SANRAL
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BUILDING SOUTH AFRICA THROUGH BETTER ROADS

THE SOUTH AFRICAN NATIONAL ROADS AGENCY SOC LIMITED

CONTRACT SANRAL N.002-300-2020/1F

CONSULTING ENGINEERING SERVICES FOR THE DESIGN AND CONSTRUCTION MONITORING OF PAVEMENT AND SETTLEMENT REPAIRS ON NATIONAL ROUTE 2, SECTION 30 FROM BUSHVELD RETREAT FARM (KM 44.00) TO HLUHLUWE INTERCHANGE (KM 55.00)

PROJECT DOCUMENT

THE CHIEF EXECUTIVE OFFICER
THE SOUTH AFRICAN NATIONAL ROADS AGENCY SOC LIMITED
58 VAN ECK PLACE
PIETERMARITZBURG
3201

THE SOUTH AFRICAN NATIONAL ROADS AGENCY SOC LIMITED

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TENDER DOCUMENT

VOLUME 6

BOOK 1 OF 1

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THIS DOCUMENT COMPILED BY:

SNA CIVIL AND STRUCTURAL ENGINEERS PTY LTD

SNAVIA Building

285 Albertus Street

La Montagne

0184

Pretoria

Telephone +27 12 842 0000

e-mail: snapta@sna.co.za

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1 PART 1: VOLUME CONTENTS, GENERAL DESCRIPTION AND DISCLAIMER

1.1 CONTENTS OF THIS VOLUME

This volume (**Volume 6)** contains a written section pertaining to all the parts of the contract along with annexed analysis and test results set out as follows:

- PARTS 1 TO 9 : Written Report
- ANNEXURES : Numbered in accordance with written report sections

1.2 PROJECT SECTIONS

The project is located on National Route 2 Section 30 from Bushveld Retreat Farm (km 47.00) to Hluhluwe Interchange (km 55.00). In addition to the limits described under the contract title, the extents of the contract have been adjusted to include a further three kilometres. The expanded limits of the project include km 44.00 to km 55.00. This project is in the province of KwaZulu-Natal and forms part of the Big 5 False Bay Local Municipality under the Umkhanyakude District Municipality.

Based on the pavement assessment as well as CUSUM data, the project was divided into 3 uniform sections. The road section starts at km 47.0 and ends at km 55.0 with a total length of 11.0 km. The new section (Section 0) does not have materials information available but is expected to be similar conditions to that of Section 1. The road sections referred to throughout the report are as follows:

- Section 0: Km 44.0 to km 47 with a length of 3.0 km
- Section 1: km 47.0 to km 49.0 with a length of 5.0 km
- Section 2: km 49.0 to km 50.5 with a length of 2.0 km (Ncemane river floodplain)
- Section 3: km 50.5 to km 55.0 with a length of 4.5 km

This contract consists of emergency repairs to temporarily mitigate the effect of deep-seated subgrade problems that will be addressed in future route upgrade projects. No geometric or structural upgrades are planned as part of this project; however surface and subsurface drainage will be attended to.

A locality plan with the original project boundaries is included in Figure 1-1.

The limit of construction below shows the road section from km 47.0 to km 55.0 only. The section from km 44.0 to km47.0 was added to the project and will form part of the limits of construction.

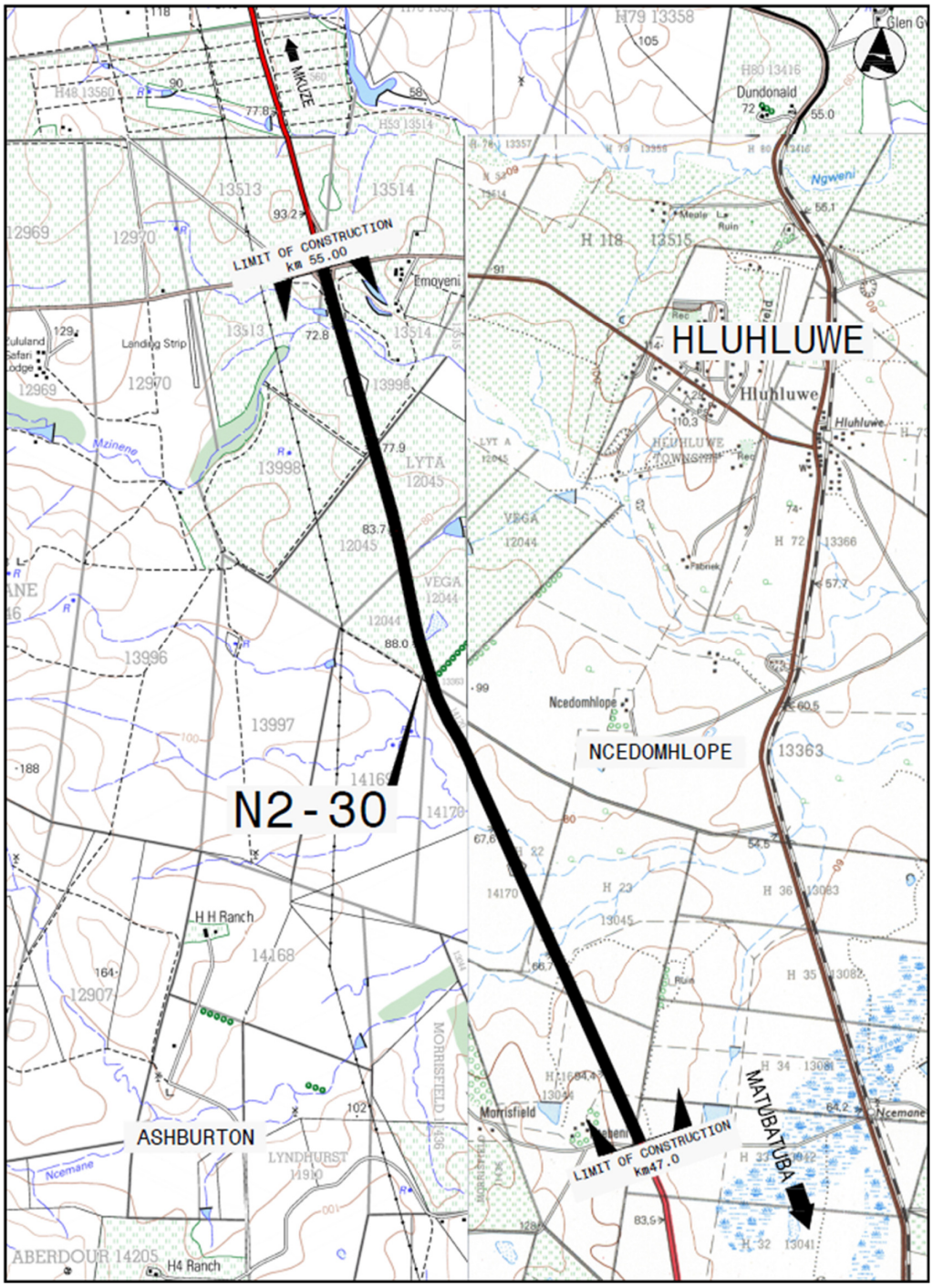


FIGURE 1-1: LOCALITY PLAN OF THE ROAD SECTION N.002-300

1.3 GENERAL PROJECT DESCRIPTION

The information supplied in this document relates specifically to the pavement and materials utilisation, geotechnical and founding conditions expected for the project.

The following main **pavement related** works are included under the contract:

Uniform Section 0, 1 & 3:

- Crack sealing,
- Asphalt patching,
- Base patching, and
- Overlay.

