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# DRAFT ENVIRONMENTAL MANAGEMENT PROGRAMME

FOR THE

PERIODIC MAINTENANCE AND RESEALING OF TRUNK  
ROADS 33/4 AND 34/2 BETWEEN DE RUST AND  
PRINCE ALBERT.

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**DATE:** 7 July 2020

**SES PROJECT REF NO:** EMP/DR/PA/TR33/TR34  
**EIA REF:** 14/12/16/3/3/1/2104

- 
- Environmental Impact Assessments • Basic Assessments • Environmental Management Planning
  - Environmental Control & Monitoring • Public Participation • Broad scale Environmental Planning



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## PROJECT INFORMATION

|                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Project Ref. No:</b>   | 14/12/16/3/3/1/2104                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
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| Expertise                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Sharples Environmental Services cc</b> Since 1998, SES has been actively engaged in the fields of environmental planning, assessment and management. We advise private, corporate and public enterprises on a variety of differing land use applications ranging from large-scale residential estates and resorts to golf courses, municipal service infrastructure installations and the planning of major arterials. Our consultants have over 40+ years of combined experience and we operate in the Southern, Eastern and Western Cape regions.</p> <p><b>MICHAEL BENNETT (Environmental Assessment Practitioner):</b><br/>Michael studied at the University of Cape Town completing a Bachelor of Science degree majoring in Environmental and Geographic Science and Ocean and Atmospheric Science. Michael joined SES in 2014 and has extensive experience in assessments and monitoring and has worked on a variety of technical projects.</p> <p><b>JOHN SHARPLES (Managing Director):</b><br/>John started Sharples Environmental Services in 1998 and has overseen the company's growth and development since then. John also started the Cape Town office in 2010. John holds a Masters in Environmental Management from the University of the Free State as well as a Bachelor's degree in Conservation. He has consulted for over 20 years running a team of highly trained and qualified consultants and prior to this gained 12 years of experience working for environmental organizations. John is registered with EAPASA as a certified Environmental Practitioner.</p> |

## LIST OF ABBREVIATIONS

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|                |                                                                                       |
|----------------|---------------------------------------------------------------------------------------|
| CBA            | Critical Biodiversity Area                                                            |
| DEA            | National Department of Environmental Affairs                                          |
| DEA&DP         | Western Cape Government: Department of Environmental Affairs and Development Planning |
| ECO            | Environmental Control Officer                                                         |
| EIA            | Environmental Impact Assessment                                                       |
| km             | Kilometre                                                                             |
| m              | Metre                                                                                 |
| m <sup>2</sup> | Square metre                                                                          |
| MMP            | Maintenance Management Plan                                                           |
| NEMA           | National Environmental Management Act, Act No. 107 of 1998, as amended                |
| NFEPA          | National Freshwater Ecosystem Priority Areas (2011)                                   |
| SES            | Sharples Environmental Services cc                                                    |
| TOR            | Terms of Reference                                                                    |

# 1. INTRODUCTION AND BACKGROUND

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*Sharples Environmental Services cc (SES)* was appointed by *Western Cape Government: Department of Transport and Public Works* to compile this Environmental Management Programme (EMPr) for the periodic maintenance of Trunk roads 33/4 and 34/2 between De Rust and Prince Albert.

Trunk road 33/4 is more commonly known as the N12, the segment of the road which is earmarked for maintenance is a popular scenic pass named Meiringspoort and is situated between De Rust and Klaarstroom, traversing the Swartberg mountain range. The segment of Trunk Road 33/4 in discussion stretches approximately 22km north from De Rust to Klaarstroom through the Swartberg mountain range. The maintenance and resealing will continue along Trunk road 33/4 for approximately 7.1km in a north-westly direction after passing through the town of Klaarstroom. Trunk road 33/4 exits the town of Klaarstroom and deviates in a northly direction towards the Central Karoo. The maintenance and resealing of Trunk road 33/4 (N12) ends at this deviation and continues along Trunk road 34/2, which is connected to Trunk road 33/4 shortly before it deviates north. Trunk road 34/2 is commonly known as the R407 and continues west towards Prince Albert. The maintenance and resealing of Trunk road 34/2 will start approximately where it exits Trunk road 33/4 and continue for approximately 43km towards Prince Albert, where the resealing and maintenance ends.

Maintenance activities include the repair of concrete spalling, the repair of concrete cracks, the strengthening of bridge decks, the reinstatement of culvert cell joint fillers, the resealing of bridge/culvert deck expansion joints, the clearance of deck scuppers, the installation of bridge number plates, the clearance of watercourse flow paths and the protection of eroded foundations.

This EMPr has been compiled to address environmental issues and impacts relating to the routine maintenance and resealing of the Trunk roads.

## 2. About this EMPr

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This document is intended to serve as a guideline to be used by the *Western Cape Government: Department of Transport and Public Works* (as the Implementing Agent) and any person/s acting on behalf of the *Western Cape Government: Department of Transport and Public Works*, during the pre-construction, construction, post-construction rehabilitation and operational (maintenance) phases of the proposed development. This document provides measures that must (where practical and feasible) be implemented to ensure that any environmental degradation that may be associated with the development is avoided, or where such impacts cannot be avoided entirely, are minimised and mitigated appropriately.

This EMPr has been prepared in accordance with the requirements of an EMPr as specified in the Amended Environmental Impact Assessment Regulations, 2014 (GN No. R. 326 of 7 April 2017), and with reference to the "Guidelines for Environmental Management Programmes" published by the Department of Environmental Affairs and Development Planning (2005).

It is important to note that the EMPr is not designed to manage the physical establishment of the development *per se*, but should rather be seen as a tool which can be used to manage the environmental impacts of the development.

The rehabilitation, mitigation, management and monitoring measures prescribed in this EMPr must be seen as binding to the *Western Cape Government: Department of Transport and Public Works*, and any

person acting on its behalf, including but not limited to agents, employees, associates, guests or any person rendering a service to the development site.

## **2.1 Important caveat to the report**

In the past, some developments have had a devastating impact on the environment even though they have had Environmental Management Programmes in place, while other developments have had a low impact even though no management plans have been compiled.

The Implementing Agent and the attitude of the construction team play an integral role in determining the impact that the development will have on the environment. The ECO needs to ensure that the all role-players are “on board” with regard to the constraints that the EMPr places on the development and construction team. The end result relies on cooperation and mutual respect and understanding of all parties involved.

## **3. How to use this document**

---

It is essential that this EMPr be carefully studied, understood, implemented and adhered to as far as reasonably possible, throughout all phases of the proposed development. The *Western Cape Government: Department of Transport and Public Works* must retain a copy of this EMPr, and another copy of this EMPr must be kept on site at all times during the pre-construction, construction and post-construction rehabilitation phases of the development.

This EMPr must be included in all contracts compiled for contractors and subcontractors employed by The *Western Cape Government: Department of Transport and Public Works*, as this EMPr identifies and specifies the procedures to be followed by engineers and other contractors to ensure that the adverse impacts of construction and maintenance activities are either avoided or reduced. The *Western Cape Government: Department of Transport and Public Works* and any appointed contractors must make adequate financial provision to implement the environmental management measures specified in this document.

This EMPr must be seen as a working document, which may be amended from time to time as needed, in order to accommodate changing circumstances on site or in the surrounding environment, or in order to accommodate requests/ conditions issued by the competent authority, the *Department of Environmental Affairs*. Amendments to this EMPr must first be approved by the competent authority, in writing.

## **4. NEMA LEGISLATIVE REQUIREMENTS**

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### **4.1 NATIONAL ENVIRONMENTAL MANAGEMENT ACT, NO. 107 OF 1998, AS AMENDED AND THE ENVIRONMENTAL IMPACT ASSESSMENT REGULATIONS, 2014 (AS AMENDED)**

Trunk Road 33/4 between km 4.6 and km 14.4 is classified as a Protected Area and is part of a UNESCO World Heritage Site (WHS), as such this stretch is listed in terms National Environmental Management Act, No. 107 of 1998, as amended and the Environmental Impact Assessment Regulations, 2014 (as amended) and the National Department of Environmental Affairs (DEA) is the competent authority to process the application for Environmental Authorisation. The rest of the maintenance route (outside of the World Heritage Site) falls within the Provincial Department of Environmental Affairs and Development Planning's (DEADP) jurisdiction. The DEADP has indicated that in terms of CIRCULAR: EADP 0024/2014 the proposed maintenance outside of the WHS is not listed and does not require Environmental Authorisation.

The *Western Cape Government: Department of Transport and Public Works* has requested that the unlisted portion of the proposal still be undertaken in accordance with an MMP to ensure that environmental impacts as a result of the activities are mitigated and managed. As such this EMPr is only legislatively required for the WHS stretch, however the unlisted section of the proposal will be managed

through this document too. This EMPr therefore includes details of the rest of the maintenance route which falls outside of the World Heritage Site boundary.

Please however note a listed activity may not commence prior to an Environmental Authorisation being granted by the relevant Competent Authority. Or in the case where an MMP exclusion applies, in accordance with an MMP adopted by the relevant Competent Authority. It is an offence in terms of Section 49A of the National Environmental Management Act, no. 107 of 1998 for a person to commence with a listed activity unless the Competent Authority has granted an Environmental Authorisation for the undertaking of an activity. Failure to comply with the requirements of Section 24F and 49A of the National Environmental Management Act, no. 107 of 1998 will result in the matter being referred to the Environmental Compliance and Enforcement Directorate for prosecution.

A person convicted of an offence in terms of the above is liable to a fine not exceeding R10 million or to imprisonment for a period not exceeding 10 years, or to both such fine and imprisonment.

In terms of the EIA Regulations, 2014 (as amended) and the information provided by the proponent in the Inception Report, compiled by inception Consulting Engineers, dated August 2018. The activities which follow have been identified **which may be triggered if the thresholds of the Listed activities are exceeded** beyond the boundaries of the Trunk Road Reserves.

### **Government Notice No. R. 327**

#### **Activity 12:**

The development of—

(i) dams or weirs, where the dam or weir, including infrastructure and water surface area, exceeds 100 square metres; or

(ii) infrastructure or structures with a physical footprint of 100 square metres or more; where such development occurs—

(a) within a watercourse;

(b) in front of a development setback; or

(c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse;

excluding—

(aa) the development of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour;

(bb) where such development activities are related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies;

(cc) activities listed in activity 14 in Listing Notice 2 of 2014 or activity 14 in Listing Notice 3 of 2014, in which case that activity applies;

(dd) where such development occurs within an urban area;

(ee) where such development occurs within existing roads, road reserves or railway line reserves; or

(ff) the development of temporary infrastructure or structures where such infrastructure or structures will be removed within 6 weeks of the commencement of development and where indigenous vegetation will not be cleared.

#### **Activity 19:**

The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse;

but excluding where such infilling, depositing, dredging, excavation, removal or moving—

(a) will occur behind a development setback;

(b) is for maintenance purposes undertaken in accordance with a maintenance management plan;

(c) falls within the ambit of activity 21 in this Notice, in which case that activity applies;

(d) occurs within existing ports or harbours that will not increase the development footprint of the port or harbour; or

(e) where such development is related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies.

**Activity 48:**

The expansion of—

(i) infrastructure or structures where the physical footprint is expanded by 100 square metres or more; or  
(ii) dams or weirs, where the dam or weir, including

infrastructure and water surface area, is expanded by 100 square metres or more;

where such expansion occurs—

(a) within a watercourse;

(b) in front of a development setback; or

(c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse;

excluding—

(aa) the expansion of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour;

(bb) where such expansion activities are related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies;

(cc) activities listed in activity 14 in Listing Notice 2 of 2014 or activity 14 in Listing Notice 3 of 2014, in which case that activity applies;

(dd) where such expansion occurs within an urban area; or

(ee) where such expansion occurs within existing roads, road reserves or railway line reserves.

**Government Notice No. R. 324**

**Activity 12:**

The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan.

i. Western Cape

i. Within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004;

ii. Within critical biodiversity areas identified in bioregional plans;

iii. Within the littoral active zone or 100 metres inland from high water mark of the sea or an estuarine functional zone, whichever distance is the greater, excluding where such removal will occur behind the development setback line on erven in urban areas;

iv. On land, where, at the time of the coming into effect of this Notice or thereafter such land was zoned open space, conservation or had an equivalent zoning; or

v. On land designated for protection or conservation purposes in an Environmental Management Framework adopted in the prescribed manner, or a Spatial Development Framework adopted by the MEC or Minister.

**Activity 14:**

**The development of—**

(i) dams or weirs, where the dam or weir, including infrastructure and water surface area exceeds 10 square metres; or

(ii) infrastructure or structures with a physical footprint of 10 square metres or more;

where such development occurs—

(a) within a watercourse;

(b) in front of a development setback; or

(c) if no development setback has been adopted, within 32 metres of a watercourse, measured from the edge of a watercourse;  
excluding the development of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour.

i. Western Cape

i. Outside urban areas:

- (aa) A protected area identified in terms of NEMPAA, excluding conservancies;
- (bb) National Protected Area Expansion Strategy Focus areas;
- (cc) World Heritage Sites;
- (dd) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority;
- (ee) Sites or areas listed in terms of an international convention;
- (ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;
- (gg) Core areas in biosphere reserves; or
- (hh) Areas on the estuary side of the development setback line or in an estuarine functional zone where no such setback line has been determined.

**Activity 23:**

The expansion of—

- (i) dams or weirs where the dam or weir is expanded by 10 square metres or more; or
- (ii) infrastructure or structures where the physical footprint is expanded by 10 square metres or more;

where such expansion occurs—

- (a) within a watercourse;
- (b) in front of a development setback adopted in the prescribed manner; or
- (c) if no development setback has been adopted, within 32 metres of a watercourse, measured from the edge of a watercourse;  
excluding the expansion of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour.

i. Western Cape

i. Outside urban areas:

- (aa) A protected area identified in terms of NEMPAA, excluding conservancies;
- (bb) National Protected Area Expansion Strategy Focus areas;
- (cc) World Heritage Sites;
- (dd) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority;
- (ee) Sites or areas listed in terms of an international convention;
- (ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;
- (gg) Core areas in biosphere reserves; or
- (hh) Areas on the estuary side of the development setback line or in an estuarine functional zone where no such setback line has been determined.

**Activities Authorised** in terms of the EIA Regulations, 2014 (as amended) and the environmental Authorisation attached to this EMPr as Appendix B. The following activities have been authorised for the Maintenance of Trunk Road 33 Section 4 between Km 4.6 and Km 14.4, Meiringspoort, Western Cape Province.

**Government Notice No. R. 327**

**19** - The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than cubic metres from a watercourse.

#### **Government Notice No. R. 324**

**12** - The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan.

**23** - The expansion of – infrastructure where the physical footprint is expanded by 10 square metres or more. Where such expansion occurs within 32 metres from a watercourse. In a World Heritage Site.

#### **4.2 SPECIFIC CONDITION OF THE EA, DATED \_\_\_\_ (EA REF:\_\_\_\_)**

**TO BE ADDED ONCE ISSUED**

#### **4.3 NATIONAL WATER ACT**

According to the Freshwater Habitat Impact Assessment, the road is within a Protected Area called the Swartberg Nature Reserve. The major river systems that meander adjacent to the road are mainly classified as aquatic CBA1. Small patches of aquatic CBA2 is found in between. Some of the drainage lines in close proximity to the major rivers have been identified as aquatic ESA1.

The impact assessment was undertaken using the Risk Matrix which is specified in the Government Notice R509 of 2016 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 (1998). Determining if a water use licence is required is associated with the risk of impacting on the watercourse. A low risk of impact could be authorised in terms of a General Authorisations (GA). All of the activities associated with the proposed maintenance works have a low impact significance and Low risk rating. However, the result of the risk assessment assumes that all of the recommended mitigation measures will be stringently implemented and monitored appropriately.

The construction will be limited to certain activities within the road reserve and within previously disturbed habitat. Minimal new impacts are anticipated, and most can be completely avoided. It is therefore recommended that the proposed project be authorised under a General Authorisation (GA).

#### **4.4 OTHER APPLICABLE LEGISLATION**

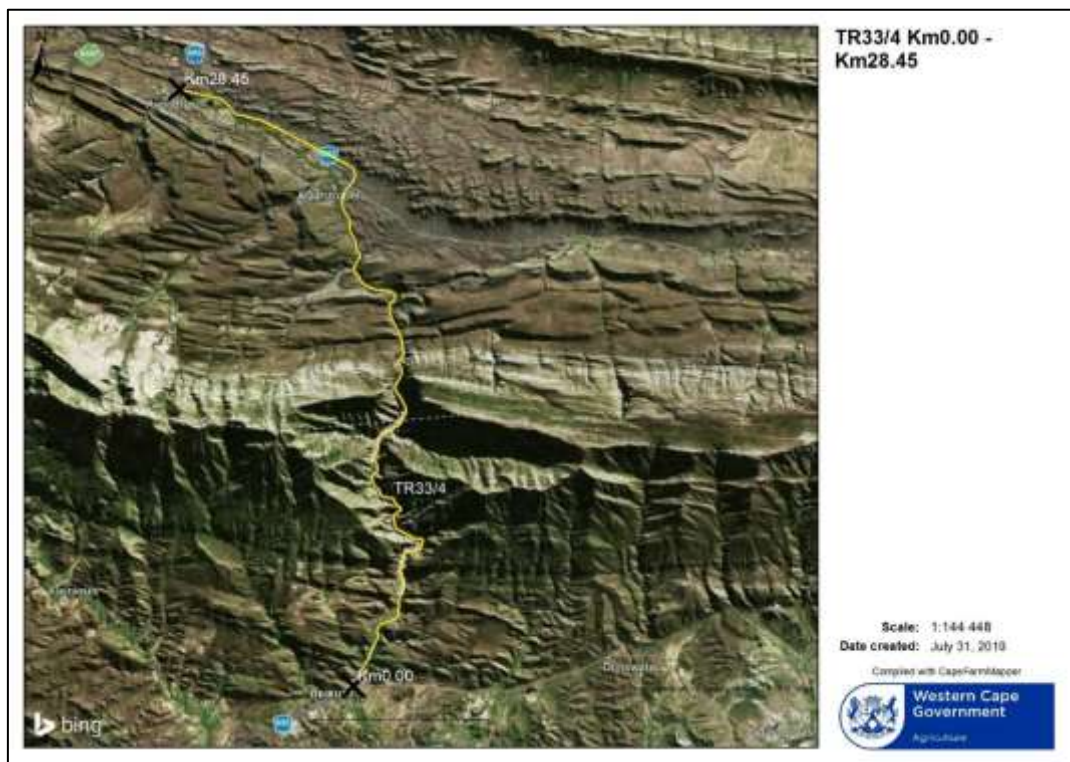
The *Western Cape Government: Department of Transport and Public Works* is responsible for ensuring that all contractors, labourers and any other appointed person/entity acting on the their behalf, remain compliant with the conditions of the received environmental authorisation and water-use authorisations, as well as the provisions of all other applicable legislation, including inter alia:

- National Environmental Management Act (NEMA) (Act No 107 of 1998, as amended);
- National Environmental Management Biodiversity Act (Act 10 of 2004);
- National Environmental Management: Waste Act (Act 59 of 2008);
- National Forest Act (Act No 84 of 1998);
- National Heritage Resources Act (Act No 25 of 1999);
- National Protected Areas Act (Act 57 of 2003)
- Mountain catchment areas Act (Act 63 of 1970);
- World Heritage Convention Act (Act 49 of 1999);
- Occupational Health and Safety Act (Act 85 of 1993);

