:

The hillslope wetland area adjacent to the crossing should be avoided and the bed and banks of the river upstream and downstream of the road reserve should be disturbed as little as possible.

Routine monitoring of the structure should be undertaken to ensure that it does not become blocked with larger boulders. Ongoing monitoring and clearing of any invasive alien plants within the disturbed areas should also take place.

Km 53.8

Proposed Activity: The road way gets flooded by the river that washes the road material away completely during floods. It is proposed to construct a 100m long concrete retaining wall.



Site description: The river channel adjacent to the road has been disturbed as result of past road maintenance activities. Indigenous vegetation includes Cape honey bells (*Freylinia lanceolata*), keurboom (*Virgilia divaricata*), silky bark (*Maytenus acuminate*), wild olive (*Olea europaea* subsp. *africana*), sand olive (*Dodonaea angustifolia*), taaibos (*Searsia laevigata*), the sedge, *Mariscus thunbergii),* broom restio (*Calopsis paniculata*), taaiblaarmalva (*Pelargonium glutinosum*) and sagewood (*Buddleja salviifolia*). Some material from past road repair works has been deposited along the bank.

Specific Mitigation measures:

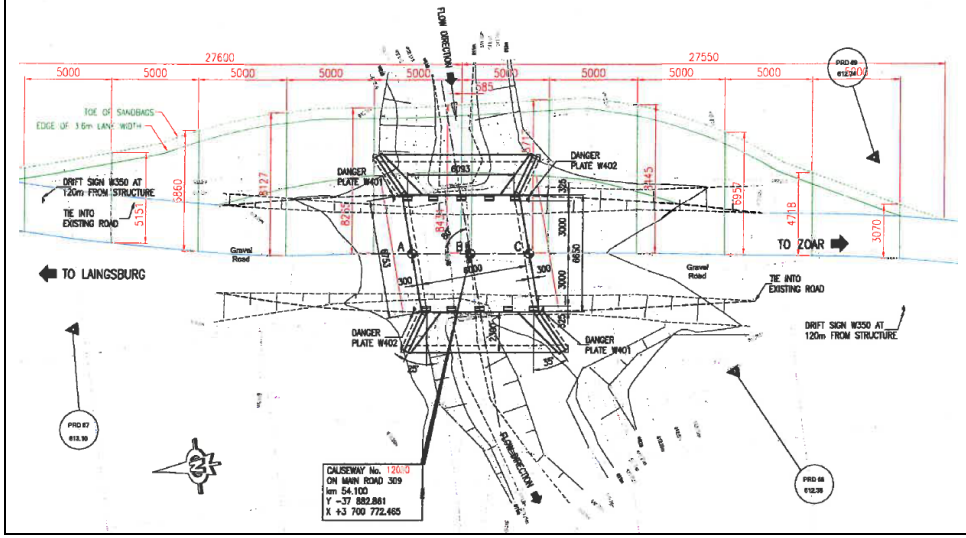
The wall should be constructed within the road reserve and should not encroach into the riparian zone of the river. It should also not significantly confine or intensify the flood flows of the river but should only protect the road from flood damage.

Any dumped material from previous road repair works should be utilised was far as possible for the construction works and the banks shaped to resemble that of the surrounding unimpacted banks. The mature trees adjacent to the crossing should be avoided and the bed and banks of the river upstream and downstream of the road reserve should be disturbed as little as possible.

Routine monitoring of the structure should be undertaken to ensure that it does not become blocked with larger boulders. Ongoing monitoring and clearing of any invasive alien plants within the disturbed areas should also take place.

Km 54.1

Proposed Activity: The existing causeway structure consists of 2x900mm encased pipes, with stone head walls at inlet and outlet that have been damaged by boulders that are abundant in the river. The structure is to be replaced with a 6m wide causeway. The temporary bypass will be placed downstream of the structure.



Site description: The river channel upstream and downstream of the crossing has been disturbed as result of past road maintenance activities. Indigenous vegetation includes Cape honey bells (*Freylinia lanceolata*), silky bark (*Maytenus acuminate*), keurboom (*Virgilia divaricata*), wild olive (*Olea europaea* subsp. *africana*), sand olive (*Dodonaea angustifolia*), taaibos (*Searsia laevigata*), the sedge, *Mariscus thunbergii* and broom restio (*Calopsis paniculata*).

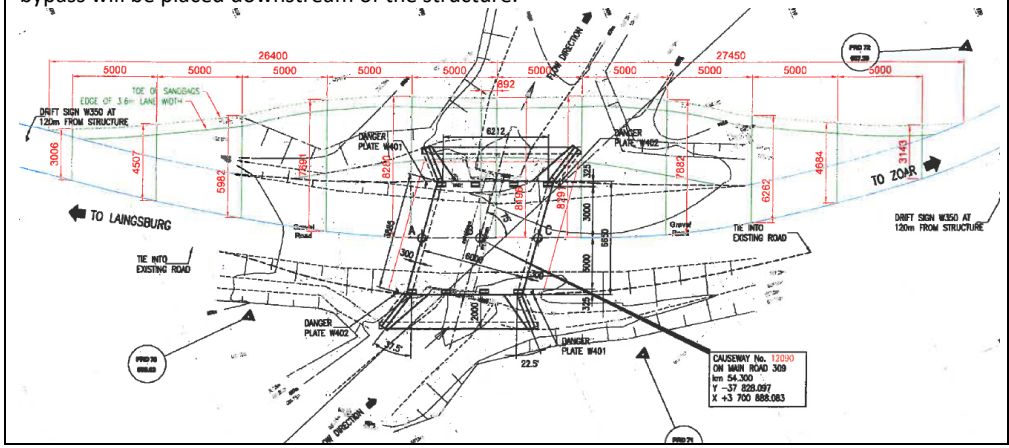
Specific Mitigation measures:

The mature trees adjacent to the crossing should be avoided and the bed and banks of the river upstream and downstream of the road reserve should be disturbed as little as possible.