Uniform section 2:

- Removal of surface,
- Reconstruction of a 150 mm base in three layers with BTB and asphalt reinforcing,
- Application of a new surfacing layer, and
- Application of an overlay (similar to Uniform Section 0, 1 & 3).

1.3.1 CHAINAGE REFERENCE

All chainage references and kilometre distances referred to herein relate to the existing typical SANRAL kilometre markers situated at 200 m intervals along both carriageways of the main route under consideration.

Based on the data provided, the current chainages are on the N2 Section 3 from km 44.00 (Southern Limit, Matubatuba end) to km 55.00 (Northern limit, Mkuze end).

Increasing chainages for the road is as follow:

N2 : Northbound

1.4 GENERAL DISCLAIMER

The information presented in this Volume records the as-built information, results and findings of the various investigations undertaken along the route during the detail assessment and design phases. This Volume is intended to provide an indication of the conditions likely to be encountered on site, based on the investigations conducted. However, it should be noted that the information is limited to conditions identified during these investigations and does not preclude the existence of unforeseen or unidentified conditions that may not have been revealed at the time.

The results are given in good faith, but no warranty is given that the information is representative of the whole area under consideration, and no responsibility will be accepted for any consequence arising from actual conditions being different from those indicated in this Volume.

All the drawings, opinions, interpretations and suggested methods of working given in this Volume are intended merely as a guide.

The Specifications and Contract Drawings always override this Volume. Any stake values, depths or limits of cut or fill, cut or fill slopes or any other dimensions referred to or given on

the drawings are only approximate and must not be regarded as instructions to the contractor.

The estimated volumes of materials in each class of excavation, the distribution and limits thereof and the bulking factors given within this Volume and as shown on the drawings herewith, are merely intended as a guide to tenderers and no warranty is given for the correctness of the interpretations of the data used or for any consequences arising from actual conditions, quantities or limits being different from those indicated in this Volume.

The tenderer should study all available information herein and form his / her own opinion of conditions likely to be encountered along the route section under consideration.

2 PART 2: PHYSIOGRAPHY

2.1 TOPOGRAPHY

The route runs along the edge of a flat coastal plain, just where hills start to rise towards the escarpment. The 11.0 km of Road Section therefore stretches along a flat to rolling terrain. The route is aligned to generally follow the topography with isolated fills up to about 3m. The road section is often in shallow cut with side drains.

2.2 CLIMATE AND RAINFALL

2.2.1 GENERAL

Average monthly maximum temperatures range from 30°C in summer (September to April) and 23°C in winter (May to August), with the average monthly minimum temperatures being 12°C and 4°C, respectively.

The months with the most rainfall are usually January and February, but rain may be expected throughout the year. The average annual precipitation is in the range of 700 to 1000 mm.

2.2.2 AVAILABLE INFORMATION

Table 2-1 contain a summary of the weather station information of the St. Lucia Lake Research Centre station situated southeast of the project.

Since the terrain is not hilly and the project is in close proximity to the coast, weather patterns and information given herein are applicable to the project area under consideration.

TABLE 2-1: WEATHER STATION DATA

Description	Information
Name	St. Lucia Lake Research Centre
Position	Lat: 32°26'36" E Long: 27°56'11" S
Height above sea level	10m
Average yearly rainfall	1058mm

2.2.3 TEMPERATURE

Figure 2-1 indicate the temperature data and statistics of the St. Lucia Lake Research Centre station relevant to the project area under consideration.

Figure 2-1 includes average monthly minimum and maximum temperatures calculated for historical data.

As can be seen, temperatures are reasonably mild throughout the year with minimum temperatures reducing slightly during the winter months.

No sub-zero temperatures have been recorded for the applicable data set, while maximum temperatures are mostly above 20 °C throughout the year with limited maximum temperatures approaching 30 °C noted.

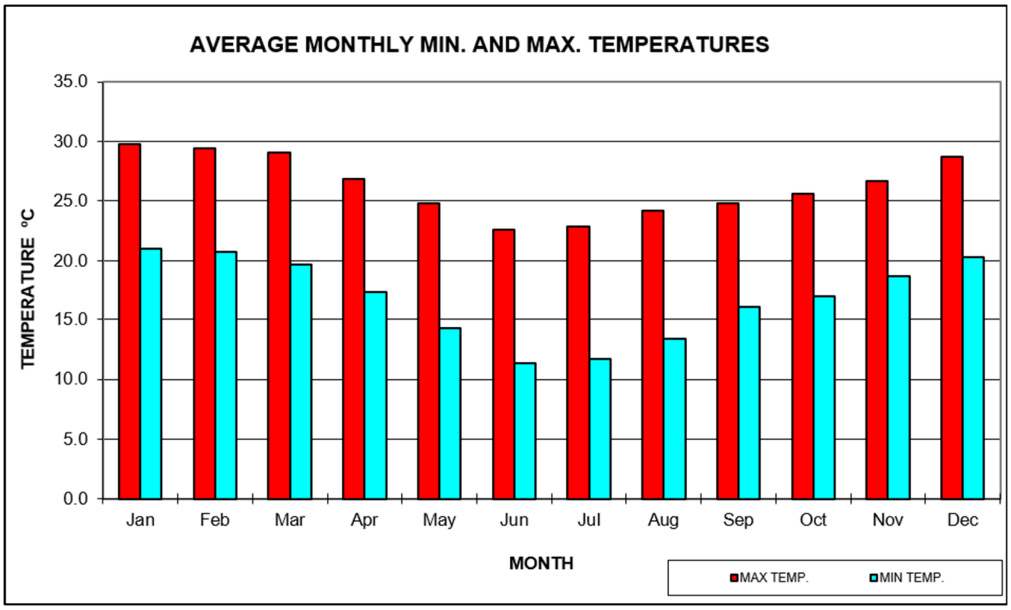


FIGURE 2-1: AVERAGE MONTHLY MINIMUM AND MAXIMUM TEMPERATURES

2.2.4 RAINFALL

As noted in Table 2-1, the average annual rainfall for the region exceeds 1 000 mm. Figure 2-2 show the rainfall pattern throughout the year. Rainfall generally occurs during the summer months of November to March with lesser rainfall present for the winter months.

Figure 2-3 shows the number of days with rainfall exceeding a certain amount. During the winter months a maximum of two days per month experience rainfall more than 10 mm.