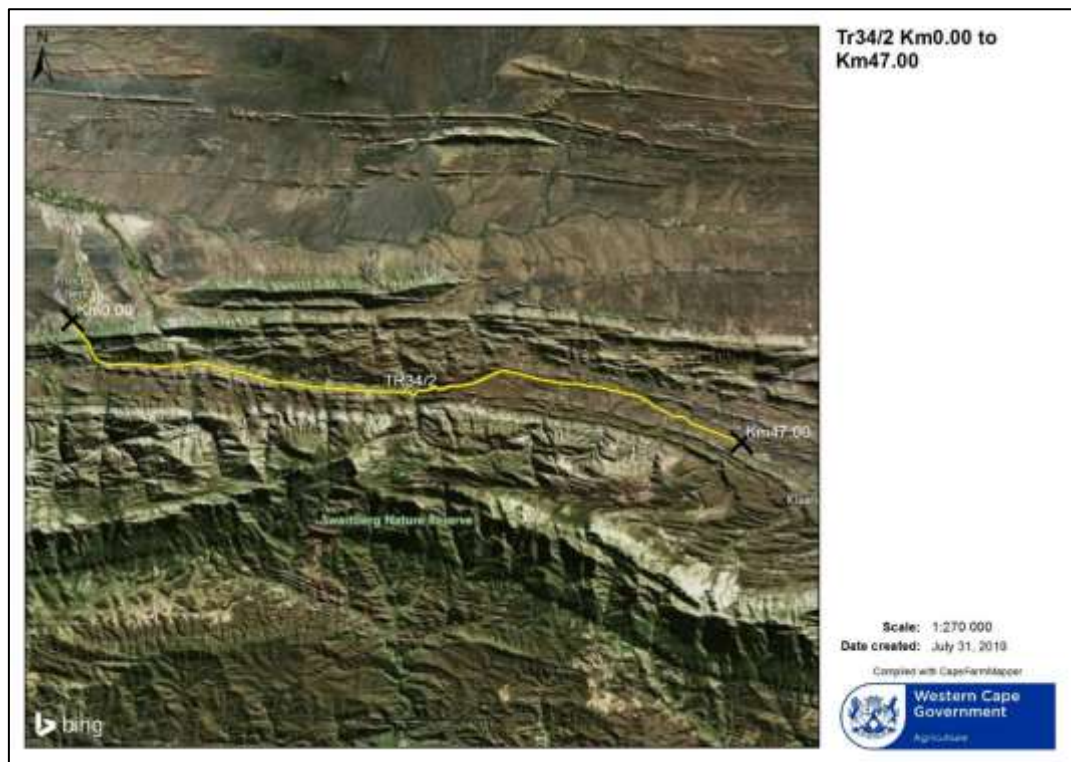
The above listed legislation have general applicability to most development applications, and it is the Western Cape Government: Department of Transport and Public Works responsibility to ensure that all contractors and employees are aware of their obligations in terms of these Acts. This EMPr does not detract from any other legal requirements

## 5. LOCATION OF THE SITE

The town of De Rust is located approximately 31km north east of the town of Oudtshoorn and approximately 79 km east of Calitzdorp. The routine maintenance is set to be undertaken on Trunk Road 33/4 and Trunk Road 34/2. Trunk road 33/4 is more commonly known as the N12, the segment of the road which is earmarked for maintenance passes through a world heritage site (Cape Floral Region Protected Areas: Swartberg Complex) and a popular scenic pass named Meiringspoort situated between De Rust and Klaarstroom, traversing the Swartberg mountain range. The segment of Trunk Road 33/4 in discussion stretches approximately 22km north from De Rust to Klaarstroom. The maintenance will continue along Trunk Road 33/4 for approximately 7.1kms in a north-westerly direction after passing through the town of Klaarstroom. Trunk Road 33/4 bypasses the town of Klaarstroom and deviates in a northly direction towards the Central Karoo. The maintenance of Trunk Road 33/4 (N12) ends at this intersection and continues along Trunk Road 34/2, towards Prince Albert. Trunk Road 34/2 is commonly known as the R407. The maintenance of Trunk Road 34/2 will end in Prince Albert (Km 0.00 of 34/2)

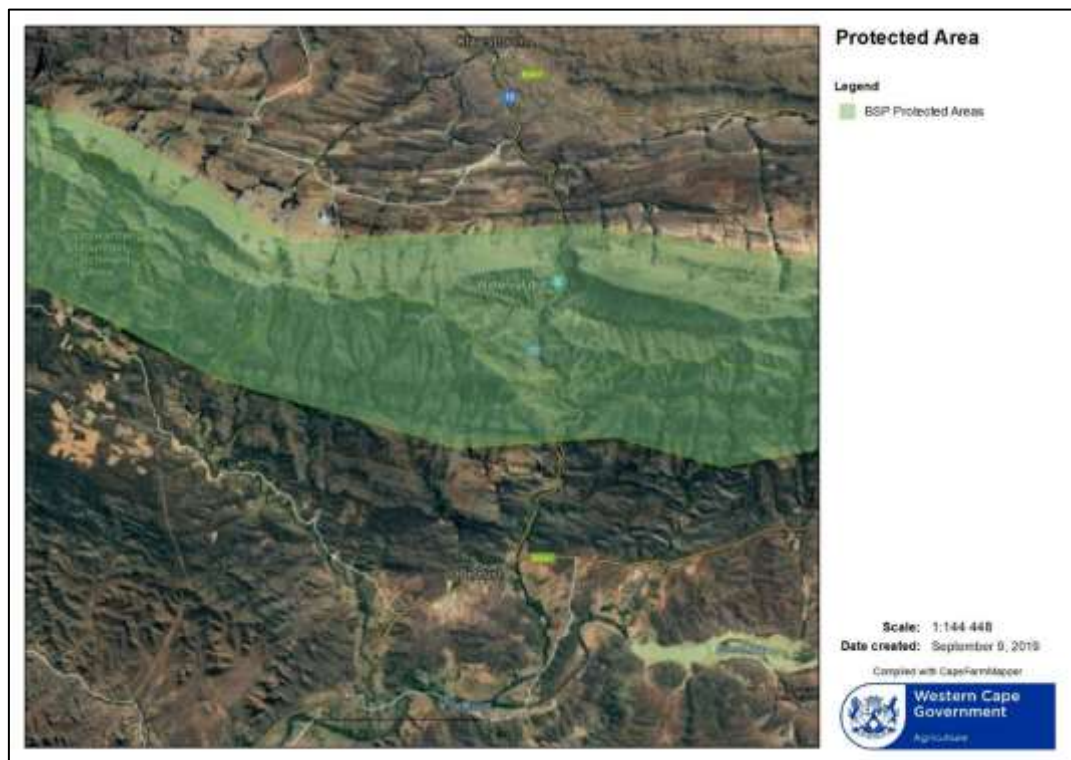


**Figure 1:** Aerial photograph highlighting the locality of TR33/4 Km0.00 – Km28.40.



**Figure 2:** Aerial photograph highlighting the locality of segment TR34/2 where maintenance will take place

This EMPr relates to the sections of the Trunk Road 33/4 which fall within the Protected Area (also World Heritage Site) as shown in Figure 3.



**Figure 3:** Protected Area

## 6. DESCRIPTION OF THE RECEIVING ENVIRONMENT

### 6.1 AQUATIC ENVIRONMENT

As Trunk Road 33/4 exits De Rust and travels north through Swartberg mountain range towards Klaarstroom, the Meiringsrivier is traversed several times by the road and is constantly within close proximity to the river due to the nature of the Meiringspoort pass. As the road exists the Meiringspoort pass (northern extent) the river changes name to the Grootrivier, the route traverses the Grootrivier several times before the route traverses the Sand River on the north western boundary of Klaarstroom.

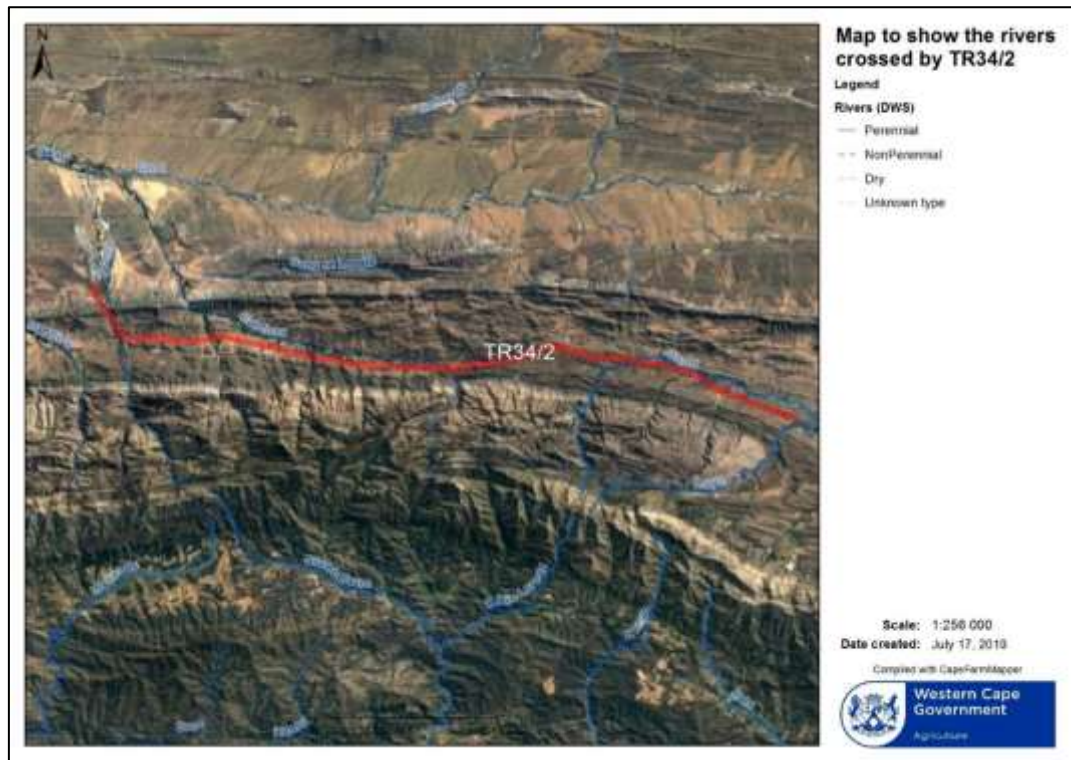
After passing through Klaarstroom, maintenance switches from Trunk Road 33/4 to Trunk road 34/2 where Trunk road 33/4 deviates north. This first section of the maintenance route on Trunk road 34/2 traverses only drainage lines and unnamed tributaries of the Groot River. As the route approaches Prince Albert, it first traverses the Cordiers river, and then the Dorps river.

All river's including dry riverbeds are however sensitive areas which play a vital role in the ecosystems which they support. All precautions and mitigation measures must be implemented to prevent avoidable impacts and contamination of watercourses found along the maintenance route.

Please refer to Figures 4 and 5 for the locality of the abovementioned rivers in relation to TR33/4 and TR34/2.



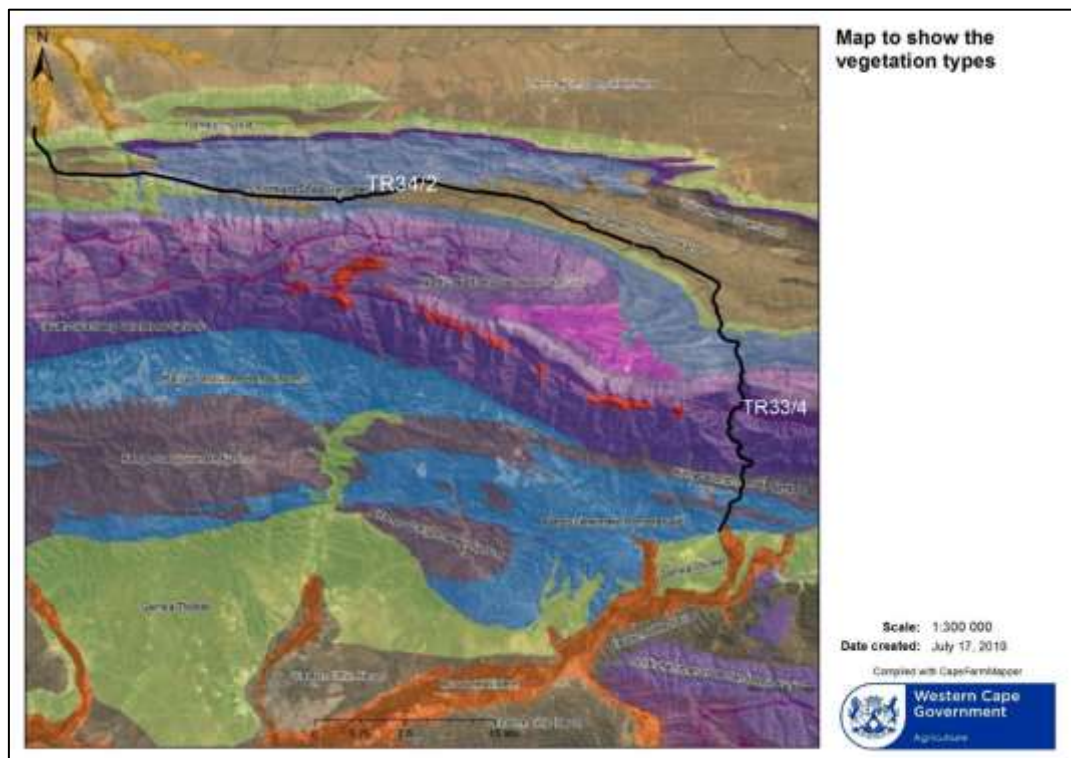
**Figure 4:** Map to indicate how TR33/4 traverses the Meirings and Groot river.



**Figure 5:** Map to indicate how TR34/2 traverses the Cordiers and the Dorps river.

## 6.2 TERRESTRIAL ENVIRONMENT

Trunk Road 33/4 and Trunk Road 34/2 pass through a number of different vegetation types between De Rust and Prince Albert, namely; Central Inland Shale Band Vegetation (FFb 3), Kango Limestone Renosterveld (FRI 1), Kango Conglomerate Fynbos (FFt 1), South Swartberg Sandstone Fynbos (FFs 24), North Swartberg Sandstone Fynbos (FFs 23), Swartberg Shale Renosterveld (FRs 15), Prince Albert Succulent Karoo (SKv 13). As seen in Figure 5.



**Figure 6:** South African National Vegetation map overlay

### **Kango Limestone Renosterveld (FRI 1) and Swartberg Shale Renosterveld (FRs 15)**

TR33/4 passes through both Kango Limestone Renosterveld (FRI 1) and Swartberg Shale Renosterveld (FRs 15). The two Renostervelds are differentiated according to the substrates they grow in, these substrates provide different nutrients to the Renostervelds which result in slight changes to the types of Renosterveld present, as well as the various thickets found within the vegetation type. According to The Nature Conservation Corporation (July 2008), Renostervelds are generally a vegetation of the mid-elevations i.e. the area between the foot of the high mountains and actual foreland flats, in this case, throughout the Swartberg mountain range, at different altitudes. Both Renostervelds are found on fine grained substrates that are more nutrient rich. These substrates may be alluvial in origin but generally they are derived from shale, granite, silcrete or exceptionally, limestone. The shale substrates are found on undulating hills and plains and broad valley floors. Silcrete is found as scattered patches on hilltops, occasionally on flats as well and is easily recognised by the presence of cobbles and pebbles. The alluvial substrates occur in valley bottoms, riverine plains and as alluvial fans. The Kango Limestone and Swartberg Shale Renosterveld are evergreen, fire-prone short to medium tall, mid-dense to dense shrubland dominated by cupressoid-leaved evergreen *asteraceous* shrubs with a well-defined understorey of shade tolerant herbs and bulbous plants. The patchy gaps are populated with a mixture of grasses, annuals and bulbous plants. Heuweltjies are frequently present and these support mid-tall bush clumps composed of mostly wild olive *Olea europaea* subsp. *africana*, candlewood *Pterocelastrus tricuspidatus* and blinkblaar taaibos *Rhus lucida*. If the vegetation is dominated by Proteaceae or Ericaceae or if there is more than 10% cover of Restionaceae, then it is not considered to be renosterveld, regardless if renosterbos *Elytropappus rhinocerotis* is present.

### **Kango Conglomerate Fynbos (FFt 1)**

Rebelo, A. et al (2006) explain that this vegetation type is predominantly found in the Northern foothills of the Little Karoo basin, within the Western Cape. The Kango Conglomerate Fynbos is found within Shallow to deep, often yellow-red apedal soils derived chiefly from Cango sandstones. The name 'conglomerate' is for expediency only as it occurs equally on sandstones and dolerites. This unit grades into FRI 1 Kango Limestone Renosterveld (also found along the TR33/4) at lower altitudes and shares with it the high abundances and dominance of *Dodonaea viscosa* var. *angustifolia*. On steep north-facing slopes, and especially in kloofs, spekboom thickets dominated by *Portulacaria afra* border on the vegetation of this 'conglomerate fynbos'.

### **Central Inland Shale Band Vegetation (FFb 3)**

This vegetation unit is found in the Western Cape Province in shale bands of the Klein and Groot Swartberge, Touwsberg, Sandberg, Rooiberg, Gamkaberg and Kammanassie. This vegetation unit is characterised by a narrow 80–200 m (wider in places), linear, smooth and flat feature of high-altitude slopes or mountain ridges. Vegetation diverse, from karoo shrublands at lower altitudes, to renosterveld and fynbos shrublands. Fynbos includes all structural types including graminoid fynbos, and usually waboomveld and *asteraceous* fynbos at lowest altitudes.

This vegetation unit has a conservational status of Least Threatened. The target of 27% has been achieved since 68% of the unit already protected in statutory reserves such as Groot Swartberg, Kammanassie, Towerkop, Swartberg East, Gamkaberg and Rooiberg. Additionally almost 25% is protected in mountain catchment areas such as Kammanassie, Klein Swartberg, Rooiberg, Swartberg-oos and Groot Swartberg. Only about 1% transformed so far.

### **North Swartberg Sandstone Fynbos (FFs 23)**

North Swartberg Sandstone Fynbos is found within the Western and Eastern Cape Provinces: stretching 270 km along the northern slopes of the Anysberg, Klein and Groot Swartberg to Slypsteenbergh and Resbosrand in the east (Rebelo, A. et al, 2006). The vegetation type can be found on very steep north-

facing slopes within acidic lithosol soils. Despite the prominence and importance of especially the Swartberg, this is a poorly known vegetation unit. Important taxa that can be found include; *Protea repens*, *Aspalathus hystrix*, *A. sceptum-aureum*, *Leucadendron rubrum*, *Protea eximia*, and *P. punctata*.

#### **South Swartberg Sandstone Fynbos (FFs 24).**

South Swartberg Sandstone Fynbos are only found within the Western and Eastern Cape Provinces: southern slopes of the Anysberg, Klein and Groot Swartberg to Slypsteenberg and Resbosrand in the east. The vegetation can be found on very steep and precipitous south-facing slopes. The vegetation is characterised by medium to tall shrubland and heathland. Proteoid and restioid fynbos dominate, with ericaceous fynbos at higher altitudes and scrub fynbos at lower altitudes (Rebelo, A. et al, 2006). Endemic taxa include *Cliffortia conifera*, *Hymenolepis cynopus*, *Liparia racemosa*, *Protea aristate* and *Stirtonanthus chrysanthus*.

#### **Prince Albert Succulent Karoo (SKv 13)**

Prince Albert Succulent Karoo is found in broad flat-bottomed, colluvium-filled valleys at 480-1120 meters above sea level. TR34/2 runs through this vegetation type which is found on sedimentary rocks of the Eccu group together with diamictite of the Dwyka Group. Mucina et al (2006) notes that the Prince Albert Succulent Karoo is dominated by succulent shrubs, such as *Augea capensis* and *Drosanthemum praecultum*, as well as low shrubs, such as *Pteronia pallens* and *Aptosimum indivisum*, and tall shrubs, such as *Cadaba aphylla* and *Gomphocarpus filiformis*.

### **6.2.1 TERRESTRIAL ENVIRONMENT MEIRINGSPOORT**

A Botanical Survey of the Proposed Meiringspoort Road Upgrade Project, dated February 2020, was compiled by Mark Berry Consultants. According to the botanical survey the vegetation recorded along the trunk road comprises two types, namely a Riviere type (fringing the River) and a renosterveld-succulent thicket type (on the drier slopes above the road). Both are in very good to pristine condition due to the location of the study area inside a nature reserve. Some disturbances were noted at a few bridge structures where localised erosion and silt build-up have occurred.

The Riviere vegetation comprises a tall riparian thicket, dominated by *Vachellia karroo*, *Searsia lancea*, *Kiggelaria africana*, *Salix cf. mucronata*, *Tarchonanthus littoralis*, *Tamarix usneoides* and *Phragmites australis*.

The dry slopes above the road host a large number of succulents, including *Mesembryanthemum junceum*, *Drosanthemum hispidum*, *D. lique*, *Ruschia multiflora*, *Ruschia sp.*, *Delosperma cf. subincanum*, *Malephora lutea*, *Carpobrotus sp.*, *Crassula tetragona*, *C. cultrata*, *C. subaphylla*, *C. pubescens*, *Adromischus triflorus*, *Cotyledon orbiculata*, *Aloe ferox*, *A. microstigma*, *Euphorbia mauritanica*, *Curio ficoides*, *Crassosiphon cacalioides* and *Senecio junceus*. Woody shrubs recorded include *Dicerotheramnium rhinocerotis*, *Helichrysum rosum*, *Senecio burchellii*, *Nidorella ivifolia*, *Athanasia tomentosa*, *A. filiformis*, *Pteronia fasciculata*, *P. incana*, *Chrysocoma ciliata*, *Aizoon africanum*, *Ficus burtt-davyi*, *Dodonaea viscosa*, *Lycium oxycarpum*, *Searsia lucida*, *S. pallens*, *S. pyroides*, *S. cf. longispina*, *Pappea capensis*, *Olea europaea ssp. cuspidata*, *Melanthus comosus*, *Aspalathus hystrix*, *Psoralea cf. affinis*, *Gymnosporia buxifolia*, *Diospyros lycioides*, *Salvia cf. aurea*, *Leonotis ocymifolia*, *Chironia baccifera* and *Asparagus aethiopicus*.