Routine monitoring of the structure should be undertaken to ensure that it does not become blocked with larger boulders. Ongoing monitoring and clearing of any invasive alien plants within the disturbed areas should also take place.

Km 54.3 and 54.4

Proposed Activity: The existing causeway structure consists of 2x900mm encased pipes, with stone head walls at inlet and outlet that have been damaged by boulders that are abundant in the river. The road way gets flooded by the river that washes the road material away completely during floods. It is proposed to construct a 350m long concrete retaining wall and a 6m wide causeway. The new structure will be placed slightly upstream of the existing structure and the temporary bypass will be placed downstream of the structure.



Site description: The river channel upstream and downstream of the crossing has been disturbed as result of past road maintenance activities. Indigenous vegetation includes Cape honey bells (*Freylinia lanceolata*), keurboom (*Virgilia divaricata*), broom restio (*Calopsis paniculata*), river pumpkin (*Gunnera perpensa*) and taaibos (*Searsia laevigata*). Material from past road repair works has been deposited on the upstream bank.

Specific Mitigation measures:

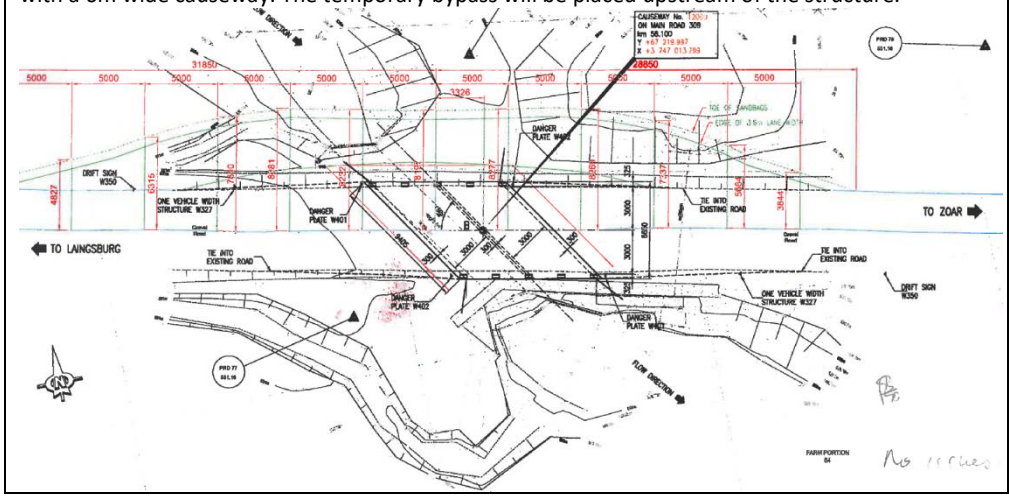
The dumped material from previous road repair works should be utilised was far as possible for the construction of the new crossing and the banks shaped to resemble that of the surrounding unimpacted banks. The mature trees adjacent to the crossing should be avoided and the bed and banks of the river upstream and downstream of the road reserve should be disturbed as little as possible.

Routine monitoring of the structure should be undertaken to ensure that it does not become blocked with larger boulders. Ongoing monitoring and clearing of any invasive alien plants within the disturbed areas should also take place.

Km 57.1	
	
Proposed Activity: The existing causeway structure consists of 57m long causeway with 6x2.4m openings with a 500mm thick slab, aprons and wing walls. Four openings area completely blocked with rocks and only 2 openings area clear. It is proposed to drop the inlet and realign the river. The temporary bypass will be placed upstream of the structure.	**Site description**: The river channel upstream and downstream of the crossing is somewhat disturbed as result of past road maintenance activities. Indigenous vegetation includes Cape willow (*Salix mucronata*), keurboom (*Virgilia divaricata*), sweet thorn (*Acacia karoo*), taaibos (*Searsia laevigata*), wild olive (*Olea europaea* subsp. *africana*), the sedges, *Carpha glomerata*, *Mariscus thunbergii, Pycreus polystachyos* and *Isolepis prolifera,* creeping rush (*Juncus lomotophyllus),* broom restio (*Calopsis paniculata*), Vleibos (*Cliffortia strobilifera*), knotweed (*Persicaria lapathifolia*), taaiblaarmalva (*Pelargonium glutinosum*) and kruidtjie-roer-my-nie (*Melianthus comosus*). Material from past road repair works has been deposited on the banks and some invasive alien black wattle (*Acacia mearnsii*) and bramble (*Rubus cuneifolius)* are present at the site. **Specific Mitigation measures:** The dumped material from previous road repair works should be utilised was far as possible for the construction of the new crossing and the banks shaped to resemble that of the surrounding unimpacted banks. The mature trees adjacent to the crossing should be avoided and the bed and banks of the river upstream and downstream of the road reserve should be disturbed as little as possible. Routine monitoring of the structure should be undertaken to ensure that it does not become blocked with larger boulders. Ongoing monitoring and clearing of any invasive alien plants within the disturbed areas should also take place.

Km 58.1

Proposed Activity: The existing causeway structure consists of 1x1.9m W causeway with 750mm pipe down steam, broken apron slabs and downstream return walls. The structure is to be replaced with a 6m wide causeway. The temporary bypass will be placed upstream of the structure.