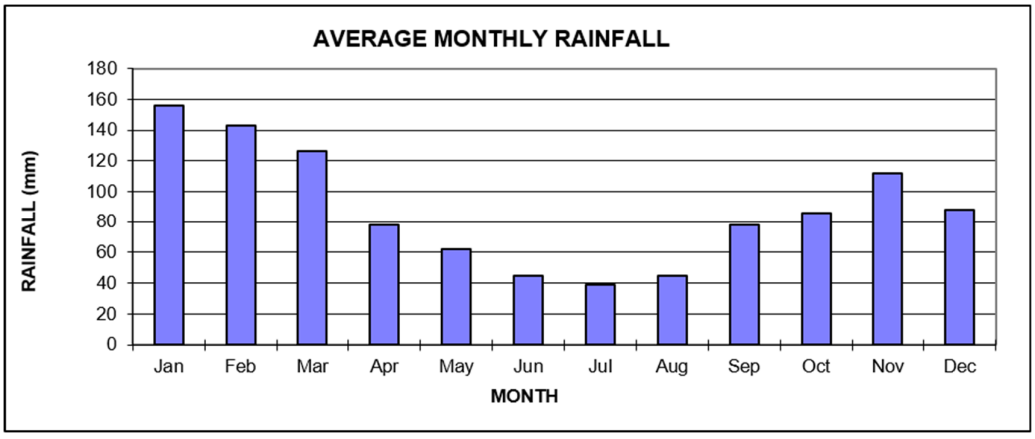


FIGURE 2-2: AVERAGE MONTHLY RAINFALL

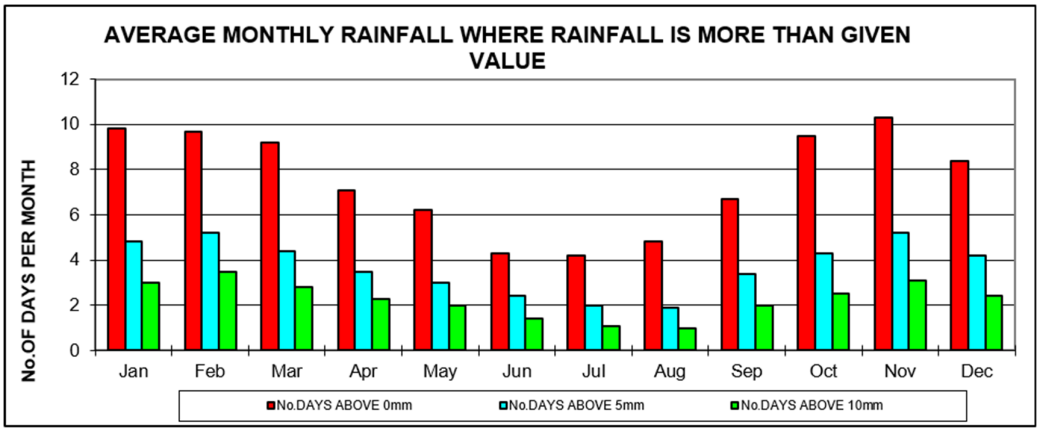


FIGURE 2-3: NUMBER OF RAINY DAYS PER MONTH EXCEEDING A MINIMUM VALUE

2.2.5 WIND AND HUMIDITY

The average monthly data for wind speed and relative humidity is presented in Table 2-2.

TABLE 2-2: AVERAGE WIND SPEED, HUMIDITY

Month	Average wind speed (km/h)	Average relative humidity (%)
January	16	75
February	15	75
March	14	75
April	14	71
May	14	66
June	14	59
July	15	61
August	17	63
September	17	67
October	17	72
November	17	74
December	16	76

The wind speed rarely exceeds 17 km/h and the relative humidity is generally above 60 %. Humidity and wind speed is higher during summer months compared to winter months.

2.3 REGIONAL CLASSIFICATION

2.3.1 THORNTHWAITE MOISTURE INDEX

The Thornthwaite Moisture Index (TMI) is generally used as an indicator of the aridity or humidity of the climate and soil conditions and is derived from the combined effects of precipitation (supply), evapotranspiration (demand), soil water storage, moisture deficit and runoff. The soil-moisture can significantly influence the performance of infrastructure, particularly infrastructure with relatively shallow foundations such as pavements.

The Project site is in a sub-humid region according to Thornthwaite's Moisture Index (Paige-Green, 204), with an index value between 0 and 20. The Thornthwaite's Moisture Index map for South Africa with the site location is presented in Figure 2-4 on the left side.

2.3.2 WEINERT N-VALUE

The project under consideration falls within a wet macro climatic region in accordance with Weinert's Macro Climatic Regions of Southern Africa (refer to Figure 2-4, right). Weinert's N value provides an indication of the mode of weathering of rocks, and an associated variation in expected performance of the weathered materials.

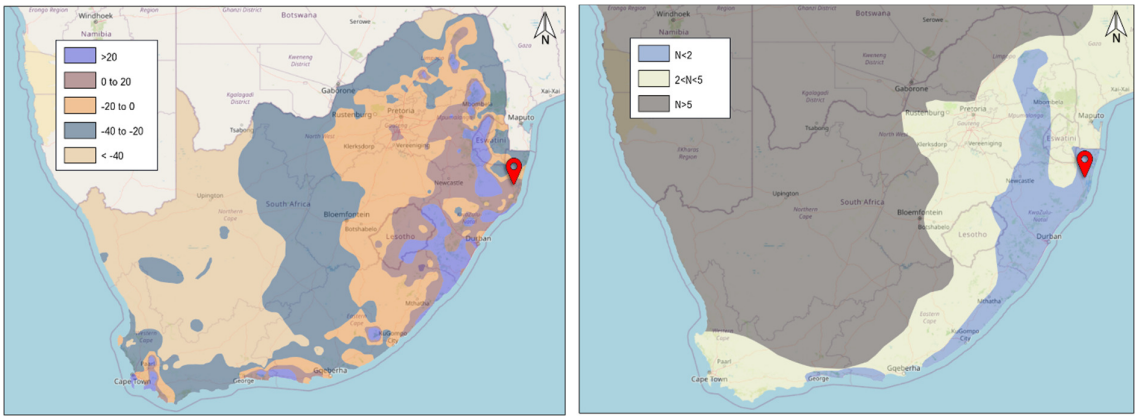


FIGURE 2-4: MACRO CLIMATE REGIONS OF SOUTHERN AFRICA (THORNTHWAITE INDEX – LEFT, WEINERT N – RIGHT)

Taking into consideration the locality and climatic conditions of the project, the Weinert N-value (according to Weinert, 1980) classification of the region is 2 (or less) which corresponds to a wet climatic region.

According to both the Weinert classification and the Thornthwaite Index, wet climatic conditions are accepted to be applicable for the project section under consideration. In terms of the applicable climatic region as described above (wet region), care should be exercised to ensure suitable drainage and pavement maintenance (preventing moisture from entering the pavement structure) measures to ensure that medium to longer term pavement performance is not affected negatively.

2.4 EXISTING LAND USE

The 11 km of road section is surrounded by grazing fields as well as cultivated land, which is generally sugarcane. The property sizes seem to be at least small farms but should not have an impact on the project, as the National Route 2 Section 30 is already a freeway with access control.

2.5 EXISTING CROSS-SECTION AND GEOMETRIC FEATURES

The existing road section comprises an undivided single carriageway with one 3.7m lane in each direction and a (2.4m or) 2.5m shoulder with a gravel shoulder on either side, as measured during the visual assessment of the road section.

No geometric upgrades are included under this project, only priority pavement interventions. All geometric alignment and structural upgrades will form part of the future route upgrade.

2.6 GEOLOGY

2.6.1 GENERAL DESCRIPTION

Available geological maps indicate that the project section is underlain by the Letaba formation of the Lebombo group of the Karoo sequence.

2.6.2 APPLIED ENGINEERING GEOLOGY

Basalt is a fast-weathering rock and could pose long term durability problems. As well as possible slope stability problems. Weathering is mainly through chemical decomposition due to being in a wet macro climatic region (N < 5). Weathering of basalt in less mountainous areas normally results in active residual soils which consists mainly of montmorillonite clay.

Basalt is a basic crystalline rock. When Basalt is used as a construction material in layer works, but also in concrete and surfacing aggregates, it can degrade rapidly, generating soft aggregates, with high plasticity leading to road failures on a large scale.