Herbaceous species and weeds recorded include *Berkheya sp.*, *Withania somnifera*, *Nemesia fruticans*, *Pelargonium zonale*, *Gomphocarpus fruticosus*, *Verbena bonariensis*, *Tagetes minuta* and *Salsola kali*. The latter three are introduced weeds. Only two bulbs were recorded, namely *Haemanthus sp.* and *Albuca canadensis*. No Species of Conservation Concern or regional endemics were recorded on site. All the recorded species are widespread and mostly common.

The report also notes that none of the vegetation types are currently listed as threatened and that given the nature of the proposal, maintenance of an existing road, it is not expected that the proposal will compromise the functions of the biodiversity network.

The report concludes that the direct impact on terrestrial and aquatic vegetation is not of great concern, provided that care is exercised during the construction phase (this EMPr will ensure this). There should be no nett loss of vegetation or habitat (after rehabilitation). The report also notes that there are no species of Conservation Concern or protected species were recorded.

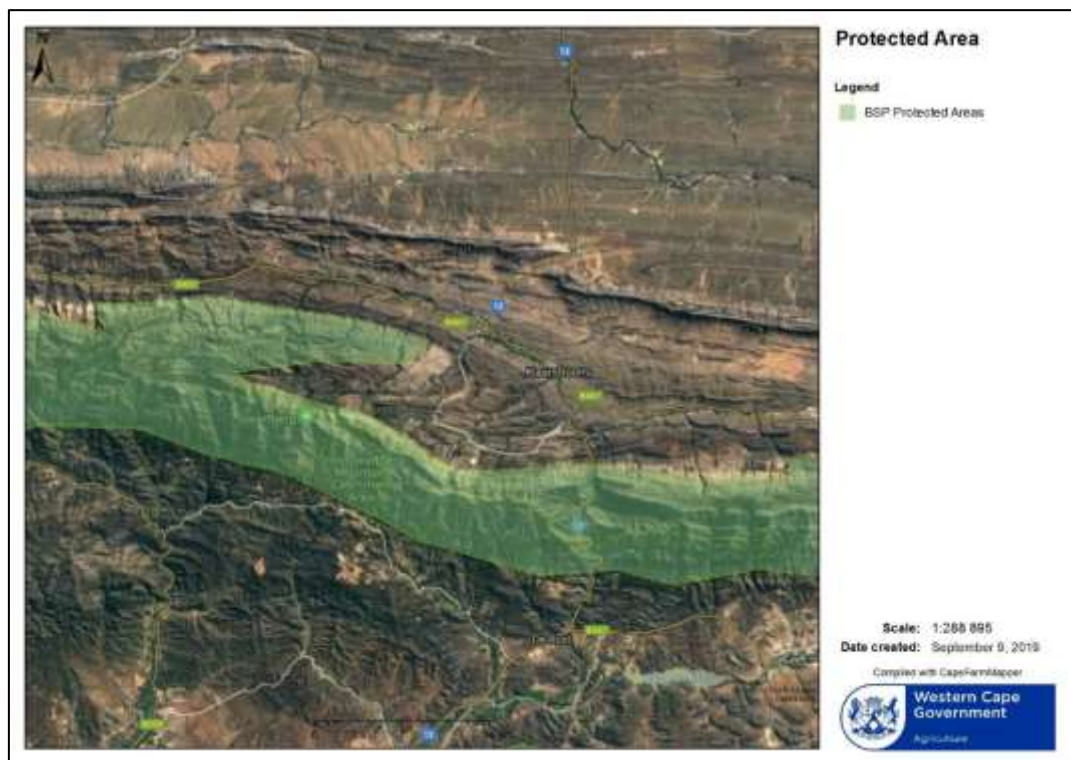
### 6.3 CULTURAL AND HERITAGE RESOURCES

A HWC NID was submitted to Heritage Western Cape. A Final Response to the submitted NID was issued (dated 7 August 2019, Case No. 19072406SB0726E) and Heritage Western Cape indicates that "since there is no reason to believe that the proposed maintenance and upgrades of Trunk Roads 33/4 and 34/2, between De Rust and Prince Albert, will impact on heritage resources, no further action under Section 38 of the National Heritage Resources Act (Act 25 of 1999) is required."

### 6.4 ENVIRONMENTAL SPATIAL PLANNING

Given the ecological diversity of the vegetation and landscapes present along the planned maintenance and resealing of TR33/4 and TR34/2 between De Rust and Prince Albert, the Trunk Road passes through a protected area and a number of Critical Biodiversity and Ecological Support Areas.

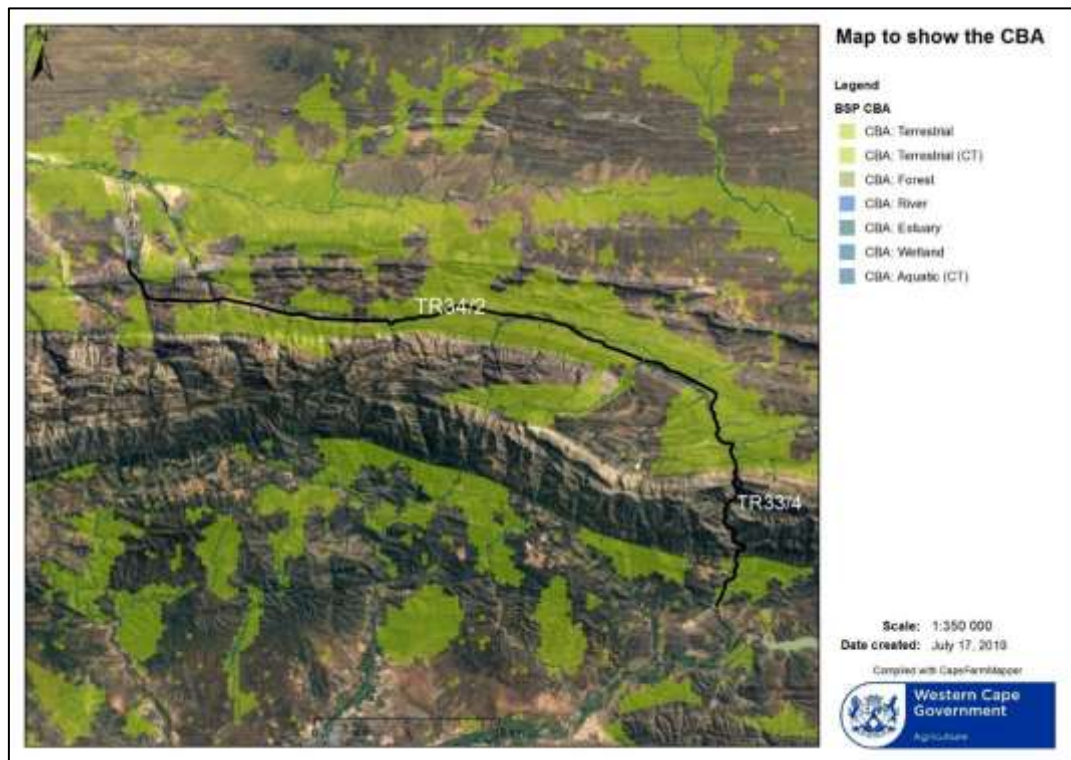
When TR33/4 traverses the Swartberg mountain range between Km0.00 and Km28.45, it passes through a World Heritage Site (Cape Floral Region Protected Areas: Swartberg Complex) and the Grootswartberg Mountain Catchment Area, which is defined as a protected area. This protected area aims to conserve a diversity of vegetation from renosterveld to mountain fynbos and spekboom veld. It also supports a variety of wildlife, including antelope, baboons, dassies and leopard. Please refer to Figure 6.



**Figure 7:** Protected area.

Critical Biodiversity areas (CBA) identified along the TR33/4 and TR34/2 include both CBA: Aquatic and CBA: Terrestrial. The Aquatic CBAs are present where TR34/2 and TR33/4 traverse the Meiringsrivier, Groot River, Cordiers river and the Dorps river. These Aquatic CBAs are identified in order to ensure that these areas are maintained in a natural or near-natural state, with no further loss of natural habitat.

The Terrestrial CBA areas dominant throughout the route and most prominent along TR34/2. The Trunk Road passes through numerous endemic vegetation types, which are in a good natural condition. The CBAs are distributed on the northern slope of the Swartberg mountain range, towards the flat alluvial plains.



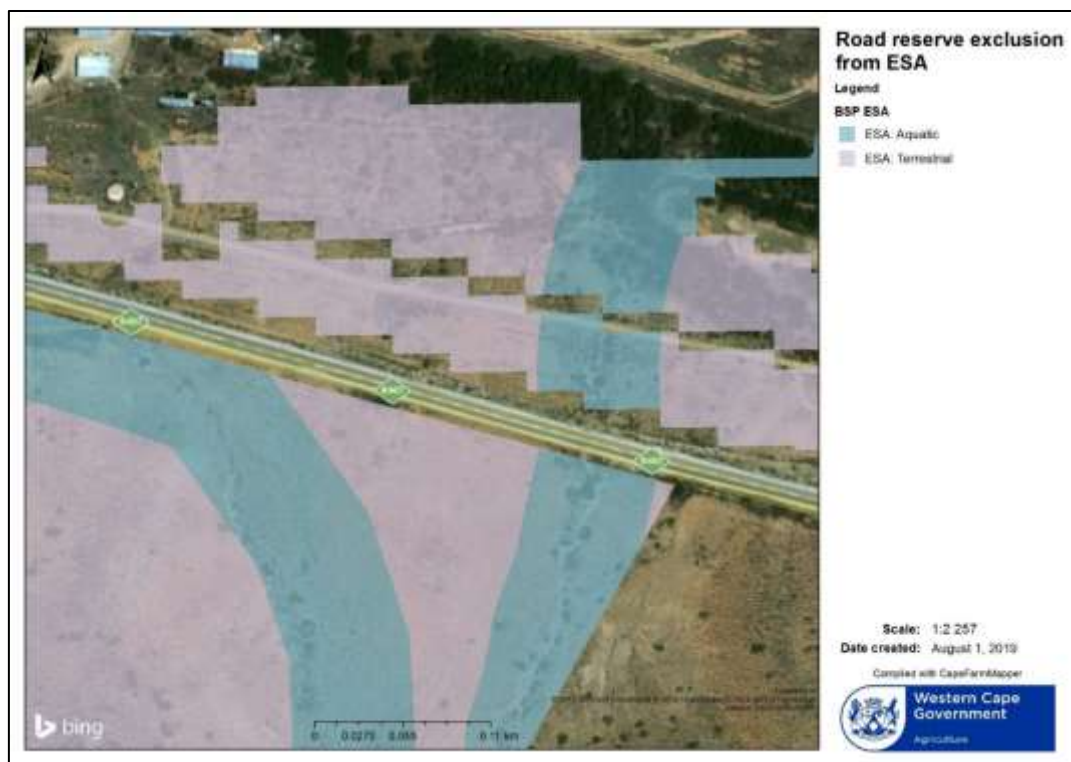
**Figure 8:** Critical Biodiversity areas

Numerous Ecological Support Areas (ESA) are present along the Maintenance route, TR33/4 and TR34/2 pass through both terrestrial ESAs and aquatic ESAs. ESAs are areas that are not essential for meeting biodiversity targets, but that play an important role in supporting the functioning of PAs or CBAs, and are often vital for delivering ecosystem services. The terrestrial ESAs are dominant on the southern slopes of the Swartberg mountain range, where TR33/4 passes through. TR34/2 passes through another ESA closer to Prince Albert, which supports the endemic Prince Albert Succulent Karoo vegetation. Aquatic ESAs present closer to Prince Albert are passed through by TR34/2, which support the Cordiers river and the Dorps river.

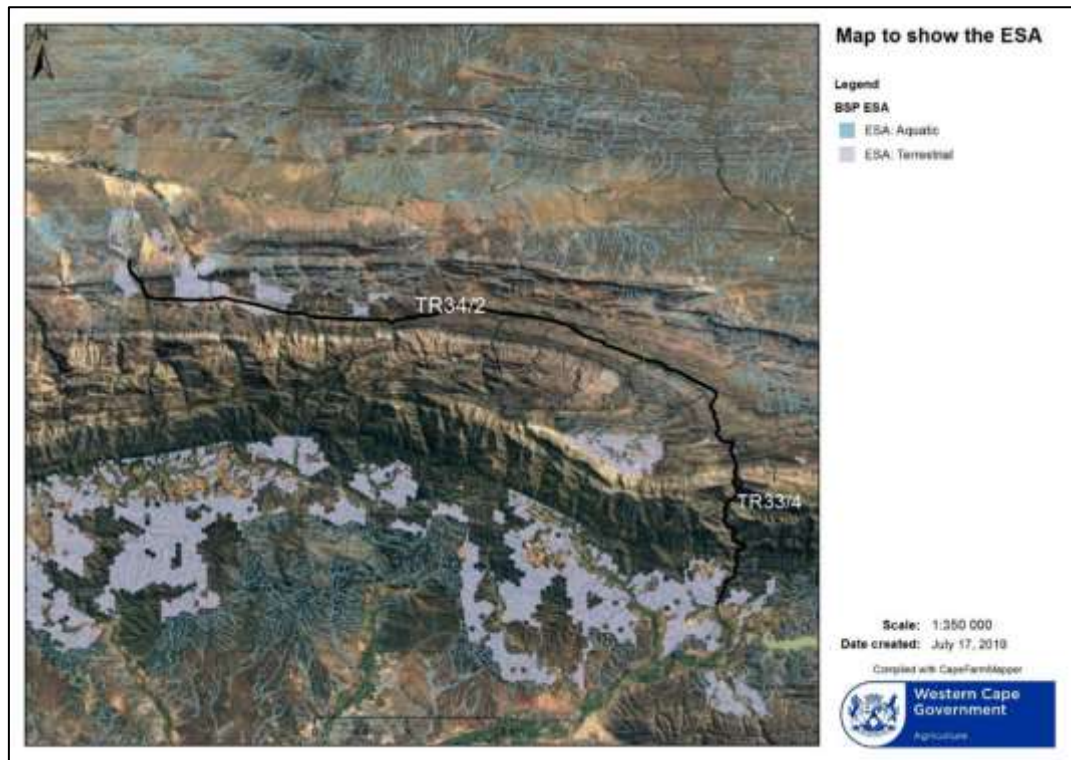
It is essential to note that the relative ESA and CBA areas fall outside of the road reserve and are essentially excluded. As seen in figures 8 and 9.



**Figure 9:** Map to show how the road reserve of TR33/4 is excluded from the CBA.



**Figure 10:** Map to show how the road reserve of TR34/2 is excluded from the ESA.



**Figure 11:** Ecological Support Areas

## 7. DESCRIPTION OF THE ACTIVITY

### 7.1 DESCRIPTION

Periodic maintenance of Trunk Roads 33/4 and 34/2 between De Rust and Prince Albert will consist of the following aspects:

#### **Site Camp Establishment:**

The site camp for the maintenance activities will be established on an adjacent property to the Trunk Roads, with the Landowners consent or on previously disturbed areas, once agreed upon by the Engineer and ECO.

#### **Proposed Rehabilitation/Maintenance Measures**

All remedial work to the structures is to be executed in accordance to Series 12000: Specifications for the Rehabilitation of Bridges that supplement the COLTO Standard Specifications for Road and Bridge Works for State Road Authorities. Typical categories of the proposed rehabilitation are as follows:

- Repair concrete spalling
- Repair concrete cracks
- Protect ASR Damaged and/or Weathered Concrete Surfaces
- Repair damaged and broken out concrete
- Strengthen bridge decks
- Reinstate previous poor concrete repairs
- Reinstate culvert cell joint fillers
- Seal bridge/culvert deck expansion joints
- Clear bridge deck scuppers
- Add structure number plates
- Clear watercourse flow path
- Protect eroded foundations
- Install guardrails

**The methodology for each repair category is as follows:**

### **Repair Concrete Spalling**

Severe spalling of concrete, and resulting cracking, in all elements are to be repaired using the following methodology:

- Mechanically remove all loose material and old surfaces until sound concrete is found. Repair areas to be cut square to a minimum depth of 25mm behind exposed reinforcement.
- Replace deteriorated reinforcement with new 16mm diameter reinforcement by tying into nonaffected reinforcement at the top and bottom of repair area. Use epoxy putty, MCC Multi Pox 1927 or similar approved, to grout reinforcement into substrate.
- Sand-blast any exposed reinforcement that is less than 20% deteriorated until it is shiny, to remove all rust.
- Clean repair surface thoroughly by low-pressure water-jetting.
- Apply primer, MCC Multi Prime 1104 Conversion Primer or similar approved, to existing reinforcement to prevent further rust from forming.
- Coat the whole area of repair with a wet to dry epoxy, MCC Multi Pox 1305 or similar approved, as per manufacturer's specification.
- Reinstall the concrete with a fibre polymer modified cementitious repair mortar, MCC Multi Plast 1038 or similar approved.
- After all repairs have been completed overcoat entire outside area with a cementitious crystal forming waterproof agent, MCC Multi Hyseal 210 or similar approved.
- Cure repair area with mist spray of potable water for 3 days after applying the waterproof agent.

### **Repair Concrete Cracks**

Severe cracking in all elements are to be repaired using the following methodology:

Smaller cracks (0.1-3mm)

- Cut open along cracks with hand held grinder machine to a depth of 3mm.
- Clean the cracks by high pressure air blasting to clear out any loose material and dust.
- Build a pond around the cleaned crack with silicone.
- Fill the pond with crack injection epoxy, MCC Multi Pox 1306 or similar approved. The epoxy will flow into the opened crack until full.
- Leave to cure for 1 day before scraping off the excess using a putty knife.

Larger cracks (3mm and larger)

- Square cut open along the crack/joint, 25mm deep and 50mm wide.
- Clean the repair area by high pressure air blasting to clear out any loose material and dust.
- Coat the area of repair with a wet to dry epoxy, MCC Multi Pox 1305 or similar approved, as per manufacturer's specification.
- Place MCC Multi Screed 50, or similar approved, in repair area as per manufacturer's specification.
- Cure repair area with MCC Multi Cure 200, or similar approved.
- Where applicable to a joint, re-cut after 24 hours seal with Bostik 200 DS 100 silicon sealant, or similar approved, available from Multi Construction Chemicals.

### **Protect ASR Damaged/Weathered Concrete Surfaces**

ASR (Alkali-Silica reaction) damaged and weathered/eroded concrete surfaces are to be repaired using the following methodology:

- Clean concrete surfaces thoroughly by low-pressure water-jetting.

- At large recessed/broken out concrete areas, first apply bonding slurry, Sika MonoTop-610 or similar approved, to repair surface and thereafter apply a free-flowing structural repair concrete,
- Sicacrete 214 or similar approved, with 9mm stone, to restore the concrete element as close to its original shape as possible.
- Apply waterproof cementitious mortar, Sikalastic 152 or similar approved.

### **Repair Damaged/Broken out Concrete**

B2697, B2697A, B2697B:

- Mechanically remove all loose material and old surfaces until sound concrete, as well as around exposed reinforcement where applicable.
- Dowel in new reinforcement to form the corner with sufficient cover.
- Sand-blast any exposed reinforcement until it is shiny.
- Clean repair surface thoroughly by low-pressure water-jetting.
- Apply bonding slurry, Sika MonoTop-610 or similar approved, to repair surface and apply anticorrosion primer, Sika Top-Armatec 110 or similar approved, to prepared and cleaned exposed reinforcement.
- Shutter and cast missing portion of deck/abutment with conventional 30MPa concrete and cure properly.
- Cure repaired surfaces with Sika Antisol 15 or similar approved. Deck Recess where Guide Block was Previously (B2701)
- Mechanically remove all loose material and old surfaces until sound concrete, as well as around exposed reinforcement where applicable.
- Sand-blast any exposed reinforcement until it is shiny.
- Clean repair surface thoroughly by low-pressure water-jetting.
- Apply bonding slurry, Sika MonoTop-610 or similar approved, to repair surface and apply anticorrosion primer, Sika Top-Armatec 110 or similar approved, to prepared and cleaned exposed reinforcement.
- Plaster re-profile the patches with polymer modified repair mortar, Sika MonoTop-612 or similar approved.
- Cure repaired surfaces with Sika Antisol 15 or similar approved.

### **Strengthen Bridge Decks**

Some decks have slightly deflected. From the roadway's perspective this has not yet caused any problems. The bridges are relatively old, and it can be assumed that the deflection is not critical at this stage as there are no major failure cracking on the soffits.

- Option 1 is to leave the decks as is.
- Option 2 is to monitor the decks' deflection.
- Option 3 is to strengthen the decks with carbon fibre strips.