Site description: The river channel upstream and downstream of the crossing has been significantly disturbed and cleared of vegetation as result of recent road maintenance activities. Indigenous vegetation includes Cape willow (*Salix mucronata*), keurboom (*Virgilia divaricata*), sweet thorn (*Acacia karoo*), taaibos (*Searsia laevigata*) and and bostolbos (*Diospyros dichrophylla*). There is a high flow bypass channel that has been constructed on the eastern bank of the river.

Specific Mitigation measures:

The dumped material from previous road repair works should be utilised was far as possible for the construction of the new crossing and the banks shaped to resemble that of the surrounding unimpacted banks.

Routine monitoring of the structure should be undertaken to ensure that it does not become blocked with larger boulders. Ongoing monitoring and clearing of any invasive alien plants within the disturbed areas should also take place.

9.2. OVERALL ASSESSMENT OF IMPACTS OF PROPOSED ACTIVITIES

This section provides a combined assessment of the potential impacts to freshwater ecosystems that are likely to be associated with the proposed road improvement activities. The specific assessment and recommended mitigation measures are per site are outlined in Section 9.1.

AQUATIC HABITAT MODIFICATION OR LOSS

Nature of Impact: A small risk of the possible impact on the ***aquatic habitat*** of the Seweweekspoort River, its tributaries and associated wetland areas (see Table 17) can be expected during the construction phase due to the fact that the activities associated with road upgrade will need to take place where the road crosses or is adjacent to the river or its tributaries. The disturbance of aquatic habitat will also provide an opportunity for invasive alien plants to proliferate in the pass which is currently relatively free of invasive alien plants.

Significance of impacts without mitigation:

Construction Phase: A localized impact of medium intensity in the short term that is expected to have a low negative significance in terms of its impact on the aquatic habitat in the study area. This is due to the fact that the habitat at the sites has already been disturbed as a result of the existing road and its structures and the long term associated road maintenance activities. In addition, a specific site visit was attended by the project team and EIA specialists to identify those areas in which the proposed activities would have the least potential impact.

Operation Phase: Over the longer term a positive impact of a low significance could be expected due to the impacted hydraulic capacity of the upgraded structures and the reduced need to undertake maintenance activities on the road and hence the reduced disturbance of aquatic habitats over the long terms with a reduce potential for invasive alien plants to establish within the pass at the river crossing sites.

Proposed mitigation:

Construction Phase:

- Work within the river channel or wetland areas should be limited as far as possible and the disturbed areas rehabilitated immediately afterwards.
- Construction within the river channel should as far as possible take place during the drier months of the year.
- To minimise the impact of the temporary bypass, the bypass route should be selected to avoid larger riparian trees as far as possible. Larger plants should be trimmed back to leave their stems and roots intact rather than removing the entire trees unless absolutely necessary. Bidem should

be placed over the existing topsoil and vegetation before placing the fill material in the channel, that the fill material can all be removed after completion of the road crossing structure. Pipe culverts should be temporarily placed within the channel to ensure the low flow in the river is not impeded. Sandbags should be placed on the outer edge of the bypass to prevent the sashing of sediment into the channel.

- Spoil material should be utilised within the construction works or removed to approved dumping sites.
- Once construction is complete, the area should be rehabilitated to resemble that of the surrounding bed and banks and where necessary vegetated with suitable local indigenous plants as occur at the site.

Operation Phase:

- Any invasive alien plants from the road reserve should be monitored and removed on an ongoing basis according to methods as provided by the Working for Water Programme.
- Minimise the frequency of, or requirement for, maintenance activities.
- All reasonable measures should be undertaken to ensure that river maintenance activities minimise erosion.

Significance of impacts after mitigation:

Construction Phase: The significance of the impact on the aquatic ecosystems with mitigation is expected to be a very low (negative) in the short term.

Operation Phase: The significance of the impact on the aquatic ecosystems with mitigation is expected to be low (positive) in the long term.

WATER QUALITY IMPACTS

Nature of impact: Impairment of the ***surface water quality*** could potentially occur during the construction phase.

Significance of impacts without mitigation:

Construction Phase: A slight risk of a localized impact of low intensity that is expected to have a low overall significance in terms of its impact on the identified aquatic ecosystems in the area.

Proposed mitigation:

Construction Phase:

Contaminated runoff from the construction site(s) should be prevented from entering the river, its tributaries and associated wetland areas. The laydown area and main construction site for the road upgrade should be located outside of the pass and away from the river and its associated wetland areas. If the construction site(s) need to be located near the rivers/streams, all materials on the construction site(s) should be properly stored and contained. Disposal of waste from the site(s) should also be properly managed. Construction workers should be given ablution facilities at the construction works that are located away from the river systems (at least 30m) and regularly serviced. These measures should be addressed, implemented and monitored in terms of the Environmental Management Plan for the construction phase.

Increased sedimentation or turbidity at each of the construction works should be mitigated as far as possible by making use of sandbags, settling ponds or screens to minimise the load of sediment being washed downstream of the sites.

Significance of impacts after mitigation:

Construction Phase: Provided that the mitigation measures are effectively implemented the water quality impacts of the proposed road upgrades should be of very low to negligible significance.

POTENTIAL FOR EROSION

Nature of Impact – There is a potential for ***increased erosion*** to take place at the river crossings as a result of a change in the runoff characteristics, a loss of vegetation cover and physical disturbance of stream banks. The proposed road upgrades should however reduce the risk of erosion due to their larger hydraulic capacity.

Significance of impacts without mitigation:

Operation Phase: Low localized impact.

Proposed mitigation:

The riparian vegetation cover should be disturbed as little as possible during the construction phase. Any disturbed areas should be rehabilitated as soon as possible after construction is completed and planted with suitable indigenous plants where necessary.