SNA was provided with a preliminary geotechnical design report compiled by JG Afrika (Pty) Ltd. This report was carried out for the upgrading of Sections 30, 31 and 32 of the National Route 2 to a dual carriageway with road widening taking place on the eastern side of the existing road. Certain fieldwork and laboratory testing along the section of the route under consideration (Section 30: km 47.0 to km 55.0) was carried out as part of the investigation work for this preliminary geotechnical design report.

The Geotechnical Report compiled by JG Africa is available in **Annexure 7.1**.

2.6.3 GENERAL COMMENTS

All materials envisaged for construction purposes shall be tested in accordance with the requirements as referenced in Volume 3 of the project documentation in order to ensure suitability for intended use.

Special consideration shall be given to testing procedures and methods emulating longer term performance characteristics in line with the geological, climatic and further related conditions of the project area under consideration.

3 PART 3: TRAFFIC INFORMATION

3.1 GENERAL

The current scope of the project does not entail any geometric upgrades.

General traffic volumes for the route sections are presented in the following sub-sections to inform tenderers of expected traffic conditions, particularly in relation to traffic accommodation, site personnel safety, associated risks, and similar considerations.

3.2 AVAILABLE DATA AND EXISTING TRAFFIC VOLUMES

CTO Stations 807 are located on the road section from Kangela to Hluhluwe Interchange, covering two (2) sections within the limits of construction, i.e. km 43.875 – km 54.600 and km 54.600 – km 55.727. CTO Station 13085 is located on the road segment from Kangela to Hluhluwe Interchange, just outside the limit of construction, km 43.091 – 43.875. CTO Station 13079 is located on segment Hluhluwe Interchange to Ngweni, again just outside of the limits of construction, km 55.727 – km 64.972. Therefore, the traffic assessment will be based on CTO Station 807, km 43.875 – km 54.600, which is within the limits of construction.

A summary of the available data at CTO Station 807 is summarised in Table 3-1.

TABLE 3-1: TRAFFIC HIGHLIGHTS FOR STATION 807

Year	ADT (Primary)	ADTT (Primary)	%HV (Primary)	ADT (Secondary)	ADTT (Secondary)	%HV (Secondary)	ADT Road	ADTT Road	%HV Road
2003	1989	480	24	2004	511	25	3993	991	25
2004	1978	435	22	1931	436	23	3909	871	22
2006	2336	516	22	2354	566	24	4690	1082	23
2007	2306	560	24	2310	620	27	4617	1180	26
2008	2310	570	25	2330	641	28	4640	1211	26
2010	2572	501	19	2568	520	20	5140	1021	20
2012	2584	616	24	2614	667	26	5198	1283	25
2019	3409	711	21	3439	744	22	6848	1455	21
2020	2874	613	21	2880	643	22	5754	1256	22
2021	3345	830	25	3387	900	27	6732	1730	26
2022	3510	1082	31	3547	1129	32	7057	2211	31
2023	3916	1371	35	3955	1423	36	7871	2794	35

Regarding the tabulated traffic volumes and associated data, the following general observations can be made:

- The linear growth for the ADT over the 20-year (2003 to 2023) span was calculated at 3.1%, whereas the ADTT growth rate over the same period was calculated at 4.7%.
- Based on the estimated 30th highest hour volume, the existing single carriageway road will be sufficient for the next 10 years with the average annual growth rates calculated.
- Heavy vehicles account for approximately 35% of the total traffic volume in 2023.

3.3 TRAFFIC VOLUMES

AM peak and PM peak traffic volumes were not available.

The traffic volumes in Table 3-1 are provided to the contractor to highlight the high volumes of vehicles traversing the project sections and the implication thereof in relation to traffic accommodation measures and the construction of all works under continuous traffic flow.

3.4 PAVEMENT RELATED TRAFFIC

The expected ADT and ADTT for 2033 is estimated at 11 365 and 5 022 respectively. Traffic growth was calculated at a growth rate of 3.9%. The 30th highest hour volume is estimated at 2 392 vehicles.

A sensitivity analysis was conducted by varying the growth rate and the E80 factor. For a design period of approximately 7 years, the expected traffic loading would vary between 10 and 16 MESA at growth rates between 3% and 5%.

Pavement design requirements are discussed in Part 5 of this document.

4 PART 4: ROAD PAVEMENT HISTORY AND CONDITION ASSESSMENT

4.1 GENERAL

In line with the project scope, the existing pavement structures will remain intact. Uniform Section 0, 1 & 3 will receive base patches and Uniform Section 2 will receive an asphalt base structure constructed in 50 mm lifts with asphalt reinforcing as an emergency repair strategy.

4.2 PAVEMENT HISTORY

4.2.1 GENERAL DESCRIPTION

As per the information received, the National Route 2 Section 30 was originally constructed in the 1970's with a major rehabilitation in 2001 which was designed to an ES3/ES10 traffic class or design life standard.

The existing pavement structure, along with the construction year is presented in Figure 4-1.

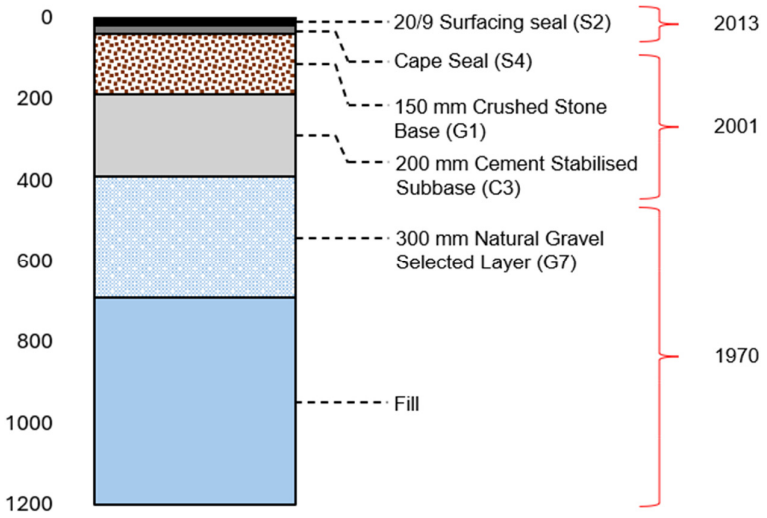


FIGURE 4-1: EXISTING PAVEMENT HISTORY

4.2.2 PAVEMENT MAINTENANCE HISTORY

It is evident that periodic maintenance has been undertaken on the project section. The known interventions are described as above but is not a true reflection of the existing pavement (refer Section 4.2.1).

The status of the Routine Road Maintenance in terms expenditure is unknown. Numerous patches are evident – especially in the floodplain (Uniform Section 2).

4.2.3 RELATED COMMENTS

Test pit investigations were undertaken to determine the following:

- Thickness and uniformity of the pavement structure.
- Material properties of the subbase, selected layers and subgrade.
- Presence of moisture in any of the layers.

4.3 VISUAL CONDITION ASSESSMENT

4.3.1 GENERAL COMMENT

The N2 pavement structure presents several distress manifestations. The main defects were existing patches that are in a poor condition, cracking (longitudinal, transverse and crocodile), potholes, undulation, edge breaks and gravel shoulder distresses.

Some of the typical distresses observed are presented in Figure 4-2 to Figure 4-5.



FIGURE 4-2: PAVEMENT FAILURE



FIGURE 4-3: CROCODILE CRACKING



FIGURE 4-4: POTHOLES



FIGURE 4-5: RUTTING

4.4 RUT DATA

Mechanical rut measurement data was provided for the northbound lane only. The supplied data contained historical rut measurements for 2012; 2015; 2017 as well as recent data for 2021 in both wheel paths every 10 m.