Option 2 is proposed for this stage. Decks should be monitored monthly by measuring each deck's deflection. If significant deflection increases are documented, further investigation should be done to design a suitable rehabilitation method to strengthen the decks.

### **Reinstate Culvert Cell Joint Fillers**

- Remove all deteriorated cell joint fillers up to sound filler.
- Place backing cord 30mm deep into joint.
- Fill joints with an expansive cementitious grout, SikaGrout-212 or similar approved.

### **Seal Bridge/Culvert Deck Expansion Joints**

Due to the ingress of dirt and other material into the open expansion joints of the decks, movement of the decks are restricted, and this causes cracks to form in the asphalt layer on top of the deck. This occurs mostly on the two edges of the asphalt covered roadway. To ensure that the decks

can move freely and not cause the asphalt to crack, the following methodology should be used for areas to which it is applicable :

- Remove a 50-100mm wide strip of asphalt over the expansion joint, depending on the extent of affected asphalt.
- Clean the open joints thoroughly of any debris by low-pressure water-jetting.
- At the concrete roadway, install a backing cord 30mm deep in the expansion joint and seal the remaining depth of the expansion joint with a highway silicon seal, Dow Corning 888 or similar approved, recessed 9mm below the surface. This sealant should be cured properly ( $\pm 15$  days), before applying the asphaltic joint material.
- At the asphalt covered roadway, install a backing cord  $\pm 50$ -60mm deep in the expansion joint and seal the remaining depth of the expansion joint with asphaltic joint material (BJ binder).
- Apply crack seal "shoe" 50mm wide over the asphalt covered roadway's expansion joint and lap with the concrete roadway's Dow Corning 888, or similar approved,  $\pm 50$ -100mm.
- Repair the 50-100mm wide recessed strip as per the road specifications.
- Create a 3mm deep saw cut joint in the repaired and existing asphalt layer for the full extent of the expansion joint along its centre line.

### **Clear Bridge Deck Scuppers**

All bridge deck scuppers to be cleaned and cleared of any debris and vegetation.

### **Install Bridge Number Plates**

For major culverts, structure number plates on steel pegs should be installed next to the structure in the shoulder of road. For bridge B4493 structure number plates should be installed at one end block per direction of traffic.

### **Clear Watercourse Flow Path**

Vegetation overgrowth, debris and sediment in the watercourse to be removed close to the structure on the up and down stream sides to clear the flow path.

### **Protect Eroded Foundations**

To protect foundations where extensive soil erosion has occurred, gabions or mass concrete fill should be installed around foundations.

## **7.2 IMPACTS ON THE RECEIVING ENVIRONMENT AND MITIGATION MEASURES**

The following impacts are expected to occur during the periodic maintenance of TR33/4 and TR34/2:

### **7.2.1 Vegetation clearance and vegetation brush-cutting**

Vegetation disturbance in two forms will likely be undertaken as part of the routine maintenance. Vegetation clearance within the drainage lines on the inlet and outlet sides of the structures to ensure the unobstructed drainage of runoff through the structures. Vegetation brush-cutting will likely also be required at some locations for site access for labourers, construction vehicles and machinery.

### **Mitigation**

The environmental impact associated with the clearing of the vegetation can be mitigated by implementing the following measures:

- Clearance of vegetation should only be undertaken as a last resort if the vegetation will or is damaging a given structure and/or if the vegetation is completely blocking the flow of water through the structure. Vegetation root systems provide unmatched soil stability and should not be cleared purely for aesthetic purposes.
- Where vegetation clearance is unavoidable, clearance should be undertaken by cutting the plants at their stems/trunk bases and treating the stumps with an herbicide to prevent them re-growing.

Cleared vegetation's root systems should be left intact as far as possible to provide much needed stability to the ground material and decrease the areas' vulnerability to erosion.

- Where practical, the maintenance areas must be properly demarcated prior to activities being undertaken. The areas outside these demarcated areas must be regarded as a No-Go areas;
- Only the minimum practical amount of vegetation must be cleared to effectively undertake the required maintenance activities;
- All vegetation clearance should be undertaken by means of manual labour;

### **7.2.2 Removal, Moving / Excavation of Ground Material**

Clearing of silt from within the culverts may be required in order to successfully clear the watercourses flow path. Disturbance to ground material may also result from the creation of temporary access to maintenance areas.

#### **Mitigation**

- The maintenance area and site access must be properly demarcated. The area outside this demarcated area must be regarded as a No-Go area;
- Where practically possible, existing two track or other access routes should be utilised and only as a last resort should temporary access routes be created;
- Only the minimum amount of excavations to undertake the required activities must be undertaken;
- Where practical and feasible, excavations should be done by means of manual labour;
- Use can be made of a Tractor-Loader-Backhoe (TLB) where excavation of large amounts of material needs to be excavated, removed, moved and deposited.

### **7.2.3 Activities within or within close proximity to a watercourse**

A number of construction activities can result in negative impacts to the watercourses that traverse TR33/4 and TR34/2. The following impacts on the watercourses may result due to road maintenance activities.

- Pollution as a result of a lack of adequate sanitary facilities and ablutions;
- Erosion to the working area as a result of no storm water provisions.
- The uncontrolled interaction of construction workers with the watercourses that could lead to the pollution of the watercourses i.e. washing off equipment in the watercourses;
- Inadequate stormwater management during rain events could lead to erosion and contamination of the watercourses.
- Leakage of hazardous materials (i.e. oils, fuels, etc.) into the watercourses due to incorrect use or leaking construction vehicles; and
- Construction related wastes that blow / fall into the watercourses.

#### **Mitigation**

- Supply adequate sanitation and ablution facilities. These facilities must however be situated away from the watercourses to prevent possible pollution if the facilities leak or are blown over.
- Provisions for storm water management must be undertaken during maintenance activities (i.e. maintenance work must be undertaken keeping in mind that a rainfall event could occur during maintenance activities, resulting in stream flow of the watercourses).
- Stormwater must be diverted away from the construction site by means of berms.
- No equipment should be left unattended to within a watercourse.
- Workers must receive necessary training to make them aware of the possible pollution they may cause by the actions in close proximity to the watercourse.
- The construction area must be demarcated to deter labourers from entering the watercourses unnecessarily.
- The area beyond the demarcation must be regarded as a no-go area.
- Stockpiles of materials must not be placed in close proximity to the watercourse.

- Vehicles must be inspected on a daily basis to check for leaks.
- No refuelling of vehicles in close proximity to the watercourse. This must preferably be done in the site camp on an impermeable surface to prevent pollution of the soil.
- A spill kit must be available at all times in the event of spillage. Polluted soil must be removed and disposed of at an appropriately licensed disposal facility.
- An integrated waste management approach must be adopted on site. Waste management is discussed in further depth in Section 10.4 of this EMP. This includes an integrated waste management approach such as re-use, recycling, etc. and the provision of waste bins on site.
- Adequate bins must be provided at all active construction sites along the road route. These bins must be fitted with lids to prevent the waste from blowing into the watercourses or surrounding vegetation.

#### **7.2.4 General construction nuisances**

The construction activities will cause possible noise, dust, visual and traffic disturbances to road users. This impact cannot be avoided, the following mitigation measures must be implemented to minimise the effect of the impact:

- Put measures in place to allow for the maximum available flow of traffic.
- Noise generating activities will be limited to normal working hours.
- Equipment must be in good working condition in order to minimise noise generation and prevent contamination as a result of fluid leaks.
- Labourers and site agents should be educated on how to control activities that have the potential to become disturbances.
- Keep the construction site clean and tidy.

#### **7.3 SITE RE-VEGETATION / REHABILITATION**

It is in our experience that vegetation encroaching on roads and associated drainage structures are undesirable for the longevity of roads and associated drainage structures. However, areas within the road reserve, including embankments can be effectively stabilised using vegetation and/or jute geotextile. No search and rescue has been recommended within this EMP because the likelihood of transplanting any worthwhile species is very low considering the need for it to be watered for the first few months to ensure it is able to grow. In terms of rehabilitation of disturbed areas within the dry climate of the Klein Karoo and with the current water shortages faced by the Western Cape, it is not deemed practical to attempt to re-vegetate disturbed areas. The end goal with regards to rehabilitation of the disturbed areas is to stabilise the slopes to prevent erosion and damage to structures, this may only be possible through physical/mechanical methods such as gabions or stone pitching within the maintenance areas. The use of jute geotextile could also be used but the likelihood of success with this material is low considering the climate. No biological rehabilitation methods are therefore recommended.

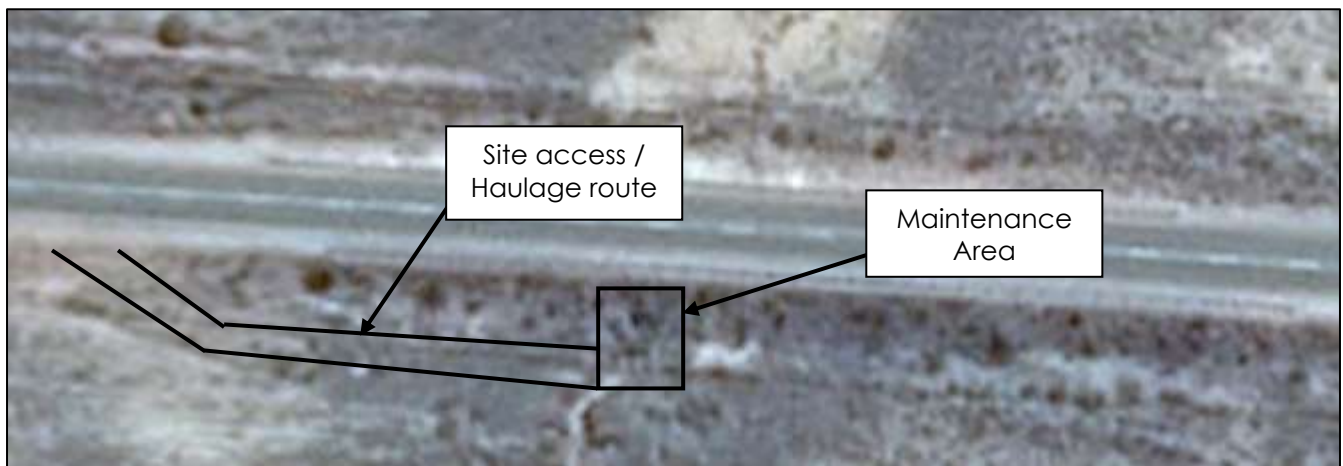
#### **7.4 WORKING WITH BITUMEN**

It must be ensured that if bitumen (or other environmentally hazardous substances) is applied to the road surface that measures are in place to prevent the substances from running down road embankments or pooling alongside the road. These pools become fatal traps for any fauna traversing the road. If at any stage bitumen does rundown the embankments or pools anywhere along the route, the spillage must be rectified immediately to prevent trapping of any fauna.

#### **7.5 DEMARCATION AND SITE ACCESS**

Demarcation of access routes is required to ensure that vehicle operators and labourers do not disturb more ground material than what is needed to undertake the required activities.

**Large Culverts or Areas with Steep Embankments:** In general, the embankments approaching the larger culverts are somewhat higher in elevation relative to the surrounding topography when compared to the smaller/lower culverts. Because of this, access to the site will require greater disturbance for a greater distance than the smaller culverts. In the case of the larger culverts, access to the site must be undertaken to create the least possible amount of disturbance and to leave stable steep slopes as undisturbed as possible. Figure 12 is an example of site access and demarcation to a relatively large culvert. As seen from the image, the access point should be created at the point where the embankment slope is most gentle and / or where it will create the least amount of disturbance to the environment. The highlighted Site access and maintenance area must be demarcated prior to activities commencing. It must also be noted that access must be created from one side only, Maintenance activities must take this into account (i.e. maintenance activities should not block access to the site, if the site is accessed from the left, maintenance activities should start on the right of the structure so that the site will not need to be accessed once activities on the left of the structure have concluded).



**Figure 12:** Demarcation example for areas with steep embankments

**Small Culverts or areas with flat embankments** Figure 13 shows an example of site access for culverts where the embankment is relatively flat. As seen from the image, the least amount of disturbance to the environment because of site access will occur if the site is accessed directly from the road level.



**Figure 13:** Demarcation example for areas with little to no embankment slope

## 7.6 SPECIALIST MITIGATION MEASURES

This section highlights the specific mitigation measures recommended by the specialists in their reports.

### Freshwater Habitat Impact Assessment

The monitoring of the activities is essential to ensure the mitigation measures are implemented. Therefore, compliance with the mitigation recommendations must be monitored by a suitably qualified individual. Monitoring for non-compliance must be done on a daily basis by the contractors. Photographic records of all incidents and non-compliances must be retained. This is to ensure that the impacts on the aquatic habitat are adequately managed and mitigated against and the successful rehabilitation of any disturbed areas within any system occurs.

- Comply with the conditions of authorization in the GA (Government Notice R509 of 2016), detailed in Annexure 12 (attached to this EMP as Appendix E), 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 (1998).
- Use the smallest possible working corridor. Outside the working corridor, all watercourses are to be considered no go areas. Any unnecessary intrusion into these areas is prohibited. Where intrusion is required, the working corridor must be kept to a minimum and identified and demarcated clearly before any construction commences to minimise the impact.
- A maximum construction working servitude width of 10m should be allowed on either side of the bridges. The 10m servitude includes the temporary bypass road required for access. Where temporary access roads/footpaths may be required, the following needs to be considered:
  - Preferably utilise existing access paths or access through disturbed/invaded vegetation before considering the clearing of vegetation.
  - Access roads must be one-way, limited to 3m width and adequate turning areas outside of the riparian areas may need to be identified and demarcated in conjunction with the ECO.
- The working servitude must be demarcated on both sides using orange hazard netting prior to construction commencing. The demarcation work must be signed off by the Environmental Control Officer (ECO) before any work commences. All freshwater habitats outside of the demarcated construction area must be considered 'No- Go' areas for the duration of the construction phase.
- Where construction is to take place within the river channel, if flowing, temporary diversions may need to be put in place to temporarily divert water away from activities and ensure a dry work area.
- Any diversions must be temporary in nature and no permanent walls, berms or dams may be installed within the river. Sandbags used in any diversion or for any activity within a watercourse must be in a good condition, so that they do not burst and empty sediment into the watercourse. Upon completion of the construction at the site, the diversions shall be removed to restore natural flow patterns.
- Diversions shall be temporary in nature and no permanent walls, berms or dams may be installed within a watercourse.
- Upon completion of the construction at the site, the diversions shall be removed to restore natural flow patterns, and the channel restored to its original configurations as soon as practically possible.
- Sedimentation must be minimised with appropriate measures.
- Construction must be carried out during the dry season and contingency plans must be in place for high rainfall events during construction.
- If the river at the site is flowing, before any work commences, sediment control/silt capture measures (e.g. bidim/silt curtains) must be installed downstream of the active working areas. Silt fences/curtains must be regularly checked and maintained (de-silted to ensure continued capacity to trap silt) and repaired where necessary. When de-silting takes place silt must not be returned to the watercourse.
- Excavated rock and sediments from the construction zone, and including any foreign materials, should not be placed within the delineated rivers and riparian areas in order to reduce the possibility of material being washed downstream.
- The solid domestic waste must be removed and disposed of offsite. All post-construction building material and waste must be cleared in accordance with the EMP.
- Spoil material must be hauled to a designated spoil site. No spoil material must be pushed down slope or discarded on site.

- Clearing of riparian vegetation should be kept to a minimum. When practicable, prune or top the vegetation instead of grubbing/uprooting.
- It is the contractor's responsibility to continuously monitor the area for newly established alien species during the contract and establishment period, which if present must be removed. Removal of these species shall be undertaken in a way which prevents any damage to the remaining indigenous species and inhibits the re-infestation of the cleaned areas. Any use of herbicides in removing alien plant species is required to be investigated by the ECO before use, for the necessity, type proposed to be used, effectiveness and impacts of the product on aquatic biota.
- Rubble is often placed aside during construction and never removed. It buries habitat and alters the sediment composition of the area, allowing alien plants to encroach.
- Mixing and/or decanting of all chemicals and hazardous substances must take place on a tray, shutter boards or on an impermeable surface and must be protected from stormwater.
- Cement/concrete batching is to be located in an area of low environmental sensitivity away from the river channel and pre-approved by the ECO. No batching activities shall occur on unprotected ground. Adequate surface protection will be required.
- Contaminated water containing fuel, oil or other hazardous substances must never be released into the environment. It must be disposed of at a registered hazardous landfill site.
- If any concrete, cast-in-place concrete, or grouting works are to be undertaken, a high potential exists for concrete and/or concrete leachate to enter the river. Concrete, concrete leachate, grout and other uncured concrete substances (e.g. concrete bags for headwall construction) are highly toxic to fish and other aquatic organisms. To perform any concrete-related works, all water must be completely isolated prior to the commencement of any instream works. In addition, measures must be taken to prevent the incidence of concrete from entering a watercourse for a minimum of 72 hours after the works have been completed. This is to ensure that the concrete has fully cured.
- Ensure that all in-water activities, or associated in-water structures, do not interfere with fish passage, constrict the channel width, or reduce flows, or result in the stranding or death of fish.
- Retain a qualified environmental professional to ensure appropriate protocols are applied, and applicable permits for relocating fish are obtained and to capture any fish trapped within an isolated/enclosed area at the work site and safely relocate them to an appropriate location in the same waters.
- If working within surface water, screen any water intakes or outlet pipes to prevent impingement of fish.
- Plan activities near water such that materials such as paint, primers, rust solvents, degreasers, grout, poured concrete or other chemicals do not enter the river.
- Develop a response plan that is to be implemented immediately in the event of a sediment release or spill of a deleterious substance and keep an emergency spill kit on site.
- Ensure that building material used in the river has been handled and treated in a manner to prevent the release or leaching of substances into the water that may be toxic to fish.
- Contact Cape Nature for assistance with any fish related queries and immediately contact such authorities if there are any fish mortalities.
- All disturbed areas beyond the construction site that are intentionally or accidentally disturbed during the construction phase must be rehabilitated immediately to the satisfaction of the ECO.
- The longitudinal gradient must not be altered in a way that results in erosion downstream or impoundment of flows upstream. The cross sectional profile of the bed and banks must also be restored as far as possible.
- A monitoring programme shall be in place, not only to ensure compliance with the EMPr throughout the construction phase, but also to monitor any post-construction environmental issues and impacts. The monitoring should be regular and additional visits must be taken when there is potential risk to freshwater habitat.
- All demarcation work must be signed off by the ECO before any work commences.
- Any contractors found working inside the 'No-Go' areas should be fined as per a fining schedule/system setup for the project.

## Botanical Survey

Strict mitigation measures will be required during the construction phase to minimise the impact. During construction, mitigation should focus on the protection of the adjacent nature areas, the

prevention of alien infestation as an indirect impact, and rehabilitation of the disturbed areas post construction. The following mitigation measures should be considered:

- Construction activities in close proximity to natural vegetation must be demarcated (fenced off) in order to contain disturbance. No disturbance may occur outside the fenced off areas.
- Screen construction/building material brought onto site for invasive plant contamination. Contaminated material should not be used.
- Care must be taken if cement is to be mixed on site. It must be contained or mixed in large buckets and not allowed to spill onto bare ground. Any spillage must be cleaned up immediately. Cement water must also be contained in the above manner and allowed to dry out and then removed from site. Cement water, which is highly alkaline, poses a threat to the soil and indigenous seedbanks.
- Rehabilitation of all construction areas should be undertaken after works in that area has been completed. The primary means of rehabilitation should involve the removal of all spoil and unused construction material, and the trimming and stabilisation of the disturbed surfaces.
- No foreign plant material should be used for rehabilitation purposes. In needed, use only locally collected indigenous species for this purpose. Permission must be obtained from CapeNature (landowner) in this regard.
- There is a good chance that indigenous species will re-colonise the disturbed areas if alien plants are controlled. Regular follow-up clearing of aliens would be required in order to achieve rehabilitation successfully.

### **CapeNature Mitigation Measures**

The following mitigation measures were extracted from the comments provided by CapeNature during the revised draft BAR PPP, these measures should be read in conjunction with the Fish Relocation Plan.