Where the tributary stream channels drop steeply at the crossings and the risk of erosion downstream of the crossings is high, erosion protection measures should be implemented or the structures stepped to accommodate the drop at the site in order to prevent the need to mitigate

erosion in the future. Stormwater runoff from the road into the stream channel at these sites may also need to be mitigated to prevent erosion at the crossings.

Significance of impacts after mitigation:

Operation Phase: Negligible localized impact during construction phase.

FLOW MODIFICATION

Nature of Impact: A ***temporary and longer term impedance of the flow*** or a change to the flow characteristics in the rivers at the river crossing sites may occur as a result of construction activities. Longer term maintenance of the river channel at the structures may be required to ensure that no debris blocks the channel at the road crossings.

Significance of impacts without mitigation:

Construction Phase: The construction activities would be expected to have a very limited impact on the flow in the stream in terms of the extent and duration.

Operation Phase: The upgraded river crossing structures are likely to result in altered flow/hydraulic characteristics. Due to the proposed increase in the hydraulic capacity of the structures, this potential impact would be a low (positive) significance.

Proposed mitigation:

Construction Phase:

Activities within the river channel during the construction phase should be limited as far as possible in terms of their spatial and temporal extent. Construction work within the river channel should preferably take place before the onset of the rainfall period to ensure minimal impact on flow. Flow in the river should be diverted around the construction works. In particular the low flow should not be impeded during construction.

Rubble and debris from existing structures and construction activities, as well as the temporary bypass structures, should be removed after construction is complete so as not to impede flow in the river.

Operation Phase:

In the longer term, the upgraded structures and the box culverts/pipes should not impede the flow and in particular the low flow in the river. In particular, the new culvert structures should not be placed higher than the base level of the river channels to ensure that low flows are not impeded. In addition, the culvert structures must be placed within the natural drainage line of the streams. The

structures should also not impede the migration of biota. The channel upstream of the river crossings should be kept free of debris, intrusive growth of invasive alien plants and sediment build-up, particularly at the culvert where it might impede flows.

Channelization or canalization associated with the proposed protection walls should be avoided as it tends to result in bigger problems than those it was intended to solve. The wall should be constructed within the road reserve and should not encroach into the riparian zone of the river. It should also not significantly confine or intensify the flood flows of the river but should only protect the road from flood damage.

Significance of impacts after mitigation:

Construction Phase: A localised impact of low intensity that is expected to have a very low (negative) significance in terms of its impact on the identified aquatic ecosystems in the area during construction phase.

Operation Phase: An impact of low (positive) significance is expected post-construction.

CUMULATIVE IMPACTS

The Seweweekspoort River, its tributaries and associated wetland areas within the proposed road upgrade area that would be impacted by the proposed activities have already been modified as a result of previous road construction activities as well as the ongoing road maintenance activities. These activities have all contributed to a modification of both the instream and riparian aquatic habitats.

Considering that the proposed activities are to the existing road, one can expect that the cumulative impact of this activity on the river systems will be of a low to very low significance. The cumulative impacts will largely take place during the construction phase when construction activities are simulatively being undertaken on a number of the crossings. While these impacts to the freshwater ecosystem in the pass are each of a low significant it is essential that they be adequately mitigated to minimise the potential cumulative impacts.

Key cumulative impacts relate to increased sedimentation of the river at a number of sites together with cumulative impedance of flows at the sites. It is thus important that these impacts be adequately mitigated. It is also essential that each site, once completed be rehabilitated. Ongoing monitoring and management of invasive alien plants within the disturbed areas along the road on a twice yearly basis for a period of at least three years is also essential to ensure that the river corridor does not become invaded with alien invasive plants.

The cumulative impacts of the proposed activities as well as the no-go alternative are considered in the following section. The no-go alternative implies that no upgrades for the road crossings will be undertaken and that the current 'ad hoc' repair of flood damaged structures would continue. The structures would also remain with many of the existing culverts becoming increasingly blocked by sediment and impeding the lower flow in the river system.

9.3. SUMMARY OF ASSESSMENT OF POTENTIAL IMPACTS OF THE PROPOSED ACTIVITIES

CONSTRUCTION PHASE:

Potential impact on freshwater features	Proposed upgrade of road crossings over watercourses	No-go Alternative
Nature of impact:	Limited disturbance of freshwater related habitats at the road crossing sites	None
Extent and duration of impact:	Localised short term impacts	-
Intensity of Impact	Medium	-
Probability of occurrence:	Probable as a result of construction activities at road crossings over the identified rivers and streams	-
Degree to which impact can be reversed:	Partially reversible	-
Irreplaceability of resources:	Medium to low	-
Cumulative impact prior to mitigation:	Low due to the existing modification by the roads within the river channel	-
Significance of impact pre-mitigation	Low	-
Degree of mitigation possible:	Low to Very low	-
Proposed mitigation:	Work within the river channel should be limited as far as possible and the river bed and banks rehabilitated immediately afterwards. Construction within the river channel should preferably take place during the drier months of the year. The temporary bypass should be according to the recommended methods was provided in the previous section.	-
Cumulative impact post mitigation:	Very Low	-
Significance after mitigation	Very Low/negligible	-

Potential impact on freshwater features	Proposed upgrade of road crossings over watercourses	No-go Alternative
Nature of impact:	Downstream ***water quality impacts*** as a result of runoff from construction activities	None
Extent and duration of impact:	Localised short term impacts	-