The 2021 Rut data was compartmentalised for the three Uniform Sections, and the relevant information is presented in Table 4-1.

TRH12 defines the condition rating for rut depth as follows for a Category A Road:

- <10 mm — Sound Condition
- >10 mm, but <20 mm — Warning condition
- >20 mm — Severe Condition

TABLE 4-1: SUMMARY OF RUT MEASUREMENTS WITHIN UNIFORM SECTIONS (2021)

NB Uniform Section 1 from km 47,0 to km 49,0 = 2,0km		
Condition	**Rut Left Wheel Path**	**Rut Right Wheel Path**
Sound	100 %	98 %
Warning	0 %	2 %
Severe	0 %	0 %
NB Uniform Section 2 from km 49,01 to km 50,29 = 1,28km		
Condition	**Rut Left Wheel Path**	**Rut Right Wheel Path**
Sound	100 %	98 %
Warning	0 %	2 %
Severe	0 %	0 %
NB Uniform Section 3 from km 50,30 to km 55,0 = 4,71km		
Condition	**Rut Left Wheel Path**	**Rut Right Wheel Path**
Sound	100 %	96 %
Warning	0 %	4 %
Severe	0 %	0 %

Uniform section 1:

2 % of the measurements in the right wheel path are above 10 mm, but below 20 mm – warning condition. This translates to 40 m of isolated instances of rut measurements in the warning condition.

Uniform section 2:

2 % of the measurements in the right wheel path are above 10 mm, but below 20 mm – warning condition. This translates to 20 m of one continuous instance of rut measurements in the warning condition.

Uniform section 3:

4 % of the measurements in the right wheel path are above 10mm, but below 20mm – warning condition. This translates to a total of 170 m of isolated instances of rut measurements in the warning condition.

4.5 ROUGHNESS DATA

TRH12 defines the condition rating for Riding Quality (IRI) as follows for a Category A Road:

- <3,5m/ km Sound Condition
- ≥3,5m/ km, but <4,2m/ km Warning condition
- ≥4,2m/ km Severe Condition (terminal)

Mechanical IRI measurement data was provided for the northbound lane only. The supplied data contained historical IRI measurements for 2015; 2017 as well as recent data for 2021 in both wheel paths every 100 m.

The 2021 Roughness data was compartmentalised for the three Uniform Sections, and the relevant information is presented in

TABLE 4-2: SUMMARY OF IRI MEASUREMENTS WITHIN UNIFORM SECTIONS 2021 DATA)

NB Uniform Section 1 from km 47,0 to km 49,0 = 2,0km		
Condition	**IRI Left Wheel Path**	**IRI Right Wheel Path**
Sound	100 %	95 %
Warning	0 %	5 %
Severe	0 %	0 %
NB Uniform Section 2 from km 49,01 to km 50,29 = 1,28km		
Condition	**IRI Left Wheel Path**	**IRI Right Wheel Path**
Sound	46 %	62 %
Warning	15 %	0 %
Severe	38 %	38 %
NB Uniform Section 3 from km 50,30 to km 55,0 = 4,71km		
Condition	**IRI Left Wheel Path**	**IRI Right Wheel Path**
Sound	93 %	88 %
Warning	2 %	7 %
Severe	5 %	5 %

A number of distresses may influence the riding quality including existing patch work, potholes, undulations, etc.

4.6 CENTRELINE SURVEY

4.6.1 BACKGROUND AND INTRODUCTION

A total of 15 test pits were excavated. Some of the test pits do not have any laboratory test results, but the material is similar throughout the project as can be seen from Table 4-3.

4.6.2 RESULTS

The available test pit results are summarized in Table 4-3. From the results presented in Table 4-3 it is clear that the material contained within upper pavement layer works are of good quality. This confirms the notion that the underlying in-situ ground conditions are contributing to the defects visible on the road surface.

TABLE 4-3: MATERIAL TEST RESULTS

Hole No.	Depth	Atterberg Limits			GM	% passing 0.075	CBR @ MDD			COTO
		LL	PI	LS			100%	95%	93%	
km 47.33 NB	0.040 - 0.175	0	SP	1	2.49	8	157	99	65	G4A
	0.175 - 0.300	0	SP	1	2.42	8	156	53	38	G4B
	0.300 - 0.370	0	SP	1	2.32	11	86	58	39	G4B
km 47.88 SB	0.200 - 0.470	0	NP	0	2.49	6				
km 48.83 NB	0.02 - 0.166	23	4	2	2.48	9	142	80	58	G4A
km 49.10 NB	0.015 - 0.180	0	NP	0	2.69	4				
	0.180 - 0.405	0	SP	1	2.38	9	90	50	38	G4A
km 49.29 NB	0.162 - 0.392	0	SP	1.5	2.18	16	86	30	22	G6
km 49.32 SB	0.000 - 0.080	26	8	4	1.74	27	20	11	8.6	G9

Hole No.	Depth	Atterberg Limits			GM	% passing 0.075	CBR @ MDD			COTO
		LL	PI	LS			100%	95%	93%	
km 49.70 SB	0.025 - 0.200	23	4	2	2.44	9	75	39	29	G6
	0.730 - 0.940	0	NP	0	1.68	15				
km 50.02 NB	0.016 - 0.203	0	NP	0	2.64	7				
	0.203 - 0.334	0	NP	0	2.6	6	79	46	36	G7
	0.334 - 0.435	0	NP	0	2.45	10				
km 50.15 SB	0.200 - 0.310	0	SP	0.5	2.33	11	71	34	24	G6
km 50.55 SB	0.00 - 0.200	0	NP	0	1.18	24	7.4	3.5	2.6	G10
km 51.56 NB	0.172 - 0.400	0	SP	1	2.45	9				

Photos of some of the test pits are presented in Figure 4-6 to Figure 4-9. These photos provide visual cues as verification of the results presented in Table 4-3.

Upper selected layer materials and all layers below it excavated from Uniform Section 1 & 2 were noted to be most during the excavation of the test pits. Lower selected layer materials and all layers below it were noted to be moist during the excavation of test pits on Uniform Section 3.

4.6.2.1 Other test results

Additional material profiles were received from SANRAL for the upgrading of Section 30, 31 and 32. These test results are included under Annexure 4.2.

4.6.2.2 Material profiles and related test results

The laboratory profiles and test result sheets are included herewith as follows:

Annexure 4.1 : Material test results,
Dated: 15 February 2024,
Prepared By: SGS Matrolab

Annexure 4.2 : Material test results,
Dated: 25 January 2018,
Prepared By: Geosure (Pty) Ltd



FIGURE 4-6: TP 1 (NO TEST RESULTS AVAILABLE)



FIGURE 4-7: TP 5 (TWO LAYERS TESTED)



FIGURE 4-8: TP 6 (ONE LAYER TESTED)



FIGURE 4-9: TP 12 (ONE LAYER TESTED)

5 PART 5: PAVEMENT DESIGN

5.1 PAVEMENT DESIGN STRATEGIES

Different pavement interventions are considered for the various failures observed. The design strategy is also based on speed (shortest construction time) to ultimately minimize road user discomfort. The emergency interventions on the N2 will consist of two main items:

- Reconstruction of the base by overlaying the existing pavement structure with reinforced asphaltic layers (Uniform Section 2),
- Maintenance in the form of crack sealing and several patching strategies (Uniform Section 0, 1 & 3).