- The river system in Meiringspoort harbours the biggest viable population of smallscale redbfin (*pseudobarbus asperi*), a species listed as Vulnerable according to the IUCN redlist for fish species. In addition chubbyhead barb are also harboured by the Groot River. Due to the sensitivity of the species search and rescue of fish located within the disturbance areas of any sites where damming, digging or diversions will take place, will have to be undertaken in accordance with the attached Fish Relocation Plan.
- Extra care should be taken during the construction phase to not destroy the instream habitat where possible.
- The fish located within the area of disturbance need to be safely relocated to a similar habitat within immediate vicinity of the sites, prior to the commencement of activities at each site. It is not feasible to relocate all fish at once throughout the system's construction footprints. This relocation plan must therefore be implemented for each site individually just prior to each site becoming active.
- It is very important to limit any disturbance to the river system to the absolute minimum when the activities are undertaken. Absolutely no heavy machines may enter the river system to clear vegetation from the riverbed or from within the culverts, where this can be avoided. If any heavy machinery is required to enter the system, this cannot be done, without CapeNature's consent. Please liaise with Mr Kgaugelo Shadung (kshadung@capenature.co.za, if this is required.
- CapeNature recommends that no more than 5 structures (within the watercourse) are active at anyone time.
- The appointed ECO must submit monitoring reports to the Conservation Manager of the Swartberg Complex World Heritage Site (Mr. Kgaugelo Shadung).
- It is recommended that a suitable site for spoil material be located outside of the World Heritage Site. There is a suggest truck rest outside of De Rust, please contact Mr. Shadung in this regard for more details on this location.

**DEFF: Biodiversity and Conservation Mitigation Measures**

The following mitigation measures were extracted from the comments provided by the Western Cape Government: Department of Environment, Forestry and Fisheries: Directorate Biodiversity and Conservation during the revised draft BAR PPP, these measures should be read in conjunction with the mitigation tables.

- Lay-down and other temporary infrastructure must be located within low-sensitivity areas;
- Vegetation clearance must be limited to the footprint of the proposed development;
- High sensitivity areas in close proximity to the development footprint must be demarcated as "No-Go" areas.
- All disturbed and cleared areas must be re-vegetated with indigenous perennial shrubs and grasses from the local area;
- An alien invasive management plan to prevent the spread and new invasions must be developed in terms of Conservation of Agricultural Resources Act (CARA) and the National Environmental Management Biodiversity Act and submitted as part of the final report; follow up actions for at least five years need to take place; and
- Concurrent rehabilitation and alien vegetation control program within all sensitive areas must be implemented.

## 8. MITIGATION TABLES

|                    | ACTIVITY                     | MITIGATION MEASURES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | TIMEFRAME                 | RESPONSIBLE PARTY       |
|--------------------|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|-------------------------|
| CONSTRUCTION PHASE | 8.1: Site establishment camp | <ul style="list-style-type: none"> <li>The area chosen for the office and / or site camp must be the minimum reasonably required, which will involve the least disturbance to the environment.</li> <li>Choice of site for the contractor's camp requires the Engineers permission. A site layout plan must be submitted to the Engineer for approval.</li> <li>The contractor's camp may not be situated on a flood plain, on slopes greater than 1:3(v:h), or within 32m of a water source</li> <li>The site layout plan should make provision for site access, parking facilities, site offices, ablution facilities, designated first aid area, hazardous substance storage areas, batching plant, refuelling area (if necessary), and a maintenance area</li> <li>The total area of the intended site camp should be stripped of all topsoil (as may be present) before any of the contractor's infrastructure or machinery is stored within the site camp.</li> <li>The site camp would need to be adequately fenced off along the boundary (preferably with 2m high fence and shade netting) and secured to prevent non-construction staff wandering around the site camp and possibly getting injured or posing a safety and security risk. Adequate signage needs to be in place, designating the site office / camp as a restricted area to non-construction people.</li> </ul> | Before site establishment | Construction contractor |
|                    | 8.2: Site access             | <ul style="list-style-type: none"> <li>The existing road network, where possible, should be used to access the construction site.</li> <li>All construction vehicles need to adhere to traffic laws. The speed of construction vehicles and other heavy vehicles must be strictly controlled to avoid dangerous conditions for other road users</li> <li>As far as possible care should be taken to ensure that the local traffic flow pattern is not be too significantly disrupted and all vehicle operators therefore need to be educated in terms of "best-practice" operation to minimise unnecessary traffic congestion or dangers. Construction vehicles should therefore not unnecessarily obstruct the access point or traffic lanes used to access the site. Construction vehicles also need to consider the load carrying capacity of road surfaces and adhere to all other prescriptive regulations regarding the use of public roads by construction vehicles.</li> <li>Contractors shall construct formal drainage on all temporary haulage roads in the form of side drains and mitre drains to prevent erosion and point source discharge runoff.</li> </ul>                                                                                                                                                                                                              | Ongoing / when required   | Construction contractor |
|                    | 8.3: Toilet facilities       | <ul style="list-style-type: none"> <li>Chemical toilet facilities or other approved toilet facilities (1 for every 30 workers) must be used and located on the site in such a way that the toilets do not cause any form of pollution of the site. This is especially important in</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Ongoing / when required   | Construction contractor |

## 8. MITIGATION TABLES

|  | ACTIVITY                                                                   | MITIGATION MEASURES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | TIMEFRAME               | RESPONSIBLE PARTY       |
|--|----------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-------------------------|
|  |                                                                            | <p>close proximity to any drainage lines. The toilets must be easily accessible and shall be secured to prevent them from blowing over or being pushed over. Toilets should be placed within the site camp as well as within reasonable proximity to working areas where construction teams are operating.</p> <ul style="list-style-type: none"> <li>The contractor shall ensure that no spillage occurs when chemical toilets are cleaned. The toilet shall be placed on level, bare ground. Performing ablutions outside toilet facilities are strictly prohibited. The toilets must be serviced regularly and kept in an orderly state.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                         |                         |
|  | <b>8.4: Waste Management</b>                                               | <ul style="list-style-type: none"> <li>An integrated waste management approach should be adopted. Emphasis must be put on waste minimisation such as reduction, recycling and re-use, where possible. The appointed ECO must regularly inspect the waste storage and removal facilities to guarantee that the waste levels are acceptable and that adequate waste management is ensuing.</li> <li>Recycling bins for the various categories (paper, glass, plastic, etc.) should be provided. These bins must be emptied on a weekly basis and dropped off at a collection point for recycling by recycling companies.</li> <li>Bins must also be provided for builder's waste. These bins should be emptied on a regular basis and solid waste must be disposed of at a landfill licensed in terms of section 20 of the Environment Conservation Act, 1989 (Act No. 73 of 1989) or the National Environmental Management: Waste Act (Act No. 59 of 2008). Any builder's waste which can be reused can be stockpiled in an area identified by the ECO.</li> <li>All bins shall not be allowed to overflow, since waste may blow around on site and into the surrounding environment. The bins must be water tight, windproof and scavenger proof and be clearly marked for the purpose of waste disposal.</li> <li>Biodegradable refuse generated from the office / site camp, construction areas, vehicle yard, storage area or any other area shall be handled as indicated above. Adequate waste receptacles, bins and skips should be available for the collection and removal of waste.</li> </ul> | Ongoing / when required | Construction contractor |
|  | <b>8.5: Storage and management of hazardous and construction materials</b> | <ul style="list-style-type: none"> <li>Storage areas must be designated and demarcated, and no unauthorised access shall be permitted.</li> <li>Storage areas should be secure so as to minimise the risk of crime, or access by children or animals.</li> <li>Material Safety Data Sheets (MSDSs) shall be readily available on site for all chemicals and hazardous substances to be used on site.</li> <li>Hazardous storage and refuelling areas must be bunded with an impermeable liner to protect groundwater quality. The bunding shall be capable of handling a volume 150% the volume of the container storing the</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Ongoing / when required | Construction contractor |

## 8. MITIGATION TABLES

|  | ACTIVITY                                                             | MITIGATION MEASURES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | TIMEFRAME               | RESPONSIBLE PARTY       |
|--|----------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-------------------------|
|  |                                                                      | <p>substance. The Contractor shall submit a method statement to the Engineer for approval.</p> <ul style="list-style-type: none"> <li>Storage areas containing hazardous substance / materials must be clearly sign posted.</li> <li>Contractors shall submit a method statement and plans for the storage of hazardous materials and emergency procedures.</li> <li>Firefighting equipment should be present on site at all times as per OHSA.</li> <li>No materials are to be stored in unstable or high risk areas such as in floodplains, watercourses or on steep slopes.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                         |                         |
|  | <b>8.6: The clearance of vegetation and vegetation brush-cutting</b> | <ul style="list-style-type: none"> <li>Clearance of vegetation should only be undertaken as a last resort if the vegetation will or is damaging a given structure and/or if the vegetation is completely blocking the flow of water through the structure. Vegetation root systems provide unmatched soil stability and should not be cleared purely for aesthetic purposes.</li> <li>Where vegetation clearance is unavoidable, clearance should be undertaken by cutting the plants at their stems/trunk bases and treating the stumps with an herbicide to prevent them re-growing. By leaving the cleared vegetation's root systems in tact the soil stability provided by the root systems will provide much needed stability to the ground material and decrease the areas' vulnerability to erosion.</li> <li>Where practical, the maintenance areas must be properly demarcated prior to activities being undertaken. The areas outside these demarcated areas must be regarded as No-Go areas;</li> <li>Only the minimum amount of vegetation necessary to maintain the road, culverts and verge integrity must be cleared;</li> <li>All vegetation clearance must be done by means of manual labour, if possible;</li> </ul> | Ongoing / when required | Construction contractor |
|  | <b>8.7: Removal, Moving / Excavation of Ground Material</b>          | <ul style="list-style-type: none"> <li>The maintenance area and site access must be properly demarcated. The area outside this demarcated area must be regarded as a No-Go area;</li> <li>Where practically possible, existing two track or other access routes should be utilised and only as a last resort should temporary access routes be created;</li> <li>Only the minimum amount of excavations must be undertaken;</li> <li>Where practical and feasible, excavations should be done by means of manual labour;</li> <li>Use can be made of a Tractor-Loader-Backhoe (TLB) where excavation of large amounts of material needs to be excavated, removed, moved and deposited.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Ongoing / when required | Construction contractor |
|  | <b>8.8: Storage of excavated material</b>                            | <ul style="list-style-type: none"> <li>All excavated material must be stored on a flat surface away from any drainage line or area susceptible to erosion.</li> <li>The location should be decided upon in consultation with the ECO.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Ongoing / when required | Construction contractor |

## 8. MITIGATION TABLES

|  | ACTIVITY                                                                 | MITIGATION MEASURES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | TIMEFRAME               | RESPONSIBLE PARTY       |
|--|--------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-------------------------|
|  |                                                                          | <ul style="list-style-type: none"> <li>Stored material should be protected from wind and water erosion and this may entail covering the material with suitable shade cloth material (if and when necessary).</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                         |                         |
|  | <b>8.9: Activities within or within close proximity to a watercourse</b> | <ul style="list-style-type: none"> <li>Supply adequate sanitation and ablution facilities. These facilities must however be situated away from the watercourses to prevent possible pollution if the facilities leak or are blown over.</li> <li>Workers must receive to necessary training to make them aware of the possible pollution they may cause by the actions in close proximity to the watercourse;</li> <li>The construction area must be demarcated to deter labourers from entering the watercourse.</li> <li>The area beyond the demarcation must be regarded as a no-go area</li> <li>Stormwater must be diverted away from the construction site by means of berms</li> <li>Stockpiles of materials must not be placed in close proximity to the watercourse</li> <li>Vehicles must be inspected on a daily basis to check for leaks.</li> <li>No refuelling of vehicles in close proximity to the watercourse. This must preferably be done in the site camp on an impermeable surface to prevent pollution of the soil.</li> <li>A spill kit must be available at all times in the event of spillage. Polluted soil must be removed and disposed of at an appropriately licensed disposal facility.</li> <li>Waste management is discussed in depth in Section 10 of this EMPr. This includes and integrated waste management approach such as re-use, recycling, etc. and the provision of waste bins on site.</li> <li>Adequate bins must be provided at all active construction sites along the road route. These bins must be fitted with lids to prevent the waste from blowing into the watercourses or surrounding vegetation.</li> </ul> | Ongoing / when required | Construction contractor |
|  | <b>8.10: Erosion Control</b>                                             | <p>Small scale erosion and storm water control measures:</p> <ul style="list-style-type: none"> <li>These control measures will entail the use of shade netting barriers (or similar) or geo-fabric barriers in areas susceptible to erosion. These storm water control measures are usually placed directly across the path of flow of storm water. Poles and logs, staked in along the contours of a slope susceptible to erosion may also be used.</li> </ul> <p>Medium scale erosion and storm water control measures:</p> <ul style="list-style-type: none"> <li>Small berms and benches cut into the slope as well as poles and logs, placed along the contours of the slope can be used for medium-scale erosion and storm water control.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Ongoing / when required | Construction contractor |

## 8. MITIGATION TABLES

|  | ACTIVITY                                          | MITIGATION MEASURES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | TIMEFRAME               | RESPONSIBLE PARTY       |
|--|---------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-------------------------|
|  |                                                   | <p>Large scale erosion and storm water control measures</p> <ul style="list-style-type: none"> <li>Large-scale erosion control is mainly accomplished with the use of temporary retention dams / settling ponds and large berms. The mode of operation is to undertake the maintenance activities while bearing in mind the possibility that a heavy rainfall event could occur at any moment. There may therefore be a need for larger berms to ensure that water does not have an unobstructed run from the top of a drainage line to the bottom. The ECO must advise in this regard.</li> </ul> |                         |                         |
|  | <b>8.11: General Construction phase nuisances</b> | <ul style="list-style-type: none"> <li>Put measures in place to allow for the maximum available flow of traffic;</li> <li>Noise generating activities will be limited to normal working hours;</li> <li>Equipment must be in good working condition in order to minimise noise generation.</li> <li>Labourers and site agents will be educated on how to control activities that have the potential to become disturbances.</li> <li>Keep the construction site clean and tidy</li> </ul>                                                                                                          | Ongoing / when required | Construction contractor |

## 9. RESPONSIBLE PARTIES / ROLES AND RESPONSIBILITIES

The Western Cape Government: Department of Transport and Public Works will be the implementing agent and will ultimately be responsible for compliance with this EMPr. The Department of Transport and Public Works must ensure that each party acting on its behalf (contractors and sub-contractors) adheres to the requirements of this EMPr.

### 9.1 NAMES AND DETAILS OF RELEVANT PARTIES

#### The Western Cape Government: Department of Transport and Public Works - Proponent

| Department of Transport and Public Works |                                            |
|------------------------------------------|--------------------------------------------|
| <b>Contact person</b>                    | Mr. Johannes Neethling                     |
| <b>Postal Address</b>                    | 3rd Floor, 9 Dorp Street, Cape Town. 8000. |
| <b>Tel:</b>                              | 021 483 0537                               |
| <b>Fax:</b>                              | 021 483 2205                               |
| <b>E-mail</b>                            | Johannes.neethling2@westerncape.gov.za     |

#### Consulting Engineers

| <b>Contact person</b>   | Herman Cronje                                             |
|-------------------------|-----------------------------------------------------------|
| <b>Physical Address</b> | 54 Oxford Street, Oxford Gate, Block C, Durbanville, 7550 |
| <b>Postal Address</b>   | PO Box 1142, Durbanville, 7551                            |
| <b>Tel:</b>             | 021 970 1940                                              |
| <b>Fax:</b>             | 021 976 8495                                              |
| <b>E-mail</b>           | hcronje@eceng.co.za                                       |

#### Environmental Control Officer

An Environmental Control Officer (ECO) must be appointed to monitor the maintenance activities to Trunk Road 33 Section 4 and Trunk Road 34 Section 2 and associated drainage structures at a frequency of once a week. The duties of the ECO will be to:

- Ensure compliance with all the mitigatory measures proposed in this EMPr;
- Assist in finding environmentally acceptable solutions to maintenance problems;
- Establishing an environmental awareness program to educate contractors & labourers;
- Inspecting all aspects of the maintenance / repair process;
- Keeping detailed records of all site activities that may pertain to the environment;
- Must ensure that all labours have attended environmental training sessions, which cover the basic requirements of sound environmental practices on construction sites;
- Liaise with site contractors, engineers and other members of the development team with regards to the requirements of the EMPr;
- Recommend that the engineer furnish errant contractors with pre-determined fines, when verbal and / or written warnings are ignored;
- Examining method statements, and;
- Recommend additional environmental protection measures, should this be necessary.
- Recommend fines with attached photos and a report.

The ECO must visit the site once a week to monitor compliance with the recommendations of this EMPr. The ECO would have the discretion to undertake additional visits, after consulting with the client, if he / she feels this is justified due to the actions of the contractors and to make ad hoc visits to ensure compliance. The ECO should ensure that the correct earthwork practices are adhered to.

The ECO must undertake Environmental Awareness Training before commencement of any work on site. During the training, the ECO will explain the EMPr and the recommendations contained therein. The following actions must be taken to ensure that all relevant parties are aware of their environmental role and duties:

1. This EMPr must be kept on site at all times.
2. The provisions of this EMPr must be explained in detail to all staff during Awareness Training.
3. Training booklets will be handed out to all labourers and must be explained to them.
4. We recommend that once per week inspections should be done by the Applicant's environmental representative (where available) who must be on site at all times.

The Construction Contractor must make allowance for all construction site staff, including all subcontractors that will be working at the site, to attend environmental awareness training sessions (undertaken by the ECO) before commencing any work on site. During this training, the ECO will explain the EMPr and the conditions contained therein. Attention will be given to the construction process and how the EMPr fits into this process. Other items relating to sound environmental management which must be discussed and explained during the environmental awareness training sessions include:

- The demarcated "No-Go" areas;
- General do's and don'ts of the site;
- Making of fires;
- Waste management, use of waste receptacles and littering;
- Use of the toilets provided;
- Use and control of construction materials and equipment etc.;
- Control, maintenance and refuelling of vehicles;
- Methods for cleaning up any spillage;
- Access and road safety;
- Emergency procedures (e.g. in case of fire, spillage etc.)
- General "best practice" principles, with regards to the protection of environmental resources.

Environmental awareness training and education must be ongoing throughout the construction phase, and must be undertaken regularly if deemed necessary (especially if it becomes apparent that there are repeat contraventions of the conditions of the EMPr), or as new workers come to site. Translators must be utilised where needed.

## **10. IMPLEMENTATION MANAGEMENT**

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The following recommendations (in addition to those tabulated in Section 8) must be implemented to ensure that maintenance / repair activities do not have a detrimental impact on the environment.

### **10.1 SITE CAMP**

The site camp must be located on a previously transformed area. It must be located in such a way that it will cause the least disturbance to the general public and the environment. The ECO must be consulted with regards to the proposed location of the site camp prior to the site camp being established.

Equipment, machinery, raw materials (wire / fencing / wood, nails), and plants will be temporarily stored in a dedicated area. The following general management measures pertaining to the set-up, operation and closure of a site camp should be applied wherever reasonable and practicable:

**Fencing & Security:** The site camp area must be secured preferably with 2m high fence and shade netting or similar, to prevent any un-authorised individuals from entering the site camp and possibly getting injured or posing a safety and/or security risk. Adequate signage must be displayed, designating the site office / camp as a restricted area to non-personnel.

**Fire Fighting Equipment:** Fire extinguishers must be present at the site camp. The extinguishers must be in a working condition and recently serviced. It is recommended that all construction workers receive basic training in fire prevention and basic fire-fighting techniques, and are informed of the emergency procedure to follow in the event of accidental fires. No open fires may be made on site.

**Waste Storage Area:** Sufficient bins for the temporary storage of construction related waste must be provided inside the site camp and / or at the working area. Construction-related waste must be managed as specified in Section 8.4.

**Potable Water:** An adequate supply of potable water must be provided to construction workers at the site camp.

**Ablution Facilities:** Chemical toilet facilities or other approved toilet facilities (at least 1 toilet for each sex and for every 30 workers) must be provided and located on the site in such a way that the toilets will not cause any form of pollution of the site. Toilets must be placed within the site camp and at the construction site. The toilets must be placed on a level surface and secured to prevent them from blowing over. The toilets must be serviced regularly (by the appointed service provider) and kept in an orderly state. The contractor must ensure that no spillage occurs when the toilets are cleaned, serviced or moved. Performing ablutions outside of the provided toilet facilities is strictly prohibited.

**Eating Area & Rest Area:** A dedicated area within which construction workers can rest and eat during breaks must be provided within the site camp. Seating and shade should be provided.

**Vehicle & Equipment Maintenance Yard:** Where possible, construction vehicles and equipment that require repair must be removed from site and taken to a workshop for servicing. If emergency repairs and/or basic maintenance of construction vehicles or equipment are necessary on site, such repair work must be undertaken within the designated maintenance yard area away from the watercourses. Repairs must be conducted on an impermeable surface, and/or a tarpaulin and/or drip trays must be laid down prior to emergency repairs taking place, to prevent any fuel, oil, lubricant or other spillages from contaminating the environment.

**House-keeping:** The site camp and related site camp facilities must be kept neat and orderly at all times, to prevent potential safety risks and to reduce the visual impact of the site during construction.

**Spill kit:** A spill kit to neutralise/treat spills of fuel/ oil/ lubricants must be available on site. Soil contaminated by spilled oil/ fuel/ lubricant must be excavated and disposed of in the hazardous waste bin.