Intensity of Impact	Low	-
Probability of occurrence:	Probable	-
Degree to which impact can be reversed:	Reversible	-
Irreplaceability of resources:	Low	-
Cumulative impact prior to mitigation:	Low	-
Significance of impact pre-mitigation	Very Low	-
Degree of mitigation possible:	Low	-
Proposed mitigation:	Contaminated runoff from the construction site(s) should be prevented from entering the rivers/streams. All materials on the construction sites should be properly stored and contained. Disposal of waste from the sites should also be properly managed. Construction workers should be given ablution facilities at the construction sites that are located away from the river (at least 30m) and regularly serviced. These measures should be addressed, implemented and monitored in terms of the EMP for the construction phase. Sediment loads to river from construction activities should be prevented or minimized.	-
Cumulative impact post mitigation:	Very Low	-
Significance after mitigation	Very Low	-

Potential impact on freshwater features	Proposed upgrade to road crossings over watercourses	No-go Alternative
Nature of impact:	A temporary ***impedance of flow*** during construction activities	-
Extent and duration of impact:	Localised short term impacts	-
Intensity of Impact	Low	-
Probability of occurrence:	Probable	-
Degree to which impact can be reversed:	Reversible	-
Irreplaceability of resources:	Medium	-
Cumulative impact prior to mitigation:	Low	-
Significance of impact pre-mitigation	Very low	-
Degree of mitigation possible:	Very low	-
Proposed mitigation:	Activities within the river channel during the construction phase should be limited as far as possible in terms of their spatial and temporal extent. Construction work within the river channel should preferably take place before the onset of the rainfall period to ensure minimal impact on flow.	-

	In the longer term, the upgraded structures and the box culverts/pipes should not impede the flow and in particular the low flow in the river. In particular, the new culvert structures should not be placed higher than the base level of the river channel to ensure that low flows are not impeded. In addition, the culvert structures must be placed within the natural drainage line of the river. The structures should not impede the migration of fish species. All rubble and waste material associated with the river crossing upgrades that are within the channel should be removed after construction is complete.	
Cumulative impact post mitigation:	Very Low to negligible impact	-
Significance after mitigation	Very Low	-

OPERATION PHASE

Potential impact on freshwater features	Proposed upgrade of road crossings over watercourses	No-go Alternative
Nature of impact:	Limited ***disturbance of freshwater related habitats*** at the road crossings where construction activities have taken place, with reduced the potential for flow modification and erosion	Ongoing ***disturbance of freshwater related habitats*** at the road crossings, with the potential for flow modification and erosion
Extent and duration of impact:	Localised longer term impacts	Localised longer term impacts
Intensity of Impact	Low	Low
Probability of occurrence:	Probable as a result of operation activities within the river channel and riparian zones	Probable as a result of operation activities within the river channel and riparian zones
Degree to which impact can be reversed:	Reversible	Reversible
Irreplaceability of resources:	Low	Medium
Cumulative impact prior to mitigation:	Low positive	Low negative
Significance of impact pre-mitigation	Low positive	Low negative
Degree of mitigation possible:	Very low	Very low
Proposed mitigation:	Disturbed areas should be revegetated post-construction phase to reduce the risk of erosion – these areas should be monitored and kept free of invasive alien plant growth. The channel upstream of the river crossings should be kept free of debris and sediment build-up, particularly at the culvert structures where it might impede flows. The roads should be maintained such that the concentration/intensity of runoff along the road is reduced to dissipate the	Disturbed areas should be monitored and kept free of invasive alien plant growth. The channel upstream of the river crossings should be kept free of debris and sediment build-up, particularly at the culvert structures where it might impede flows. The roads should be maintained such that the concentration/intensity of runoff along the road is reduced to dissipate the energy and erosion potential of the flow from the road.

	energy and erosion potential of the flow from the road.	
Cumulative impact post mitigation:	Low positive	Low negative
Significance after mitigation	Low positive	Low negative

10. RISK ASSESSMENT

A risk assessment was carried out for the proposed road upgrade activities. The assessment indicates the level of risk certain activities pose to freshwater resources where the outcomes are used to guide decisions regarding water use authorisation of the proposed activity. A summary of the potential risks can be seen in Table 18 and the full assessment tables are contained in Appendix D. These risk rating classes can be seen in Table 19.

Table 18: Summary risk assessment for the proposed project

Phases	Activity	Aspect	Impact	Significance	Risk Rating
Construction	Construction works associated with the flood damage repairs to structures on MR309	Construction of Culvert Structures proposed at 27 sites	Loss of biodiversity & habitat and modification of the flow and water quality	74.75	M
Operation	Construction works associated with the flood damage repairs to structures on MR309	Maintenance of infrastructure at watercourse crossings		54	L

Table 19: Risk rating classes for the Risk Assessment

RATING	CLASS	MANAGEMENT DESCRIPTION
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated. Wetlands may be excluded.
56 – 169	M) Moderate Risk	Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and require specialist input. Wetlands are excluded.
170 – 300	(H) High Risk	Always involves wetlands. Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve.

The risk associated with the shorter term construction and longer term maintenance related activities are deemed to be moderate and low respectively provided that the mitigation measures as recommended are implemented. The findings of the risk assessment imply that the water use activities associated with the proposed project would need to be authorised by means of a water use licence for the Section 21(c) and (i) water uses.

11. CONCLUSIONS AND RECOMMENDATIONS

The main freshwater features in the study area are the Seweweekspoort River, a tributary of the Kobus Tributary (J25B) in the Gouritz River System. There are some turbutaries and valley bottom wetland areas associated with the river in the area where the road will be upgraded.

The present ecological state of the river system within the pass is largely natural. The ecological importance and sensitivity of the river is high and for the wetland areas is moderate to high. The Seweweekspoort River and tributaries is mapped as a Fish Support Area. Most of the study area is located within the formally protected Towerkop Nature Reserve, with the southern portion also forming part of a Mountain Catchment Area. The portions of the study area immediately north and south of the protected areas are mapped as Critical Biodiversity Areas that should be protected.