For further detailed descriptions / drawings related to this part, the contractor is referred to **Volume 3 and 4** of the project documentation.

5.2 EXISITING PAVEMENT STRUCTURE

The existing pavement structure is presented in Section 4.1. Test pit results presented in Section 4.6 shows the variability in layer thicknesses on the project along with the material quality that can be expected.

5.3 PAVEMENT DESIGN

5.3.1 DESING STRATEGY FOR UNIFORM SECTIONS

Section 1: Pre-treatments by cracksealing, asphalt surface and base repairs (including the use of geosynthetic fabric reinforcing material where required) as the distress manifestations require. Overlay with new 50mm AC wearing course with existing overpass bridge clearances retained.

Section 2: Concerning deep-seated founding problems and floodplain moisture management cannot be addressed in this emergency project. To limit the impact of road user discomfort, a fast-track solution is recommended to plane the existing surfacing, overlay the existing pavement with a series of asphaltic pavement layers to incrementally construct new pavement base and surfacing layers. The aim is to keep the road in operation, hence 50mm lifts are proposed. To mitigate (not entirely eliminate) the effect of the active subgrades (which will result in cracking of the overlay), the introduction of asphalt reinforcing interlayers (ARI) are proposed of which the resultant effect is estimated to extend the service life by 3 to 6 MESA (equivalent to a 6 to 7 year holding action).

Section 3: Pre-treatments by cracksealing, asphalt surface and base repairs (including the use of geosynthetic fabric reinforcing material where required) as the distress manifestations require. Overlay with new 50mm AC wearing course with existing overpass bridge clearances retained.

Section 0 was added to the project and the scope of work is expected to be similar to that of Section 1.

5.3.2 DEFINITION OF ACTIONS

Crack sealing:

Crack sealing using modified binder class C-R1 and shall be in accordance with the latest publication of TG1. Blowing out of cracks shall be by utilising a hot air lance and where required or so indicated by the Engineer, a vibratory steel-wheeled roller of between 2 to 4

tons mass with an adjustable amplitude and frequency of vibration shall be utilised to flatten out any ridges.

Asphalt Surface patching (Uniform sections 0, 1 & 3):

- Mill out 40mm
- Inlay 40mm AC (PG58H-22 (SBR), 14mm)
- Application of asphalt reinforcing paving grid (type 2) at the discretion of the Engineer.
- Final 50mm AC overlay (PG58H-22 (SBR), 14mm)
- 10mm rolled-in chips

Asphalt Base patching or structural patching (Uniform sections 0, 1 & 3):

- Mill out 190mm
- Inlay 150mm BTB (PG58H-22 (SBR), 20mm)
- Inlay 40mm AC (PG58H-22 (SBR), 14mm)
- Application of asphalt reinforcing paving grid (type 2) at the discretion of the Engineer
- Final 50mm AC overlay (PG58H-22 (SBR), 14mm)
- 10mm rolled-in chips

Large area pavement rehabilitation (Uniform Section 2):

- Plane existing surfacing
- Overlay 40mm AC levelling screed layer 1 (PG58H-22 (SBR), 14mm)
- Fibreglass asphalt reinforcement grid (type 2) layer 1
- Overlay 50mm AC layer 2 (PG58H-22 (SBR), 14mm)
- Fibreglass asphalt reinforcement grid layer (type 2) layer 2
- Overlay 50mm AC layer 3 (PG58H-22 (SBR), 14mm)
- Fibreglass asphalt reinforcement grid layer (type 2) layer 3
- Final Overlay 50mm AC layer 4 (PG58H-22 (SBR), 14mm)
- 10mm rolled-in chips

6 PART 6: MATERIAL USAGE, QUANTITIES AND REQUIREMENTS

6.1 MATERIAL SOURCES

Materials generated by the work:

- Asphalt millings, owned by the employer.
- Material excavated to complete patching.

Materials required for the work:

- Granular material for base patches (Stabilised to form a cemented layer).
- Asphalt materials for surface patches, base patches, base reconstruction and overlays.

Material sources and areas:

- All material will be obtained from commercial sources as per the contract document.
- AfriSam has a quarry north of the road section which should be able to provide most of the gravels and aggregates. The quarry is shown in Figure 6-1. Available material test results are presented in **Annexure 6.1**.
- The closest asphalt manufacturer is Much Asphalt located in Empangeni. This plant is roughly 1h40min away from site.

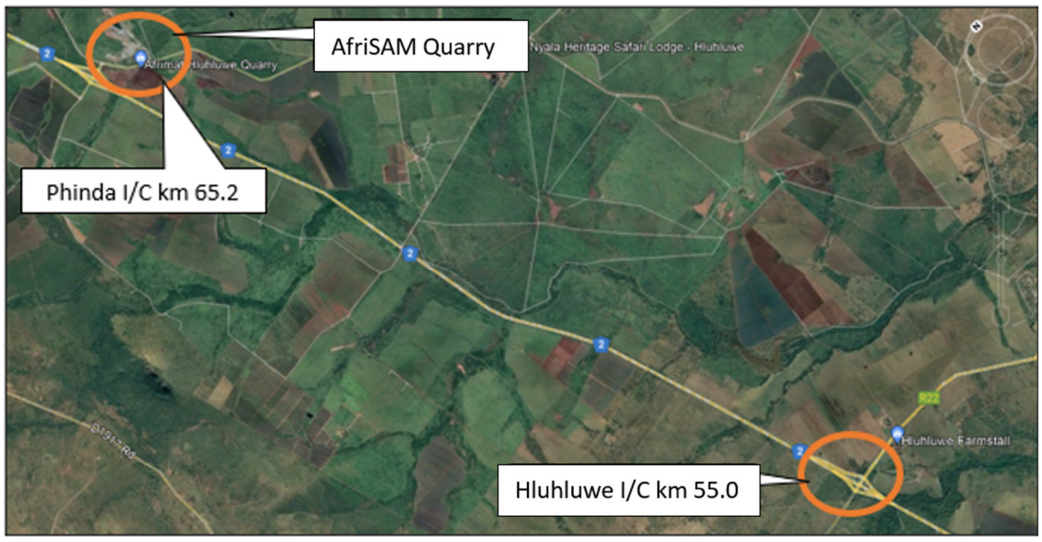


FIGURE 6-1: LOCATION OF AFRISAM QUARRY

6.2 WATER SOURCES

Existing water sources on site is limited and insufficient for construction. The contractor should source water from farmers in the region or consider obtaining municipal water sources in the nearest town.

6.3 STOCKPILING AND HAUL

Based on the land use in the area, limited space is available for stockpiling on site. Some environmental constraints do exist for land use for stockpiling and spoil purposes (wetland area). Stockpile and/or spoil sites in the vicinity to be confirmed which will require haul.

6.4 MATERIAL SPECIFICATIONS AND REQUIREMENTS

All materials specifications as described herein (refer Part 5), indicated on the drawings (**Volume 4**) as well as in the Schedule of Quantities (**Volume 3**) should be noted by the tenderer / contractor as no relaxation of standards shall be allowed after finalisation, appointment and during construction of the project.

It is further accepted that upon completion and submission of a tender bid, the tenderer / contractor is fully aware of further requirements, specifications and guidelines contained in the various documents referenced in all the volumes of the tender documentation.

6.5 MATERIAL QUANTITIES

All quantities regarding materials required for the project under consideration is clearly laid out in the Schedule of Quantities included in **Volume 3** of the tender documentation. No further reference to specific quantities is further included hereunder.