**Spoil material:** Spoil material must be temporarily stored in accordance with Section 8.8 of this EMPr. Spoil material should be removed without delay once maintenance activities have concluded. Spoil material produced from maintenance activities will be removed from site and disposed of at an appropriately registered facility.

**Rehabilitation:** Any contaminated soil must be removed and disposed at an appropriately registered disposal site. Any areas that have been compacted should be ripped to allow for the establishment of vegetation, if required by the Engineer. This ripping must not result in the mixing of sub- and topsoil. No

imported soil material may be utilised for rehabilitation. No biological rehabilitation measures are recommended for disturbed areas, instead areas vulnerable to erosion should be physically stabilised using mechanical methods such as gabions, stone pitching or jute geotextile. The site camp must be deconstructed and cleared to the satisfaction of the landowner/occupier.

## **10.2 SITE ACCESS**

The existing road network and where possible, two track farm roads must be used for access to the site. Some sites may require the construction of temporary access routes for machinery and labourers to access a said site as described in Section 7.5 of this MMP. A method statement outlining the proposed access, for those sites which require it, must be approved by the Engineer and ECO.

## **10.3 WASTE MANAGEMENT**

An integrated waste management approach must be adopted on site. This approach must include reduction, re-use and recycling. Recycling bins for the various categories (paper, glass, plastic, etc.) should be provided (as seen in Images 1 and 2). These bins must be emptied on a weekly basis and dropped off at a collection point for recycling by recycling companies. Bins must also be provided for builder's waste. These bins should be emptied on a regular basis and solid waste must be disposed of at a landfill licensed in terms of section 20 of the Environment Conservation Act, 1989 (Act No. 73 of 1989) or the National Environmental Management: Waste Act (Act No. 59 of 2008). Any builder's waste which can be reused can be stockpiled in an area identified by the ECO. Biodegradable refuse generated from the office / site camp, construction areas, vehicle yard, storage area or any other area shall be handled as indicated above. Adequate waste receptacles, bins and skips should be available for the collection and removal of waste.



**Image 1:** Example of marked recycling bins within a site camp



**Image 2:** Example of marked recycling skips within a site camp

## 10.4 METHOD STATEMENTS

The Competent Authority and/or the ECO may require the Applicant or Construction Contractor to submit Method Statements for one or more construction-related activity, or any aspect of the management of the site, before the activity is undertaken or during the performance of the activity, if the activity is causing or may cause significant environmental damage, or pose a health and safety risk.

Method Statements need not be complex and lengthy, but must clearly state **how**, **when** and **where** the activity concerned will be undertaken, and must specify **who** will be responsible for undertaking each component of that activity. Method Statements must be prepared by the Construction Contractor and submitted to the ECO for approval before undertaking the activity concerned.

The ECO and / or Competent Authority have the authority to request method statements for other activities, including but not limited to:

- Establishment of site camp and stockpile area.
- Cement/ concrete batching, disposal and emergency contingencies.
- Topsoil and sub-soil storage/ stockpiling.
- Storage of fuels and hazardous chemicals and emergency contingencies.
- Waste management system.
- Storm water management and control.
- Emergency preparedness plan / emergency response procedure (see Chapter 13).

The ECO has the authority to prevent activities from being undertaken until such time as a satisfactory Method Statement has been submitted to the ECO and approved by the ECO.

## 11. EMERGENCY PREPAREDNESS

### 11.1 Emergency response procedures

The potential environmental risks that may arise as a result of construction activities, or during the maintenance of the structures must be identified, and appropriate emergency response procedures must be compiled for each emergency scenario. Potential environmental emergencies that require an emergency response include – but are not limited to – unplanned fires, sewage spills, spills of hazardous chemicals, snake bites etc.

- The construction contractor is responsible for identifying potential significant environmental risks that may arise as a result of pre-construction, construction and rehabilitation activities, and the contractor must formulate emergency response procedures for these potential incidents.
- The Applicant (or Maintenance Contract team) is responsible for identifying the environmental risks that may arise during the operational (maintenance) phase of the development, and must formulate emergency response procedures for these potential incidents.
- The ECO, the contractor and the Applicant are responsible for ensuring that all construction workers are aware of the emergency procedures, and are properly trained on how to identify and respond to an emergency incident during construction.
- Depending on who is managing/ undertaking maintenance activities, the Applicant is responsible for ensuring that all members who form part of the maintenance team during the operational phase are aware of the emergency procedures to be followed in response to an emergency incident during the undertaking of maintenance of the structure.
- An emergency procedure must clearly indicate who will take charge during an emergency, and the roles and responsibilities of workers and authorities during an emergency.
- The construction contractor is responsible for ensuring that the requirements of the Occupational Health & Safety Act (OHSA) are adhered to during the construction phase. The Applicant is responsible for ensuring compliance with the OHSA during the undertaking of maintenance activities.

## **11.2 Emergency preparedness**

The following measures must be implemented, as appropriate, to ensure effective responses to emergencies:

- All workers on site during the construction and maintenance phase must be properly educated about possible emergency incidents that may arise, how to avoid such incidents and how to respond in the event of an incident. "Refresher" training sessions on emergency procedures must be held if needed.
- All workers must ideally be given basic fire-awareness training, and advised on basic firefighting and safety techniques. Fire-fighting equipment must be available on site during construction activities.
- All workers must be trained on how to respond in the event of a spill of a hazardous substance (fuel, chemicals etc.), if hazardous substances are to be used on site.
- A spill kit for containing and/or neutralising spills of hazardous substances (e.g. hydrocarbons) must be available on site at all times, when hazardous substances are present.
- Any incidents of pollution or spillage of hazardous materials during construction must be reported to the ECO as soon as possible. The ECO must then (depending on the nature of the spill) notify the relevant authorities, if needed. During the operational phase of the development, the Applicant is responsible for notifying the relevant authorities of any pollution incidents that arise as a result of maintenance activities.
- A first aid kit must be available on site at all times.
- Emergency contact numbers (including the fire department, police and ambulance) must be prominently displayed on site at all times and regularly updated.
- All emergency incidents must be recorded in a site incident log. The cause of the incident, the measures taken in response to the incident and the efficacy of those measures must also be recorded. This information must be used to inform future emergency preparedness planning, and to avoid or prevent similar incidents from arising again.

## 12. Monitoring, Record Keeping and Reporting

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### 12.1 Environmental Auditing

In accordance with the requirements of the Amended Environmental Impact Assessment Regulations of 2014 (GN No. R.327 of 7 April 2017), the holder of the Environmental Authorisation (i.e. the Applicant) must, for the period that the Environmental Authorisation is valid, appoint a suitably qualified independent person to conduct an environmental audit to audit compliance with the conditions of the Environmental Authorisation and the EMPr.

The Applicant is responsible for appointing, managing and remunerating the appointed auditor. The auditor may be the appointed Environmental Control Officer (ECO), provided the ECO is sufficiently qualified and experienced to fulfil the auditing requirements specified below.

The appointed auditor must undertake regular environmental audits according to the frequency specified in the Environmental Authorisation. Following each audit the environmental auditor must submit an audit report to the Competent Authority (in this instance the DEA).

- Environmental auditing and environmental audit reports must adhere to the requirements of the Environmental Impact Assessment Regulations, in particular Section 34 (*Auditing of Compliance with Environmental Authorisation, Environmental Management Programme*) and Appendix 7 (*Objective and Content of Environmental Audit Report*)
- The audit report must provide verifiable findings on the level of compliance with the provisions/ conditions of the Environmental Authorisation and the EMPr, and must also comment on the ability of the measures contained in this EMPr to sufficiently avoid, manage and mitigate environmental impacts.
- Where the findings of the audit report indicate that the impact management measures stated in the EMPr are insufficient to adequately address environmental impacts, recommendations as to how the EMPr must be amended so as to address the identified shortcomings must be made and submitted to the competent authority together with the audit report.

## 12.2 MONITORING PROGRAMME

| WHAT SHOULD BE MONITORED                              | FREQUENCY OF MONITORING                                                                                                                                                                                                                      | MONITORING PROCEDURE                             | HOW RESULTS ARE ANALYSED AND PRESENTED                                                                                                          |
|-------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| The clearance of vegetation                           | Inspections by the ECO prior to the commencement of clearing activities and during the clearing activities to provide advice to the constructor. May require site visits of four per month                                                   | Inspect the site and take photographic evidence. | ECO must compile a checklist for completion during each site visit. Data must be used to compile an audit report as/if requested by the client. |
| The excavations and/or disturbance of ground material | Inspections by the ECO prior to the commencement of activities. ECO to advise on where stockpiles may be located. May require site visits of four per month                                                                                  | Inspect the site and take photographic evidence. | ECO must compile a checklist for completion during each site visit. Data must be used to compile an audit report as/if requested by the client. |
| Implementation of 'Duty of Care'                      | Inspections by the ECO to ensure that pollution prevention measures (such as drip trays, etc) are in place and that maintenance activities are not causing detrimental impacts to the environment. May require site visits of four per month | Inspect the site and take photographic evidence. | ECO must compile a checklist for completion during each site visit. Data must be used to compile an audit report as/if requested by the client. |

## 12.3 CORRECTIVE ACTION PROCEDURE

Corrective actions need to be followed in the event where there is non-compliance with a condition of the EMP and any recommendation and mitigation measure as stipulated in this EMP in order to rectify the non-compliance and to prevent reoccurrence.

The ECO must report all non-compliance issues to the contractor whose responsibility it is to correct. A timeframe for the completion of the corrective actions must be agreed to the ECO. Once the corrective actions have been implemented the contractor must notify the ECO. The ECO must review the effectiveness of the corrective actions and if it is found to be inadequate, additional measures must be implemented. Only once the corrective actions have been completed to the satisfaction of the ECO will the matter be considered as closed.

Depending on the nature of transgression, the Engineer and/or ECO may issue one or more warnings to the Contractor prior to the issuing of a fine. Warnings may be given in writing or orally, but oral warnings must be followed up with written confirmation of the warning within 48 hours of the oral warning. The Engineer has the discretion to issue a fine without first issuing a warning, if the severity of the transgression is judged by the Engineer and/or ECO and/or Competent Authority to warrant such action.

The table below specifies the transgressions for which the Construction Contractor may incur financial penalties, and the amount of the fines that may be levied. Levying of fines/ penalties is subject to alignment with South African Contractual Law. For repeat offences of the same/ similar transgression by the same party, the value of the fine shall be doubled for each subsequent repeat offence to a maximum value of **R50 000.00** per offence.

| # | Finable Transgression                                                                                                                                                         | Min Fine | Max Fine |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------|
| 1 | Failure to notify the ECO of the commencement of construction or pre-construction activities, prior to the commencement of such activities                                    | R1 000   | R2 000   |
| 2 | Failure to comply with the provisions relating to the demarcation of the working area, site camp and associated facilities, and the maintenance of the demarcated boundaries. | R1 000   | R5 000   |
| 3 | Failure to comply with the provisions relating to the demarcation of all "no-go" areas, and the maintenance of the demarcated boundaries.                                     | R2 000   | R5 000   |
| 4 | Failure to provide secured ablution facilities (1:30 ratio) on site.                                                                                                          | R500     | R15 000  |
| 5 | Failure to comply with the provisions relating to the clearance of vegetation on site.                                                                                        | R2 000   | R5 000   |
| 6 | Clearance of indigenous vegetation (regardless of the density of alien vegetation present) outside of the demarcated boundaries of the working area and site camp.            | R2 500   | R15 000  |
| 7 | Excessive clearance of indigenous vegetation in areas earmarked for construction.                                                                                             | R1 500   | R5 000   |
| 8 | Failure to adhere to designated access routes.                                                                                                                                | R1 000   | R5 000   |

|    |                                                                                                                                                                                                                                                                                                                                         |        |         |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------|
| 9  | Movement of vehicles and/or construction workers in no-go areas;                                                                                                                                                                                                                                                                        | R1 000 | R10 000 |
| 10 | Movement of construction vehicles within the river flow without approval from the ECO and Engineer                                                                                                                                                                                                                                      | R5 000 | R15 000 |
| 11 | Parking or storage of vehicles, machinery, tools and other materials or equipment related to the Contractors operations, within designated "no-go" areas.                                                                                                                                                                               | R1 000 | R10 000 |
| 12 | Parking or storage of vehicles, machinery, tools and other materials or equipment related to the Contractors operations, outside of the areas demarcated for such parking/storage.                                                                                                                                                      | R500   | R5 000  |
| 13 | Failure to comply with the provisions relating to waste management on site i.e. recycling of                                                                                                                                                                                                                                            | R500   | R5 000  |
| 14 | Failure to comply with the provisions relating to the storage, use and management of hazardous substances and fuels on site and/or the spillage of hydrocarbons or hazardous substances on site leading to environmental damage                                                                                                         | R1 000 | R10 000 |
| 15 | Mixing cement or concrete on bare ground and/or failure to comply with any other provision regarding cement/ concrete batching                                                                                                                                                                                                          | R1 000 | R5 000  |
| 16 | Failure to provide adequate fire-fighting equipment (in working order) on site at all times and/or failure to comply with the provisions relating to fire prevention and/or the occurrence of unattended or out of control fires.                                                                                                       | R500   | R5 000  |
| 17 | Refueling of vehicles, machinery or equipment outside of the designated refueling area.                                                                                                                                                                                                                                                 | R500   | R2 000  |
| 18 | Maintenance of vehicles, machinery or equipment outside of the designated maintenance yard, except in emergencies                                                                                                                                                                                                                       | R500   | R2 000  |
| 19 | Failure to undertake refueling or repairs over a drip tray or other impermeable bunded surface to collect spilled hydrocarbons (fuels, lubricants, oils etc.) and other hazardous substances; failure to provide drip trays under fuel burning equipment (including pumps and generators) where there is a risk of hydrocarbon leakage. | R500   | R2 000  |
| 20 | Failure to produce a required method statement/s to the engineer's and ECO's satisfaction prior to undertaking the activity concerned and/or failure to adhere to an approved method statement                                                                                                                                          | R1 000 | R5 000  |

## 13. CONCLUSION

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This MMP is binding to the Western Cape Government: Department of Transport and Public Works for any future maintenance work and the conditions contained herein must be adhered to. The periodic maintenance of Trunk Roads 33/4 and 34/2 between De Rust and Prince Albert will not result in any detrimental impacts on the receiving environment if all mitigation measures are adhered to. The proposed maintenance work will be limited to the existing road reserve and if work is required beyond the extent of the road reserve then all threshold of the Listed Activities highlighted in Section 3 of this MMP will apply, if it is foreseen that the threshold will be exceeded an Application for Environmental Authorisation will be required in terms of Government Notice No. R326 of 7 April.

## 14. REFERENCES

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# **ALIEN MANAGEMENT PROGRAMME**

## **FOR THE**

### **PERIODIC MAINTENANCE AND RESEALING OF TRUNK**

### **ROADS 33/4 AND 34/2 BETWEEN DE RUST AND**

### **PRINCE ALBERT.**

Produced as part of a Basic Assessment EIA Application for Environmental Authorisation in terms of the National Environmental Management Act (Act 107 of 1998) and the amended (April 2017) Environmental Impact Assessment Regulations, 2014

| PROJECT INFORMATION |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Prepared For:       | Department of Transport and Public Works                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
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All vegetation clearance must be undertaken with utmost care to ensure that only that vegetation, which needs to be removed, is removed.

Eradication of alien plants must be completed in such a manner that indigenous vegetation is not damaged.

It is important to remove both young plants (saplings) and old trees that are seed bearing. Different strategies can be employed to remove different species, but all methods will involve manual labour as mechanical means other than chain saws and brush cutters, should be used where necessary. It is important to tackle the smaller, more dispersed plants first, and then the larger stands of alien vegetation.

To ease the removal of the alien plants present on the site, it is recommended that all alien plants be removed during the initial site clearing activities at the start of the construction process rather than during the operational phase of the development.

### **1. Clearing of small alien plants**

The best method of clearing small plants is by hand pulling them. They must then be stacked for removal to a recognised waste site, or alternatively mulched on site. Mulched material can be used as a ground cover where necessary.

### **2. Clearing of alien trees**

Alien trees must be cut down with chain saws and then chopped into smaller portions. Some species of alien plants like Black Wattle trees are coppicing species and will re-grow from roots and stumps. This means that a chemical such as Roundup or Garlon will need to be used to prevent the trees from re-sprouting. These chemicals can either be sprayed onto the stump with a knapsack sprayer or painted on with a paintbrush. Another alternative to prevent re-growth is to strip the bark from the remaining part of the stump.

### **3. Methods for controlling alien vegetation**

Biological control, chemical control, mechanical clearing, and burning have all been used with varying results. Each method has been successful but nearly all require follow-up control. The most successful clearing projects have included an integrated approach to account for initial clearing and continued management.

#### **3.1 Mechanical control:**

- Mature non-coppicing trees must be cut as low as possible and no herbicide treatment is needed on the cut stumps.
- Debris may be removed immediately from site to be burned in a safe area, mulched or used as firewood.
- Large branches should be used as firewood.
- Smaller branches should be mulched.
- Alien material containing seed must be removed from the site and burned.
- Should debris be left on site:
- In sparser areas, where felled debris will not hinder follow-up operations, plants can be felled and left in situ.
- In dense areas, stack debris in rows five metres apart parallel to the contours to facilitate follow-up operations.
- Low density seedling regeneration must be hand pulled.

- Hand pulling around pockets of indigenous vegetation (1m swathe around clumps) is important so as to not damage indigenous vegetation pockets.

### 3.2 Chemical control

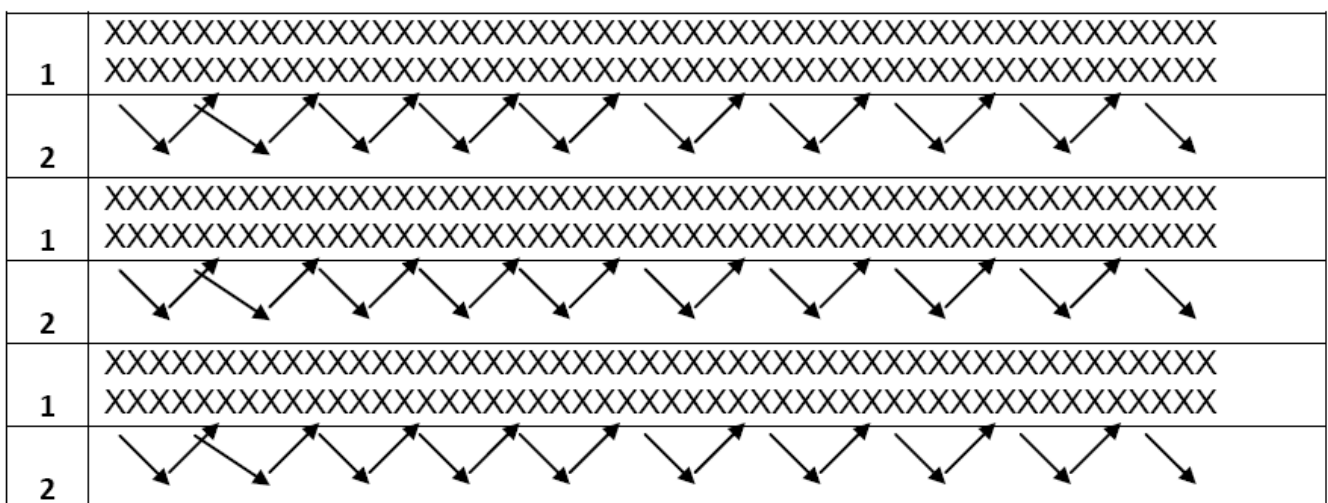
- Follow-up visitation no later than three months after initial operation.
- Follow-up control will be needed because soil stored seed may stay dormant in soil for up to 50 years.
- Follow-up control will involve a combination of hand pulling and foliar spraying.
- Seedlings, saplings and coppice can be foliar sprayed.
- Follow-up spray operation when sufficient regeneration has taken place.
- Blanket or foliar spray.

### 3.3 Tools

- Loppers, bow saws and chainsaws
- 12 –15 litre back pack spray units
- Flat fan nozzles or solid cone and 1 bar constant flow valves.

### 3.4 Team composition

- 6 persons, each being equipped with a lopping shear, bow saw and herbicide applicator, must first sweep through the area in individual lanes 5 metres apart. These persons target all plants less than 8 cm in basal diameter, felling, stacking and applying herbicide. De-branching should only be used to facilitate stacking of larger branches.
- 2 chainsaw operators thereafter follow through these lanes felling all plants more than 8 cm in basal diameter. Two assistants are responsible for stacking and herbicide application.
- For the denser areas, methodology must follow the illustration below. All rows are five metres wide. Swathes labelled 1 must be cut first and the debris placed back into these swathes. Thereafter debris generated in swathes labelled 2, must be placed into swathes labelled 1.