The roadway and associated structures are already in existence adjacent to or within the Seweweekspoort River System. The road, together with some other physical modifications to the freshwater features in the upper catchment, has resulted in the current ecological condition of the river and its associated wetland areas. Therefore it can be expected that the likely impacts of the proposed upgrade of the road crossings are of a limited extent and of a short term nature, occurring mostly during the construction phase.

Longer term impacts that are likely to occur relate to how the maintenance work is undertaken for the road as well as the potential encroachment of invasive alien vegetation into the freshwater features where they have been disturbed by the construction activities. However, the proposed upgrades will also result in an overall positive impact as the capacity of the crossing structures will be increased which will reduce the impact of the structures on the hydraulics of the river and the likelihood that the structures will become blocked. This will result in a reduced need to repair flood damage to the road and structures or remove sediment and debris at the structures on an ongoing basis.

The following mitigation measures are recommended:

- Work within the river channel or wetland areas should be limited as far as possible and the disturbed areas rehabilitated immediately afterwards.
- Construction within the river channel should as far as possible take place during the drier months of the year.
- To minimise the impact of the temporary bypass, the bypass route should be selected to avoid larger riparian trees as far as possible. Larger plants should be trimmed back to leave their stems and roots intact rather than removing the entire trees unless absolutely necessary. Bidem should be placed over the existing topsoil and vegetation before placing the fill material in the channel,

that the fill material can all be removed after completion of the road crossing structure. Pipe culverts should be temporarily placed within the channel to ensure the low flow in the river is not impeded. Sandbags should be placed on the outer edge of the bypass to prevent the sashing of sediment into the channel.

- Rubble and debris from existing structures and construction activities, as well as the temporary bypass structure, should be removed after construction is complete so as not to impede flow in the stream.
- Once construction is complete, the area should be rehabilitated to resemble that of the surrounding bed and banks and where necessary vegetated with suitable local indigenous plants as occur at the site.
- The channel upstream of the crossing should be kept free of debris and sediment build-up, particularly at the culvert where it might impede flows.
- Any invasive alien plants from the road reserve should be monitored and removed on an ongoing basis according to methods as provided by the Working for Water Programme.

With mitigation, the significance of the cumulative impacts of the proposed activities are deemed to be a very low negative for the construction phase and a low positive for the operation phase. The no-go alternative implies that no upgrades for the road crossings will be undertaken and that the current 'ad hoc' repair of flood damaged structures would continue. The structures would also remain with many of the existing culverts becoming increasingly blocked by sediment and impeding the lower flow in the river system. The significance of the no-go alternative is deemed to be a low negative for the operation phase.

The Breede-Gouritz Catchment Management Agency should be approached for comment on the requirement that the water use aspects of the proposed activities may need to be authorised. The proposed works within the river system in the pass are deemed to be changing the characteristics of the associated freshwater ecosystems and would therefore require authorization. In terms of the risk assessment for the proposed works, the level of the proposed water use activities is such that they would need to be authorised by means of a water use licence.

12. REFERENCES

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ANNEXURE A: DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

APPENDIX 1: DECLARATION OF INDEPENDENCE BY THE INDEPENDENT PERSON WHO COMPILED A SPECIALIST REPORT OR UNDERTOOK A SPECIALIST PROCESS

I, Antonia Belcher, as the appointed independent specialist hereby declare that I:

- act/ed as the independent specialist in this application;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2010 and any specific environmental management Act;
- have and will not have no vested interest in the proposed activity proceeding;
- have disclosed, to the applicant, EAP and competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the Environmental Impact Assessment Regulations, 2010 and any specific environmental management Act;
- am fully aware of and meet the responsibilities in terms of NEMA, the Environmental Impact Assessment Regulations, 2010 (specifically in terms of regulation 17 of GN No. R. 543) and any specific environmental management Act, and that failure to comply with these requirements may constitute and result in disqualification;
- have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- have ensured that the names of all interested and affected parties that participated in terms of the specialist input/study were recorded in the register of interested and affected parties who participated in the public participation process;

- have provided the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not; and
- am aware that a false declaration is an offence in terms of regulation 71 of GN No. R. 543.

Note: The terms of reference is included in the report.

Signature of the specialist: 

Date: 29 November 2016

APPENDIX 2: ATTACHED CURRICULUM VITAE:

Contact details: PO Box 455, Somerset Mall, 7137

Name: Antonia Belcher

Profession: Aquatic Scientist (Pr. Nat. Sc. 400040/10)

Fields of Expertise: Specialist in river and wetland monitoring and reporting

Relevant work experience:

Due to my involvement in the development and implementation of the River Health Programme as well as the Resource Directed Measures directorate of the Department of Water Affairs in the Western Cape, I have been a key part of the team that has undertaken six catchment or area wide 'state-of-river' assessments as well as routine monitoring and specialized assessments of rivers and wetlands in all the major catchments for the Western Cape. In the past eight years, I have undertaken numerous freshwater assessments as input into both the environmental authorization and water use authorization process throughout the Western Cape as well as greater Southern Africa.

Papers and Publications:

More than 250 publications, papers and posters relating mostly to water resource quality and river health assessments in South African rivers and their management.