6.6 FURTHER INFORMATION

All further information related to the materials and material requirements are, inter alia included in the relevant drawings and in the project documentation. The contractor should ensure that he / she takes all requirements into consideration during pricing and programming of the project under consideration.

For information Purposes, Table 6-1 provides contact details for the AfriSam quarry.

The list of available materials is not exhaustive. For a comprehensive list of available materials, the suppliers should be contacted.

TABLE 6-1: MATERIAL SOURCES CLOSE TO HLUHLUWE

Supplier	Available Materials	Distance from Site	Contact Details
Afrimat Hluhluwe Aggregates	G1, G2, G4, G5, G6, G7 10 mm, 14 mm, 20 mm roadstones Crusher sand	11.00 – 14.00 km	Ngweni Road, Hluhluwe Tel: +27 83 658 5074 Email: info@afrimat.co.za Website:https://www.afrimat.co.za/ https://www.afrimat.co.za/

7 PART 7: GEOTECHNICAL INVESTIGATION

7.1 GENERAL DESCRIPTION

In considering the nature of the project (emergency repairs), a full geotechnical investigation has not been undertaken to assess the founding conditions for the road. Test pit excavations were conducted and were discussed under Section 4.6 of this report. A geotechnical report is included herewith (**refer to Annexure 7.1**) to aid the contractor / tenderer regarding geotechnical conditions to be encountered during construction of the project. Details of the reports are as follows:

- Contract NRA N002-300-2015/1 for Consulting Engineering Services for the Preliminary Design of the Upgrade of National Route 2, Section 30, 31 and 32, from Kangela (N2/30 km14.0) to Pongola (N2/32 Km 29.4): Preliminary Design Report (Rev0): Preliminary Geotechnical Design Report. Dated: August 2020. Prepared by: JG Africa

All recommendations / proposals related to the geotechnical conditions have been considered during the detail design phase of the project.

7.2 BOREHOLE DRILLING AND RELATED

Borehole drilling has been carried out in support of bridge foundation design. Although this contract does not contain the upgrading of bridge structures, the Geotechnical report (compiled by JG Africa) is included for information. The emergency repairs do not require the contractor to construct deep excavations into the natural material within the area, but he / she should be aware of the material conditions that they might encounter on site. The report compiled by JG Africa is contained in Annexure 7.1.

7.3 GEOLOGICAL CONDITIONS

Formations from the Lebombo Group contains basic and acidic lavas that formed along the eastern edges of Southern Africa. The Lebombo Group consist of Letaba and Jozini Formations.

The Letaba formation overlies the Clarens Formation with a disconformity that dips to the south-east, east and north-east at varying angles. The formations are built from a massive pile of basalt. The average thickness of basalt flows is approximately 5.5 m. Basalts are typically tholeiitic, occasionally fine grained and mineralogically similar to dolomites.

The upper layer of the Letaba Formation comprises of andesitic material which form a transition zone into the overlying acidic lavas of the Jozini Formation.

The geological map of the project area is presented in Figure 7-1 with the legend to the map presented in Figure 7-2.

Basalt is a fast-weathering rock and could pose long term durability problems. As well as possible slope stability problems. Weathering is mainly through decomposition due to being in a wet macro climatic region (N < 2). Weathering of basalt in less mountainous areas normally results in active residual soils which consists mainly of montmorillonite clay.

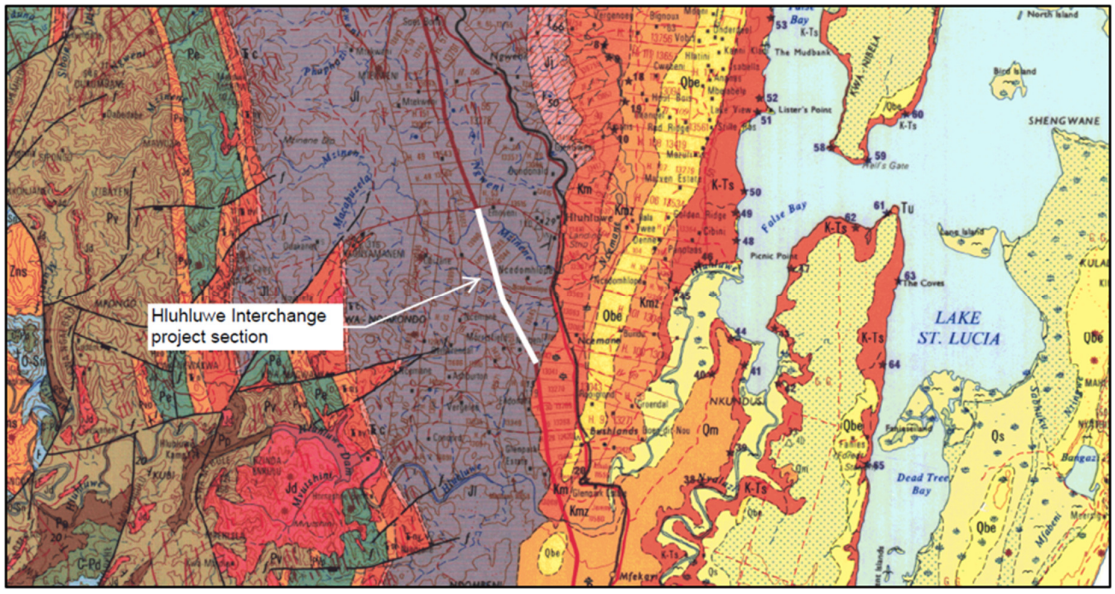


FIGURE 7-1: ROCK FORMATIONS OF THE STRATIGRAPHIC SYSTEMS/COMPLEXES UNDERLYING THE PROJECT SYSTEM

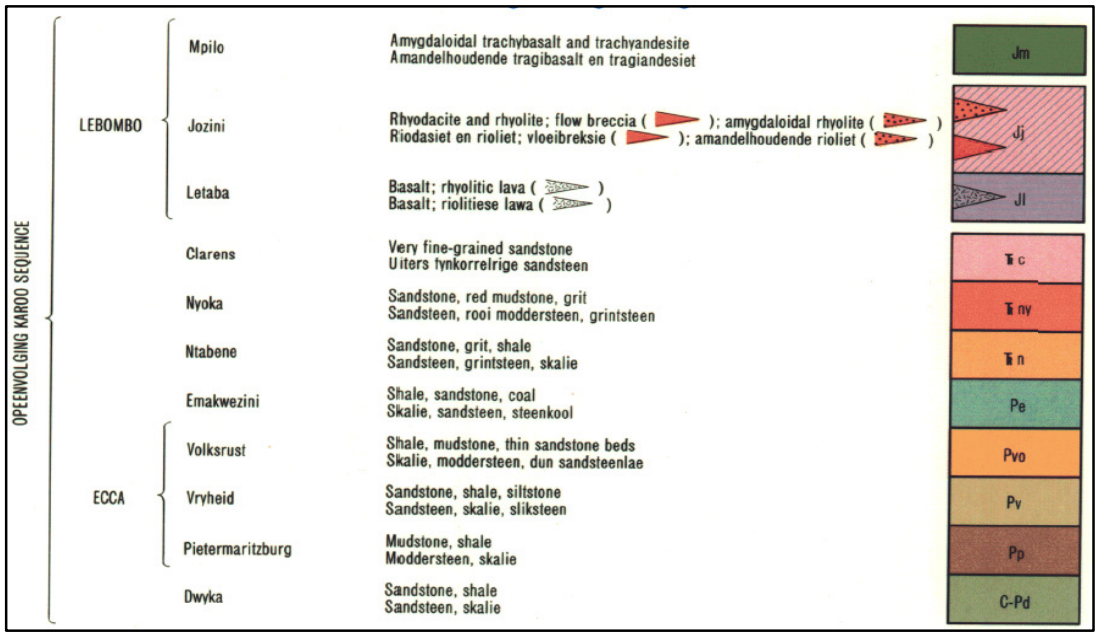


FIGURE 7-2: LEGEND TO ROCK FORMATIONS OF THE STRATIGRAPHIC SYSTEMS/COMPLEXES UNDERLYING THE PROJECT SYSTEM

7.4 RELATED CONCLUSION

The geotechnical reports included herein cover geological and foundation conditions, and other related aspects of the project. The associated design considerations have been incorporated into the drawings, quantified accordingly, and are further detailed in the Project Documents (**Volume 3**).