### 3.5 Follow up

Once the source of the problem has been removed, namely the seed bearing trees, it is important to follow up on any seedlings and saplings that may have grown in the interim. If this is not done the effort of the removal of the adult trees will have been wasted, as the alien vegetation problem will intensify.

#### **Author of document:**

This Alien Management Programme was compiled by *Sharples Environmental Services cc (SES)*. The company has over 20+ years combined experience in the field of environmental management on a variety of differing landuse applications ranging from large-scale residential estates and resorts to golf courses, municipal service infrastructure installations and the planning of major arterials.



## **Fish monitoring summary**

### **Meiringspoort diesel spill incident**



**Dr Martine S. Jordaan**  
**CapeNature Biodiversity Capabilities Unit**  
**18 April 2019**

# 1. Introduction

Freshwater systems and their associated biota are among the most threatened ecosystems globally (Dudgeon et al 2006). Freshwater fishes represent an important component of freshwater ecosystems and are presently under threat from five major types of anthropogenic activity: habitat degradation and fragmentation; water use, including impoundment and abstraction; water quality deterioration; invasive alien species and overexploitation (Collares-Pereira and Cowx 2004; De Moor and Day 2013). Of these, the presence of non-native fish species is considered the greatest threat to native fishes of the Cape Fold Ecoregion (CFE), followed by the loss of habitat (Skelton 1983; Tweddle et al. 2009; Weyl et al. 2014). The CFE is one of the six aquatic ecoregions of Southern Africa and is characterised by an endemic and highly threatened freshwater fish fauna (Skelton 2001). Many indigenous fish species are range restricted and vulnerable to anthropogenic impacts such as water abstraction and pollution. One such example is the fish community of the Groot River that is located partially within the Swartberg Provincial Nature Reserve and forms part of the greater Gouritz River system. The Groot River is home to four native fish species and is listed as a nationally important fish sanctuary in the National Freshwater Ecosystem Priority Areas (NFEPA) Atlas. The native fish fauna of the Groot River consist of three cyprinid species, two of which are endemic to the Gouritz system, and a native anabantid that is endemic to the CFE (Figure 1). The endemic cyprinids are the smallscale redfin *Pseudobarbus asper* (Vulnerable) and the slender redfin *Pseudobarbus tenuis* (Near Threatened). The chubbyhead barb *Enteromius anoplus* (Least Concern) is not a Gouritz system endemic and has a wider distribution range to the north of South Africa. The Cape kurper *Sandelia capensis* (Data Deficient) is endemic to the CFE.



**Figure 1:** Smallscale redfin *Pseudobarbus asper* (Top-L), Slender redfin *Pseudobarbus tenuis* (Top-R), chubbyhead barb *Enteromius anoplus* (Bottom-L), Cape kurper *Sandelia capensis* (Bottom-R)

The motivation for the present survey was to investigate the short-term effects of a diesel spill into the Groot River that occurred on 15 August 2017. Based on a field report compiled shortly after the incident by Hilland Environmental, approximately 40 000L of diesel was spilled into the river following a truck accident towards the northern side of Meiringspoort. Spill containment measures were implemented by SpillTech and included the deployment of containment berms, removal of contaminated soils and the use of absorbent materials to soak up diesel for later removal. The use of BioSolve, a known hydrocarbon mitigation agent, was used to rehabilitate affected soils in the spill zone. It must be noted that due to the threatened nature of the native fish community, all fish collected from the impact zone was salvaged and relocated downstream from the lowest sampling sites and that the results of the surveys must be interpreted with this in mind.

## 2. Survey area and sampling methodology

The Groot River was sampled at nine sites within three zones in the river (Figure 2). These zones were a control zone (located upstream of the contaminated zone), an impact zone (between the spill site and the furthest downstream containment berm) and a downstream site located some distance downstream of the end of the impact zone (Table 1). Sampling was conducted for four sampling intervals: (1) two weeks after the spill - September 2017, (2) three months after - December 2017, (3) nine months after - June 2018 and (4) one year after - October 2018. In each zone, three replicate fyke net efforts were conducted to determine the fish community composition and to investigate whether there were differences between the three zones. Fyke nets were deployed for a soak time of 16 hours. All nets had a base width of 600mm and 4mm mesh size. All fish that were collected were measured and both fork length (FL) and total length (TL) was recorded, and catch per unit effort (CPUE) was calculated for each site. Habitat characteristics were noted for each site and water quality parameters (pH, temperature, conductivity and dissolved oxygen) were collected along with SASS5 sampling (reported separately).



**Figure 2:** Locality of the sampling sites within the control (C1-C3), impacted (I1-I3) and downstream (D1-D3) areas

**Table 1:** Geographical localities of sample sites

| Zone       | Site number | DDS        | DDE       |
|------------|-------------|------------|-----------|
| Control    | C1          | -32,527861 | 22,541667 |
|            | C2          | -33,361806 | 22,541972 |
|            | C3          | -33,362    | 22,542389 |
| Impact     | I1          | -33,372306 | 22,554083 |
|            | I2          | -33,372639 | 22,553889 |
|            | I3          | -33,364194 | 22,558889 |
| Downstream | D1          | -33,409111 | 22,554361 |
|            | D2          | -33,409056 | 22,555111 |
|            | D3          | -33,409278 | 22,553583 |

### **3. Results of field surveys**

#### **3.1 Habitat assessments**

##### **3.1.1 Control zone**

The sites in the control zone was located directly downstream of a causeway on the farm Middelwater towards the northern end of the Meiringspoort. For the initial September 2017 survey the river was flowing well and consisted of a number of medium sized pools (30-40 m long, max depth  $\pm 1.2$ m). The water was slightly turbid at the time of sampling. Pool substrate was mostly gravel, sand and mud that was covered in periphyton with some rocky riffle areas between. As with pool habitat, the majority of shallower habitat also had sand and mud substrate. Some of the pools also had some shale bedrock substrate but this was not common. Periphyton was present on all bedrock substrate. All pools had moderate amounts of undercut banks and root wads and marginal vegetation consisting of sedges. Woody debris was present in all pools. By the time of the December 2017 survey, the river had very little flow and the furthest upstream control site had dried up. Pool volume was severely reduced and only two sites were suitable for deploying nets. By June 2018 the entire control zone had dried up and no sampling could be conducted (Figure 3). The river was flowing again by October 2018 but pool volume was still reduced relative to the initial sampling event of September 2017.

##### **3.1.2 Impact zone**

Three sites were selected in the impacted zone, with two sites located near the upper end of the spill zone and the third site located at the end of the spill zone immediately upstream from the furthest downstream containment berm. For the September 2017 survey, the habitat at the first site was a small and relatively shallow pool (approximately 2m wide and less than 10m long) with a cobble substrate and abundant woody debris and marginal vegetation. In contrast, the other two netting areas were associated with large and deep pools in the river. These pools were characterised by a sand and mud substrate and the middle site (I2) had large shale bedrock banks on the left bank. Both sites had relatively turbid water and slow flow and marginal vegetation consisting of sedges. The drought effects observed at the control zone in December 2017 was also evident in the impact zone at this time as both the upstream and downstream sites were dry. Also, similar to the control zone, pool volume was reduced compared to the September 2017 sampling event. By June 2018 all three sampling sites within the impact zone had dried up and no sampling could be conducted (Figure 4). It must be noted that some water remained in the impacted zone close to sites I2 and I3, but these sites were not sampled due to very deep mud substrates which complicated setting and retrieving of nets. The river was flowing again by October 2018 but pool volume was still reduced relative to the initial sampling event of September 2017.

##### **3.1.3 Downstream zone**

The downstream sampling sites were located approximately 500m downstream of the rest stop at the Meiringspoort waterfall. The habitat in this zone was markedly different from the control and impacted zones in that it had more typical "mountain stream" type of characteristics. The substrate was mainly rock and cobble covered in periphyton with some larger boulders. Sand and gravel substrate was limited to pool areas. There was a roughly 1:1 mix of pool and run/riffle habitat and the water was far less turbid than in the control zone. Undercut banks and root wads were especially common in pool habitat. Brown algae was observed in shallow out of current areas. In contrast to the control and impacted sites, the river was flowing moderately well for all four sampling intervals and as a result all three sampling sites could be netted at each sampling interval.



**Figure 3:** Site 2 (C2) of the control zone during September 2017 and June 2018 indicating the impacts of severe drought and possible water abstraction.

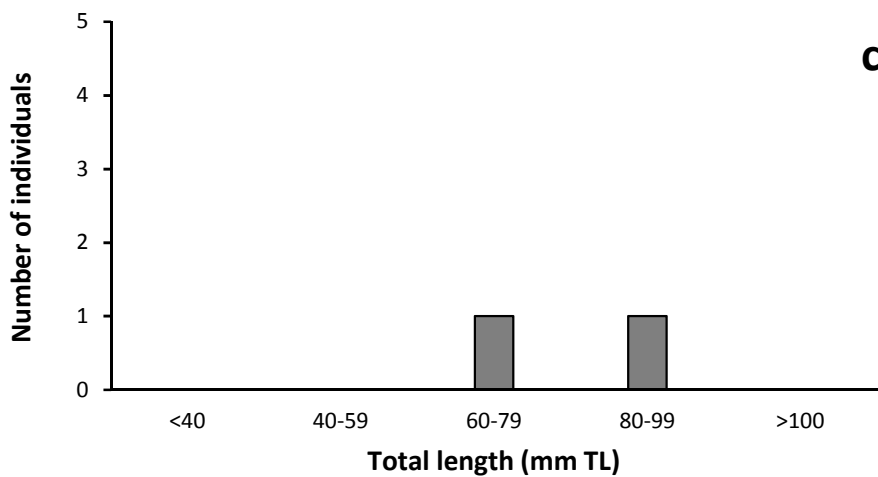
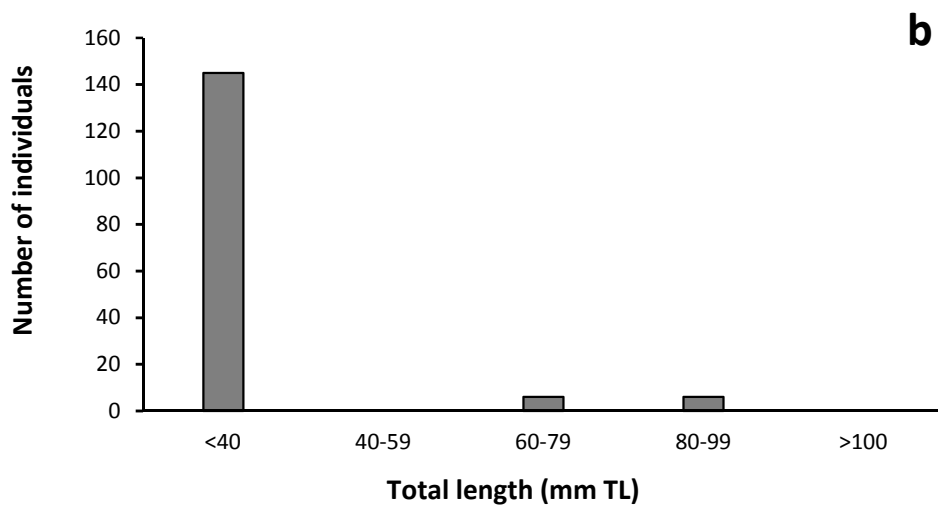
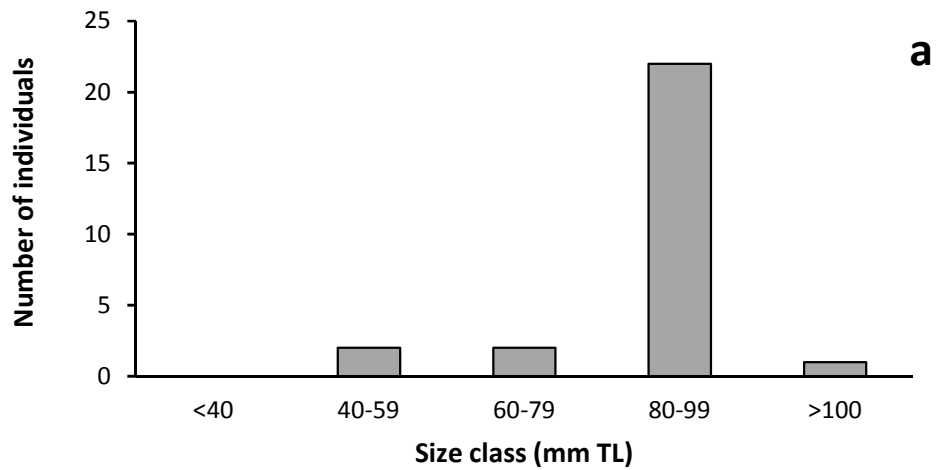


**Figure 4:** Site 2 (I1) of the impact zone during September 2017 and June 2018 indicating the impacts of severe drought and possible water abstraction.

## 3.2 Fish survey results

### 3.2.1 Control zone

For the September 2017 survey, the smallscale redbfin *Pseudobarbus asper* was detected in two of the three netting efforts and the mean CPUE for the zone was 9.0 fish/effort (Figure 9). The size range of the redbfins were 48-104 mm TL and a total of 27 fish were caught in this zone. The majority of the fish caught were either gravid females or males with tubercles and fish in the large size classes dominated the population (Figure 5a). The common platanna *Xenopus laevis* was also present (n=6). For the December 2017 survey size data provided evidence for a successful spawning season as the majority of fish caught were in the <40mm TL size class (Figure 5b). This was despite reduced flow and the fact that the furthest upstream sampling pool (C1) had dried up. The CPUE for the control zone for December was 57.0 fish/effort (Figure 9). Other biota caught included *X. laevis* adults (n=3) and tadpoles (n=48). Three adult frogs, provisionally identified as the Cape River frog *Amietia fuscigula* was observed along with two distinct types of tadpoles that were not *X. laevis* but could not be identified in field. The control zone was not sampled in June 2018 as all pools were dry. By October 2018, some flow was observed in the river but the pool volume was reduced compared to the September 2017 sampling. All pools were netted but only two fish were caught, resulting in a CPUE for the zone of 1.0 fish/effort. Other biota caught were 31 adult *X. laevis*, one adult *A. fuscigula* and numerous tadpoles of both species.



**Figure 5a-c:** Size class distribution of *P. asper* collected from the control zone of the Groot River during (a) September 2017, (b) December 2017 and (c) October 2018.

### 3.2.2 Impact zone

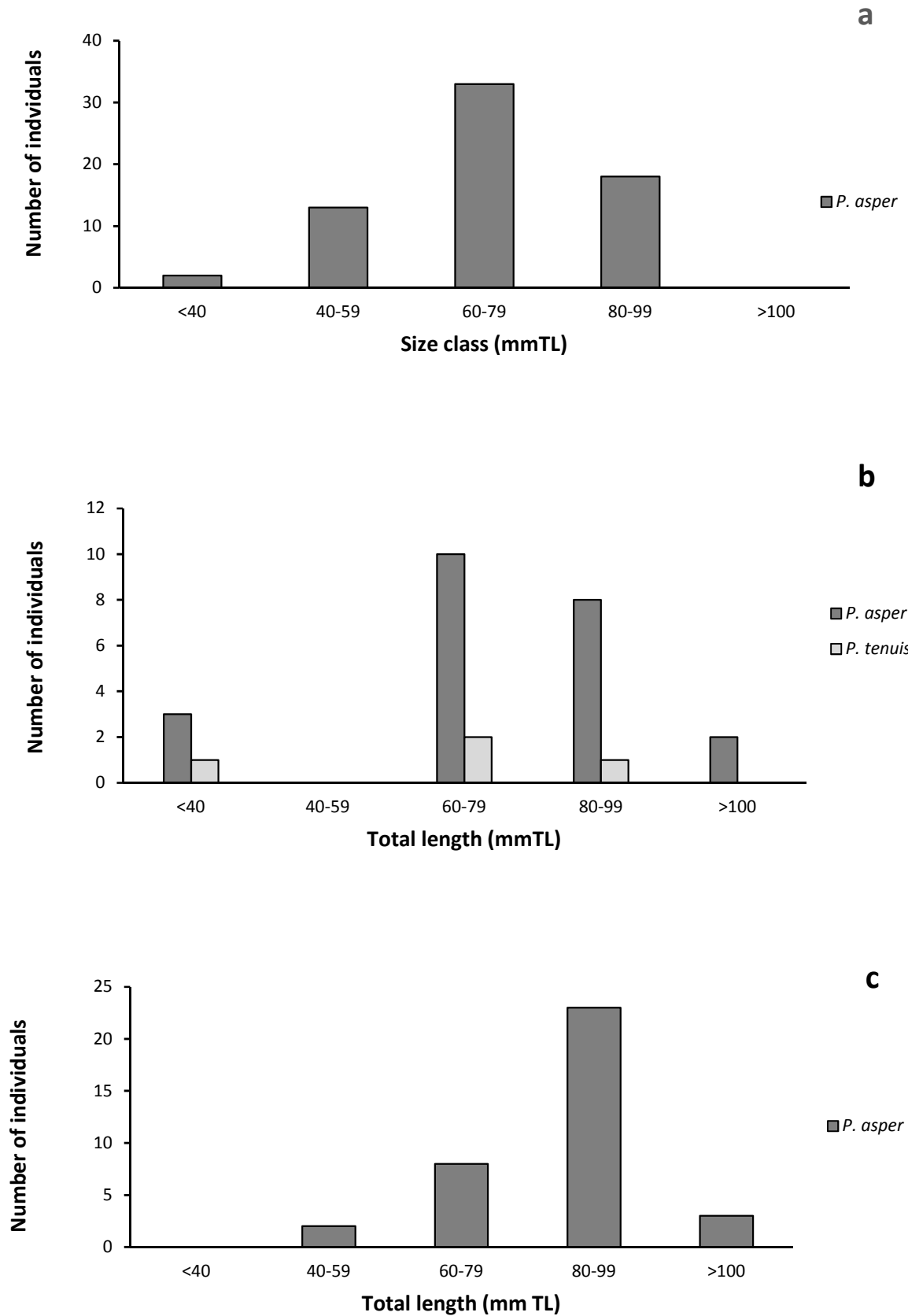
When inspecting the spill zone two days after the incident, several containment berms were observed in the affected zone and clean-up of contaminated soil was underway (Figure 6). The river was low at the time of the site visit with visible flow in riffle areas. It appeared that the spill had been contained by the furthest downstream berm (Figure 6). The SpillTech team reported that the area did receive rain but it appeared not to significantly affect the river's flow rate. No signs of affected animals were initially observed (with the exception of a dead duck and a dead frog), but dead and moribund *P. asper* were detected at approximately 14:00 on Friday 18 August in a small pool in the affected area. The first dead fish were thus observed roughly four days after the spill.



**Figure 6:** Containment berms and clean-up of contaminated soil (left) and furthest downstream containment berm (right)

For the September 2017 survey, the smallscale redfin *Pseudobarbus asper* was detected in all three netting efforts and the mean CPUE for the zone was 22.3 fish/effort (Figure 9). The size range of the redfins were 36-96 mm TL and a total of 67 fish were caught in this zone. Very few fish in this zone were gravid females or males with tubercles and fish of all size classes were present. The most abundant size class were the 60-79mm TL class. (Figure 7a). There was large variation between the numbers of fish caught per sampling effort. The upper two sites yielded relatively low fish numbers (one and nine redfins respectively), while the net set at the end of the impacted zone yielded more fish ( $n=57$ ) than all three control zone netting efforts combined. These results must however be interpreted with the differences in the habitat in mind. The common platanna *X. laevis* was also present ( $n=10$ ) but no tadpoles were observed. All fish from the impacted zone were salvaged and moved to clean habitat at Spookdrif located at the entry to the Meiringspoort.

For the December 2017 survey, site I1 was dry and I3 was reduced in volume and yielded no fish. The middle site I2 was sampled and in addition to *P. asper* that was detected in the first survey, the slender redfin *P. tenuis* was detected, although in very low numbers (Figure 7b). For the June 2018 survey, all sample sites in the impacted zone had dried up and no fish were sampled during this survey. It must be noted however that some water remained in this zone in the form of a few isolated pools so any surviving fish would be able to find refuge in these pools. For the October 2018 survey, sites I1 and I2 were netted but I3 remained dry. No fish were detected at site I1 but 37 *P. asper* were caught at site I2, resulting in a CPUE value of 12.3 fish/effort for the zone. Fish ranged in size from 48-115mm TL and larger fish in the >80mm TL size class dominated the population (Figure 7c). More than 50% of individuals were observed to have well developed tubercles, indicating potential spawning activity.