Recent projects that she has been involved in are:

- Classification of Water Resources in the Olifants-Doorn Water Management Areas, Department of Water Affairs;
- Development and piloting of a National Strategy to Improve Gender Representation in Water Management Institutions, where the focus is on improving the capacity to participate in water related decision making, Department of Water Affairs and Forestry;
- Compilation of a background document as well as a framework management plan towards the development of an integrated water resources management plan for the Sandveld;
- Specialist on the City of Cape Town project: Determination of additional resources to manage pollution in storm water and river systems;
- River Health Programme monitoring for the Free State Region, Department of Water Affairs; and
- Framework for Education and Training in Water (FETWATER), Resource Directed Measures Network partner which has undertaken training initiatives on environmental water requirements in the SADC region.

APPENDIX B: PES AND EI&ES FOR THE KOBUS RIVER

SELECT SQ REACH	SQR NAME	LENGTH km	STREAM ORDER	PES ASSESSED BY XPERTS? (IF TRUE="Y")	REASONS NOT ASSESSED	PES CATEGORY DESCRIPTION	PES CATEGORY BASED ON MEDIAN OF METRICS
J25B-08591	Kobus	41.36	1	Y		LARGELY MODIFIED	D
MEAN EI CLASS	**MEAN ES CLASS**	**DEFAULT ECOLOGICAL CATEGORY (EC)**	**RECOMMENDED ECOLOGICAL CATEGORY (REC)**				
VERY HIGH	HIGH	A	#NUM!				

PRESENT ECOLOGICAL STATE		ECOLOGICAL IMPORTANCE				ECOLOGICAL SENSITIVITY	
INSTREAM HABITAT CONTINUITY MOD	SMALL	FISH SPP/SQ	2.00	INVERT TAXA/SQ	25.00	FISH PHYS-CHEM SENS DESCRIPTION	VERY HIGH
RIP/WETLAND ZONE CONTINUITY MOD	LARGE	FISH: AVERAGE CONFIDENCE	5.00	INVERT AVERAGE CONFIDENCE	5.00	FISH NO-FLOW SENSITIVITY DESCRIPTION	VERY HIGH
POTENTIAL INSTREAM HABITAT MOD ACT.	SMALL	FISH REPRESENTIVITY PER SECONDARY: CLASS	VERY HIGH	INVERT REPRESENTIVITY PER SECONDARY, CLASS	VERY HIGH	INVERT PHYS-CHEM SENS DESCRIPTION	VERY HIGH
RIPARIAN-WETLAND ZONE MOD	SERIOUS	FISH REPRESENTIVITY PER SECONDARY: CLASS	VERY HIGH	INVERT RARITY PER SECONDARY: CLASS	VERY HIGH	INVERTS VELOCITY SENSITIVITY	VERY HIGH
POTENTIAL FLOW MOD ACT.	LARGE	FISH RARITY PER SECONDARY: CLASS	VERY HIGH	ECOLOGICAL IMPORTANCE: RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) RATING	VERY HIGH	RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) INTOLERANCE WATER LEVEL/FLOW CHANGES DESCRIPTION	LOW
POTENTIAL PHYSICO-CHEMICAL MOD ACTIVITIES	LARGE	ECOLOGICAL IMPORTANCE: RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) RATING	VERY HIGH	HABITAT DIVERSITY CLASS	VERY HIGH	STREAM SIZE SENSITIVITY TO MODIFIED FLOW/WATER LEVEL CHANGES DESCRIPTION	LOW
		RIPARIAN-WETLAND NATURAL VEG RATING BASED ON % NATURAL VEG IN 500m (100%=5)	MODERATE	HABITAT SIZE (LENGTH) CLASS	HIGH	RIPARIAN-WETLAND VEG INTOLERANCE TO WATER LEVEL CHANGES DESCRIPTION	VERY HIGH
		RIPARIAN-WETLAND NATURAL VEG IMPORTANCE BASED ON EXPERT RATING	HIGH	INSTREAM MIGRATION LINK CLASS	VERY HIGH		
				RIPARIAN-WETLAND ZONE MIGRATION LINK	MODERATE		
				RIPARIAN-WETLAND ZONE HABITAT INTEGRITY CLASS	LOW		
				INSTREAM HABITAT INTEGRITY CLASS	VERY HIGH		

APPENDIX C: SIGNIFICANCE RATINGS OF POTENTIAL ENVIRONMENTAL IMPACTS

For each impact, the **EXTENT** (spatial scale), **MAGNITUDE** (severity of impact) and **DURATION** (time scale) are assessed and used to ascertain the **SIGNIFICANCE** of the impact, firstly in the case of no mitigation and then with the most effective mitigation measure(s) in place. The tables below indicate the scale used to assess these variables, and defines each of the rating categories.

Extent: "Extent" defines the physical extent or spatial scale of the impact.

Rating	Description
LOCAL	Extending only as far as the activity, limited to the site and its immediate surroundings. Specialist studies to specify extent.
REGIONAL	Western Cape. Specialist studies to specify extent.
NATIONAL	South Africa
INTERNATIONAL	

Duration: "Duration" gives an indication of how long the impact would occur.

Rating	Description
SHORT TERM	0 - 5 years
MEDIUM TERM	5 - 15 years
LONG TERM	Where the impact will cease after the operational life of the activity, either because of natural processes or by human intervention.
PERMANENT	Where mitigation either by natural processes or by human intervention will not occur in such a way or in such time span that the impact can be considered transient.

Intensity: "Intensity" establishes whether the impact would be destructive or benign.

Rating	Description
ZERO TO VERY LOW	Where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected.
LOW	Where the impact affects the environment in such a way that natural, cultural and social functions and processes continue, albeit in a slightly modified way.
MEDIUM	Where the affected environment is altered, but natural, cultural and social functions and processes continue, albeit in a modified way.
HIGH	Where natural, cultural and social functions or processes are altered to the extent that it will temporarily or permanently cease.

Loss of resources: "Loss of resource" refers to the degree to which a resource is permanently affected by the activity, i.e. the degree to which a resource is irreplaceable.

Rating	Description
LOW	Where the activity results in a loss of a particular resource but where the natural, cultural and social functions and processes are not affected.
MEDIUM	Where the loss of a resource occurs, but natural, cultural and social functions and processes continue, albeit in a modified way.
HIGH	Where the activity results in an irreplaceable loss of a resource.

Status of impact: The status of an impact is used to describe whether the impact would have a negative, positive or zero effect on the affected environment. An impact may therefore be negative, positive (or referred to as a benefit) or neutral.

Probability: "Probability" describes the likelihood of the impact occurring.

Rating	Description
IMPROBABLE	Where the possibility of the impact to materialise is very low either because of design or historic experience.
PROBABLE	Where there is a distinct possibility that the impact will occur.
HIGHLY PROBABLE	Where it is most likely that the impact will occur.
DEFINITE	Where the impact will occur regardless of any prevention measures.

Degree of confidence: This indicates the degree of confidence in the impact predictions, based on the availability of information and specialist knowledge.

Rating	Description
HIGH	Greater than 70% sure of impact prediction.
MEDIUM	Between 35% and 70% sure of impact prediction.
LOW	Less than 35% sure of impact prediction.

Significance: "Significance" attempts to evaluate the importance of a particular impact, and in doing so incorporates the above three scales (i.e. extent, duration and intensity).

Rating	Description
VERY HIGH	Impacts could be EITHER: of *high intensity* at a *regional level* and endure in the *long term*; OR of *high intensity* at a *national level* in the *medium term*; OR of *medium intensity* at a *national level* in the *long term.*
HIGH	Impacts could be EITHER: of *high intensity* at a *regional level* and endure in the *medium term*; OR of *high intensity* at a *national level* in the *short term*; OR of *medium intensity* at a *national level* in the *medium term;* OR of *low intensity* at a *national level* in the *long term*; OR of *high intensity* at a *local level* in the *long term*; OR of *medium intensity* at a *regional level* in the *long term.*
MEDIUM	Impacts could be EITHER: of *high intensity* at a *local level* and endure in the *medium term*; OR of *medium intensity* at a *regional level* in the *medium term*; OR of *high intensity* at a *regional level* in the *short term*; OR of *medium intensity* at a *national level* in the *short term*; OR of *medium intensity* at a *local level* in the *long term*; OR of *low intensity* at a *national level* in the *medium term;* OR of *low intensity* at a *regional level* in the *long term.*
LOW	Impacts could be EITHER of *low intensity* at a *regional level* and endure in the *medium term*; OR of *low intensity* at a *national level* in the *short term*; OR of *high intensity* at a *local level* and endure in the *short term*; OR of *medium intensity* at a *regional level* in the *short term*; OR of *low intensity* at a *local level* in the *long term*; OR of *medium intensity* at a *local level* and endure in the *medium term.*
VERY LOW	Impacts could be EITHER of *low intensity* at a *local level* and endure in the *medium term*; OR of *low intensity* at a *regional level* and endure in the *short term*; OR of *low to medium intensity* at a *local level* and endure in the *short term.*
INSIGNIFICANT	Impacts with: Zero to very low intensity with any combination of extent and duration.
UNKNOWN	In certain cases it may not be possible to determine the significance of an impact.

Degree to which impact can be mitigated: This indicates the degree to which an impact can be reduced / enhanced.

Rating	Description
NONE	No change in impact after mitigation.
VERY LOW	Where the significance rating stays the same, but where mitigation will reduce the intensity of the impact.
LOW	Where the significance rating drops by one level, after mitigation.
MEDIUM	Where the significance rating drops by two to three levels, after mitigation.
HIGH	Where the significance rating drops by more than three levels, after mitigation.

Reversibility of an impact: This refers to the degree to which an impact can be reversed.

Rating	Description
IRREVERSIBLE	Where the impact is permanent.
PARTIALLY REVERSIBLE	Where the impact can be partially reversed.
FULLY REVERSIBLE	Where the impact can be completely reversed.

APPENDIX D: RISK ASSESSMENT MATRIX

ASPECTS AND IMPACT REGISTER/RISK ASSSESSMENT FOR WATERCOURSES INCLUDING RIVERS, PANS, WETLANDS, SPRINGS,DRAINAGE LINES
COMPILED BY: Toni Belcher (SACNASP 400040/10), BlueScience
PROJECT: Proposed works associated with the flood damage repairs to structures on MR309

				Severity																
Phases	**Activity**	**Aspect**	**Impact**	**Flow Regime**	**Physico & Chemical (Water Quality)**	**Habitat (Geomorph+ Vegetation)**	**Biota**	**Severity**	**Spatial scale**	**Duration**	**Consequence**	**Frequency of activity**	**Frequency of impact**	**Legal Issues**	**Detection**	**Likelihood**	**Significance**	**Risk Rating**	**Control Measures**	**Watercourse; PES; EIS**	**Confidence**
Construction	Construction works associated with the flood damage repairs to structures on MR309	Construction of Culvert Structures proposed at 27 sites	Loss of biodiversity & habitat and modification of the flow and water quality	2	2	2	2	2	2	2.5	**6.5**	1	3.5	5	2	**11.5**	**74.75**	**M**	See Freshwater Report	Seweweekspoort River, tributaries and associated wetland areas in Pass; PES: B; EIS: High/Moderate to high	High
Operation	Construction works associated with the flood damage repairs to structures on MR309	Maintenance of infrastructure at watercourse crossings		1	1	1	1	1	1	4	**6**	1	1	5	2	**9**	**54**	**L**			Medium