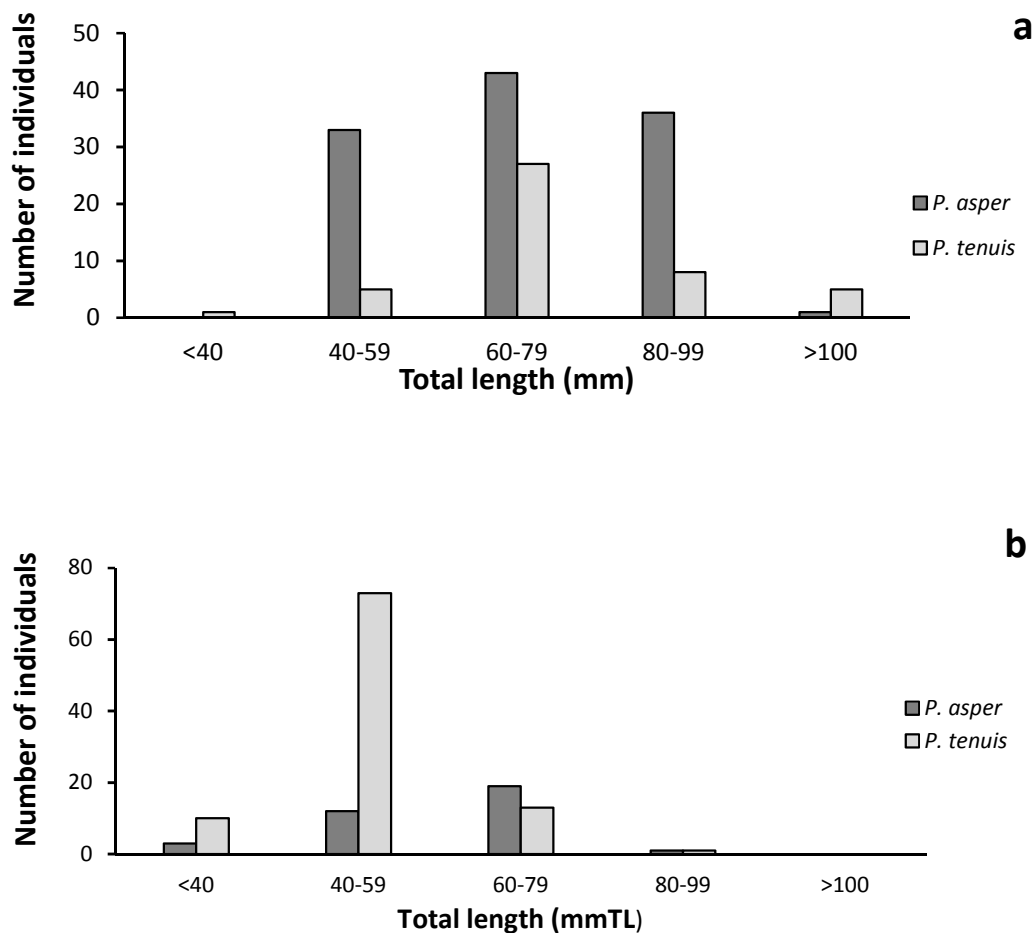


**Figure 7a-c:** Size class distribution of *P. asper* and *P. tenuis* collected from the impacted zone of the Groot River during (a) September 2017, (b) December 2017 and (c) October 2018.

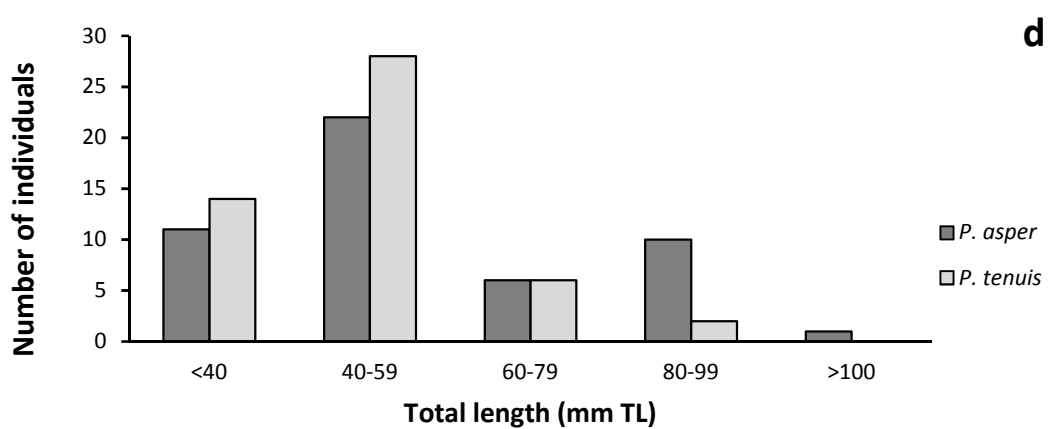
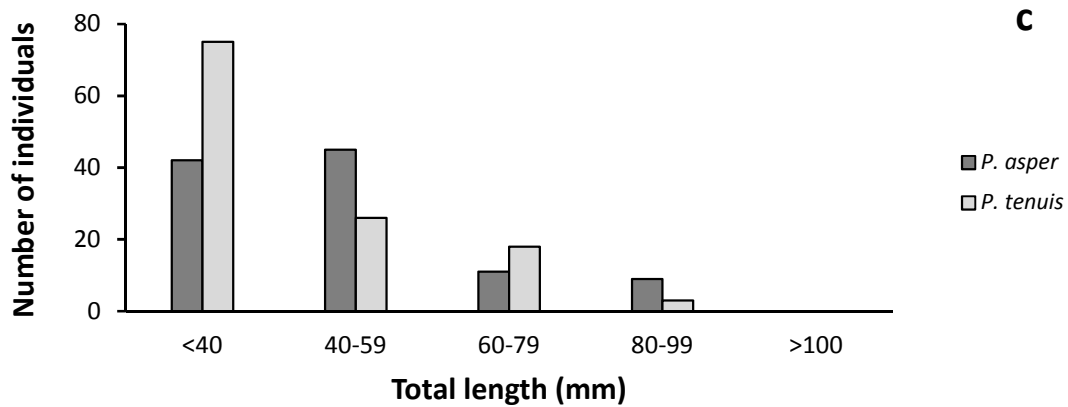
### 3.2.3 Downstream zone

For the September 2017 survey, *P. asper* as well as the slender redbfin *P. tenuis* was detected in all three of the netting efforts. A range of size classes were detected and the size range of the redbfins were 44-102 mm TL for *P. asper* and 38-78 mm TL for *P. tenuis* (Figure 8a). A total of 160 fish were caught in this zone of which 47 (29%) were *P. tenuis* and the 113 (71%) were *P. asper*. The CPUE for the zone was 53.3 fish/effort (Figure 9). Some of the fish caught were either gravid females or males with tubercles but these were not common. The common platanna *X. laevis* was detected in low numbers and all size classes were observed. For the December 2017 survey, 152 fish were caught in four netting efforts, of which 44 were *P. asper* and 108 were *P. tenuis*. The mean CPUE for the sampling trip was 38.0 fish/effort (Figure 9). The size range of the redbfins were 54-88 mm TL for *P. asper* and 40-90 mm TL for *P. tenuis*. There was limited evidence of successful spawning as there was few fish of less than 40mm TL detected during sampling (Figure 8b).

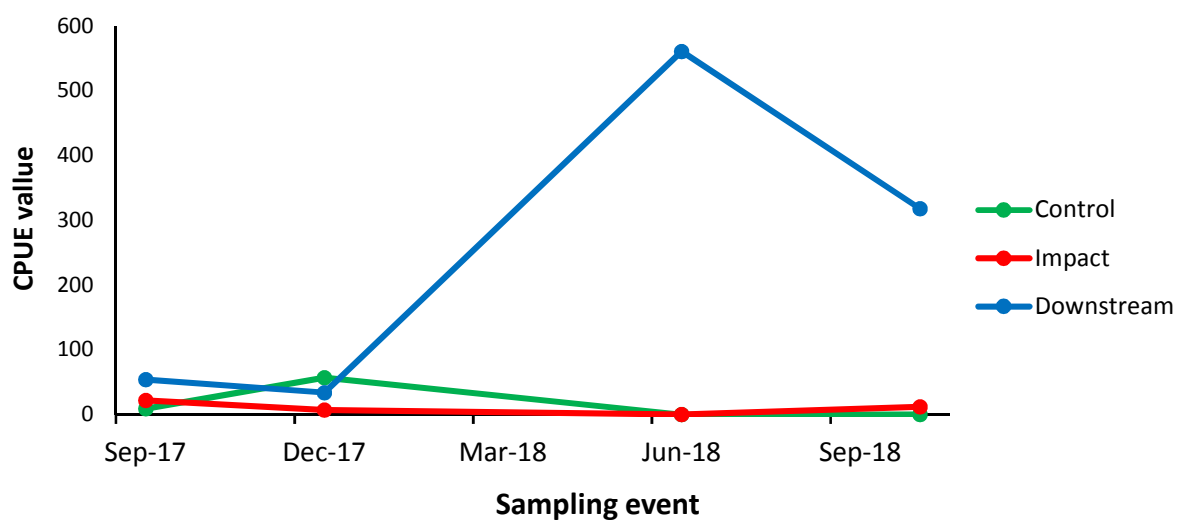
In contrast, for the June 2018 survey, young of year fish were abundant and the observed size range was 32-94 mm TL for *P. asper* and 20-88 mm TL for *P. tenuis* (Figure 8c). A total of 1378 *P. asper* were caught along with 306 *P. tenuis* resulting in a total of 1684 fish and a CPUE of 561.0 fish/effort (Figure 9). For the September 2018 survey, less fish were caught (n=916) of which there were 622 *P. asper* and 294 *P. tenuis*. This resulted in a CPUE of 318.0 fish/effort (Figure 9). The size range of the redbfins were 32-104 mm TL for *P. asper* and 32-88 mm TL for *P. tenuis* (Figure 8d).



**Figure 8a-b:** Size class distribution of *P. asper* and *P. tenuis* collected from the impacted zone of the Groot River during (a) September 2017 and (b) October 2017.



**Figure 8c-d:** Size class distribution of *P. asper* and *P. tenuis* collected from the impacted zone of the Groot River during (c) June 2018 and (d) October 2018.



**Figure 9:** Mean catch per unit effort (CPUE) for all three zones of the Groot River for the four sampling intervals

## Discussion and Conclusion

The aim of the present study was to monitor the short-term effects of a diesel spill on the fish community of the Groot River within the Groot Swartberg Nature Reserve and World Heritage site. The Groot River is of high biodiversity value as it is home to three indigenous cyprinid species, one (*P. asper*) of which is listed as Vulnerable (Jordaan and Chakona, 2018). Despite its high biodiversity value and being partially located within a formally protected area, the Groot River is extremely vulnerable to anthropogenic impacts, mainly related to a national road running through the reserve along the river. The risk of point-source pollution related to the use of the road was illustrated in 2017 with the spill of large amounts of diesel into the river following a truck accident. Clean-up and remediation efforts were underway within a very short time (<48h) after the accident which included containment berms, removal of contaminated soils and pumping out of diesel floating on the water surface. The visible impacts of the spill was contained to approximately 900m below the point of entry of the spill into the river. Despite this, significant concerns exist regarding the potential impacts on the aquatic ecosystem of the Groot River.

Fossil fuels such as crude oil and diesel are considered significant global pollutants in both freshwater and marine ecosystems. Sources include ruptured transport pipelines, leakage from storage tanks, storm water drainage and spillage from transport vehicles (Simonato et al. 2011). It is estimated that approximately 5 million tons of crude oil from a variety of sources enters the marine environment each year (Neff, 1990). While an estimation of the pollution load for fossil fuels in freshwater is not known, significant spills and resultant fish kills have been reported. For example, Kubach et al. (2011) reported a diesel spill of 3 624 910 L diesel fuel into the Reedy River, South Carolina from a damaged pipeline which resulted in a 37km fish kill in the river. Diesel is a complex mixture of numerous chemicals including water-soluble polycyclic aromatic hydrocarbons (PAHs) i.e., benzene, toluene, ethylbenzene and xylene (BTEX hydrocarbons), and polyaromatic hydrocarbons such as naphthalene and phenanthrene. Diesel has water soluble fraction (WSF) and water-insoluble fraction (WIF). The WSF is of concern as it is readily bioavailable to aquatic biota and can result in mortality at high concentrations. Sub-lethal effects of the WSF that has been observed in fish include oxidative stress, abnormal liver enzyme activity, imbalance in ion homeostasis, pericardial oedema and spinal deformities in juvenile fish and reduced immune response (Schein et al. 2009). Furthermore, PAHs can combine with the particulate organic or inorganic matter on the stream bed, resulting in increased consumption of oxygen by bacteria during decomposition, thereby reducing available O<sub>2</sub> to aquatic biota (Crunkilton & Duchrow 1990). PAHs can also bind to food or sediment particles, therefore short and long lasting biological effects of oil spills are likely to occur (Neff et al., 1976). Fishes are considered particularly vulnerable to polycyclic aromatic hydrocarbons (PAHs) and other persistent contaminants due to their high position in the aquatic food web (Baird and Burton, 2001). Other impacts of diesel contamination can include changes in diatom and invertebrate communities. The latter was investigated during following the spill event through the SASS5 invertebrate sampling methodology and will be reported separately (J. Gouws, unpublished data).

During the short-term observations (<7days) following the spill event, observed mortality of native fish was low (n<25). The clean-up crew was requested to report and collect any dead animals the spill zone, and field rangers walked along the riverbanks in the spill zone every two days. Only a dead duck and dead frog were reported and it is uncertain whether these mortalities can be attributed to the diesel spill. The first dying and moribund fish were observed at roughly four days after the spill in a medium sized pool in the spill zone. The delayed toxic response could be attributed the diesel film preventing oxygen exchange with the atmosphere, thereby causing oxygen depletion and associated mortality, the water soluble fraction of diesel accumulating to acutely toxic concentrations over time, or a combination of these factors. The affected fish were observed in the first approximately 200 m of where the spill occurred and no individuals affected in a similar way were observed at the lower end of the impact zone.

Following the first sampling event conducted two weeks after the spill (September 2017), native redbfin species were detected in all three zones sampled. *Pseudobarbus asper* was detected in all three zones sampled while *P. tenuis* was only present at the downstream sampling sites. There were prominent differences in fish abundances between the sites, with the lowest CPUE (9 fish/netting effort) recorded in the control zone and the highest (54 fish/netting effort) in the downstream zone (Figure 9). It is evident that fish abundances increase when moving downstream, but this is likely strongly influenced by the changes in habitat and river size when moving downstream. Redfins were still present in the impacted zone, but fewer fish were detected near the upper end of the spill zone. Fish collected from these two sites were lethargic and showed no avoidance response to being netted or handled when being measured. The netting effort near the end of the spill zone (I3) yielded high numbers of *P. asper* and the behaviour of these fish were markedly different from the fish at sites I1 and I2 in that they showed normal avoidance and startle response to netting and handling. This is likely indicative of less pollutant being present towards the lower end of the spill zone, but this cannot be concluded in the absence of analytical data on diesel pollution concentrations.

*Pseudobarbus tenuis* was only detected at the downstream sampling sites and were absent from the control and impacted sites, with the exception of the December 2017 sampling of site I2 (Figure 7b). This is unlikely to be a result of the diesel contamination. Historical distribution data (CapeNature State of Biodiversity database) indicate that this species has a different distribution range from *P. asper* in the Groot River. Their discontinuous distribution is likely determined by habitat and water quality characteristics in the river, which in turn is determined by the underlying geology of the area. Geologically, the catchments that make up the Groot River is a complex mixture of arenite (a sandstone type of rock formation) in the upper and lower sections of the river and a shale band running through the central section of the Groot River upstream of the reserve border. Downstream sections of the Groot River close to the confluence with the Olifants there are also sections dominated by conglomerates. The downstream zone has markedly different habitat characteristics from the control and impacted zones (see Section 3.1). It must be noted that *P. tenuis* was detected in the Aaps River, a tributary of the Groot River upstream of the Meiringspoort, in a 2016 survey (Jordaan et al. unpublished data) and in the upper Groot River upstream of the Meiringspoort by Swartz (2005). This presents evidence for a naturally discontinuous distribution within the Groot River, most likely driven by this species' habitat preference for clear cold mountain stream habitat (Skelton, 2001).

In terms of population size structure observed in the September 2017 sample event, the redbfin population for both the control and impacted zones were dominated by larger size classes (>60mm TL) with a few young fish (<40mm TL) observed in the downstream zone (Figures 5a, 7a and 8a). This is expected as most *Pseudobarbus* redbfins commence spawning activity in the spring and the timing of sampling would thus have been prior to the commencement of spawning. Cambray (1994) studied the reproduction biology of the *P. asper* and its sister species, the Eastern Cape redbfin (*Pseudobarbus afer*) in the greater Gamtoos River System. It was reported that *P. asper* exhibited a protracted spawning season, ranging from October to April and that spawning is induced by increased river flows. From the December 2017 survey, evidence of successful spawning activity was observed in the control zone, as the majority of fish sampled was in the young of year (<40mm TL) size class (Figure 5b). Less animals were observed in this size class in the impacted and downstream zones (Figures 7b and 8b), presenting limited evidence for successful recruitment and a possible impact resulting from the diesel spill. However, when considering the June 2018 data from the downstream zone however, it is evident that the young of year size class (Figure 7c) dominate the population of both redbfin species. Data from October 2018 shows evidence for ongoing successful spawning activity and high survival of young fish, as the population is dominated by fish of less than 60cm TL. The reduced fish numbers in the impact zone must be interpreted with the fish salvage operations in mind.

The impact of drought is very evident in both the control and the impacted zones and this confounds the impacts of the diesel spill. The control zone started to dry up during December 2017 and was completely dry during the June 2018 survey (Figure 3). Despite reduced flow and associated impacts on habitat, the control zone had the highest CPUE value of all three zones (Figure 9) during December 2017 (Figure 9). This can largely be attributed to successful spawning, illustrated by the dominance of the young of year size class detected during sampling (Figure 5b). It is very likely that some if not all of these fish have perished as a result of this section of river drying up completely during the winter of 2018. While the river was flowing again in October 2018, pool volume was still reduced compared to September 2017 and only two fish were caught, illustrating the severe effects of intermittent droughts on the distribution of threatened native fishes of the region. The few fish observed in the control zone in October 2017 has likely recolonised this section of river from upstream sources (upper Groot River and Aaps River) where populations of both redbfin exist (Jordaan and Gouws, 2017). The upstream source populations of redbfins are also likely to be the source of the *P. tenuis* individuals that was observed in the impacted zone of the Groot River during the December 2017 survey. When considering the CPUE and size distribution data collected from the downstream zone for all four sample events, there is no evidence to date that suggests significant impacts on the fish community downstream of the spill zone. While a reduction in CPUE was observed between the September 2017 and December 2017 sample events, a CPUE of over 500 fish/netting effort was observed for the June 2018 sample event. The fish that were sampled was also dominated by young of year and juvenile size classes (<60mm TL), presenting evidence for successful recruitment during the past spawning season.

In summary, from the results of this survey, and especially the data from downstream sampling sites, it can be concluded that the Groot River has significant and conservation-worthy populations of two native redbfins *P. asper* and *P. tenuis* and that these have not suffered significant deleterious effects from the diesel spill of August 2017. Based on survey work conducted in the Gouritz system between 2015 and 2016, it would appear that *P. asper* has lost the majority of its native range in the Gouritz system to the impacts of alien invasive fish and water over abstraction. This also appears to be the case for the Gamtoos system (Jordaan and Chakona, 2018). The Groot River population is at present one of the biggest *P. asper* populations in the system and has extremely high conservation value. In addition to the threats of pollution and water abstraction, the presence of the highly invasive sharptooth catfish *Clarias gariepinus* was confirmed in the Groot River in 2017 by an independent researcher (R. van der Walt, unpublished data). It appears that *C. gariepinus* have penetrated a significant distance upstream into the poort as this species was detected at Aalwynsdrift, which is a relatively short distance downstream of the Swartberg Reserve border. This species was not detected in downstream sections of the river (Spookdrift bridge) in the direction of the town of De Rust during the 2016 survey of the Swartberg Nature Reserve, but their presence was reported in Stompdrift Dam by several sources (A. Chakona, pers. comm., T. Barry, pers. comm.). An illegal introduction into Stompdrift Dam is the likely source of the invasion. Alarming, *C. gariepinus* was also reported to be present in farm dams in the Klaarstroom area towards the northern end of the poort (R. van der Walt, pers. comm.). *Clarias gariepinus* is widespread and established in many mainstream river systems in the CFE where there is evidence that their impacts are severe (Ellender et al (2015) illustrated that *C. gariepinus* has the ability to invade headwater streams but their impact on these fragile ecosystems remains largely unstudied. The *C. gariepinus* invasion into the Groot River warrants urgent attention in the form of monitoring to provide a basis for developing management interventions.

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