8 PART 8: TRAFFIC ACCOMMODATION

8.1 GENERAL

The existing road section comprises an undivided single carriageway with one 3.7 m lane in each direction and a 2.5 m surfaced shoulder with a gravel shoulder on either side, as measured during the visual assessment of the road section.

During construction, accommodation of traffic shall be in accordance with the latest SADC Road Traffic Signs Manual and approved SANRAL standards.

General safety to the public and reduction in delays is of utmost importance.

Reference should be made to:

- The detailed traffic accommodation drawings contained in **Volume 4.**
- Project Specifications in Book 3, **Volume 3.**
- Description of the works in Book 3, **Volume 3.**

8.2 ONSTRUCTION LINITATIONS

Accommodation of traffic will be managed through half/Partial width construction during nightime from 18:00 to 6:00.

The works shall be limited to two (2) temporary lane road closures at any time. (Half or Partial width construction only allowed for nightwork between 18:00 and 6:00)

A lane closure of 1 km will be allowed where one way traffic is managed using stop-go control. (Night work only, 18:00 to 6:00)

A shoulder closure of 2.5 km long will be allowed on sections where two-way traffic can be maintained. (Day work 6:00 to 18:00)

Half or partial width sections shall be separated by a minimum of three kilometres (3.0 km) of unrestricted full width road section.

Temporary road closures with stop-go control shall account for all major intersections with stop-go control provided at the intersection within the closure along the route.

8.3 TYPICAL LAYOUTS

Typical half width traffic accommodation layout shown in Figure 8-1.

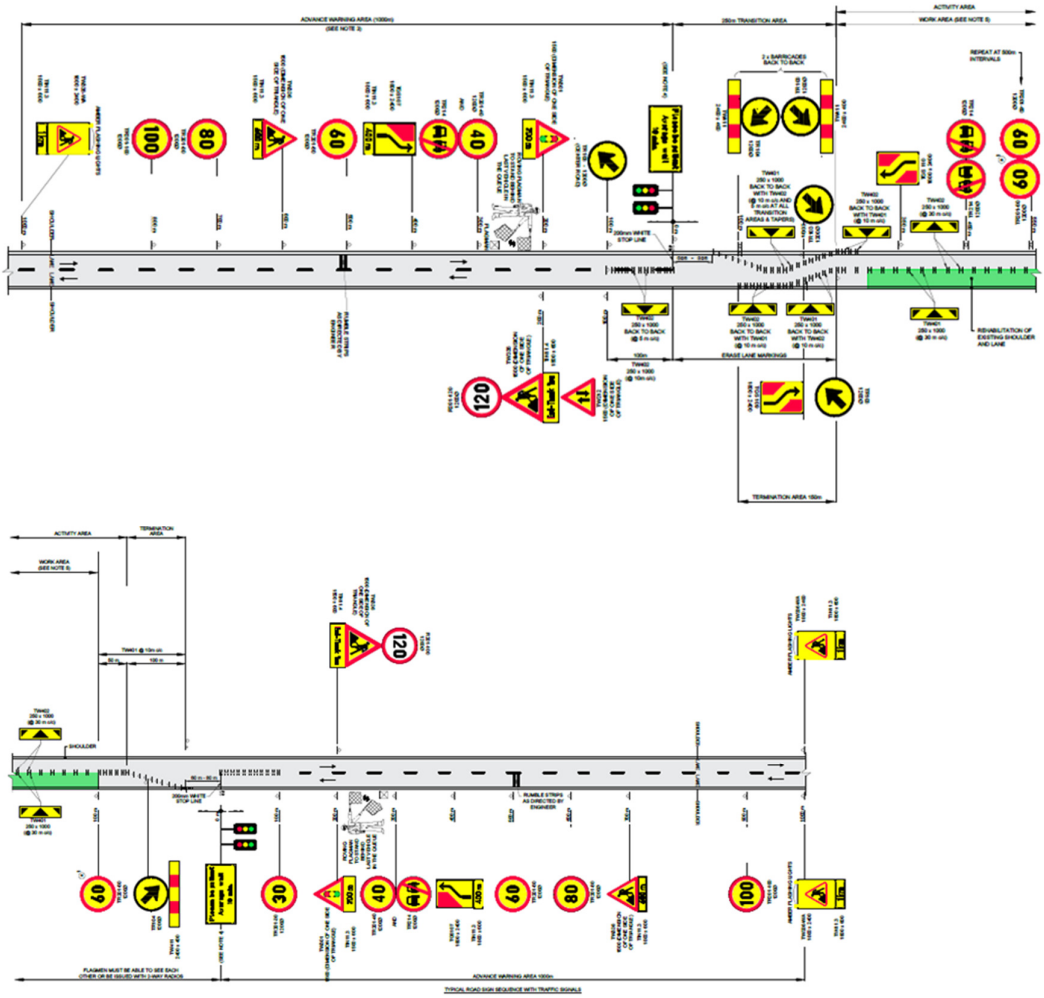


FIGURE 8-1: TYPICAL LAYOUT OF TRAFFIC ACCOMMODATION

Typical traffic accommodation layout at ramps shown in Figure 8-2:

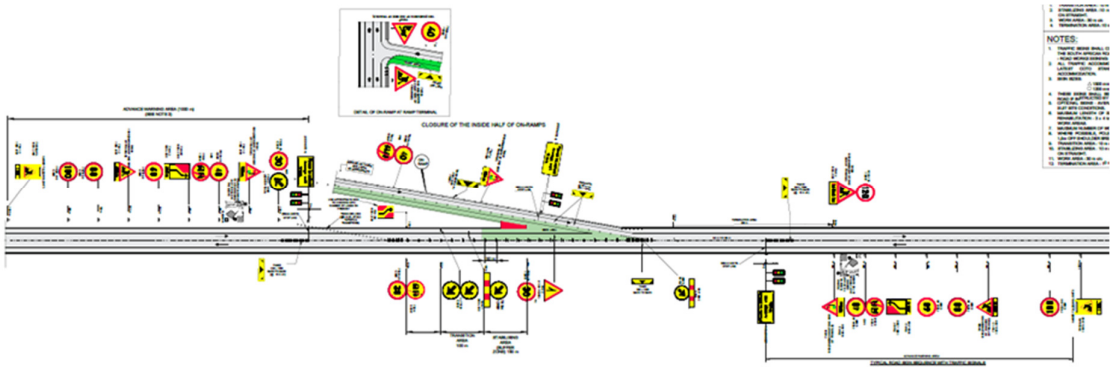


FIGURE 8-2: TYPICAL LAYOUT OF TRAFFIC ACCOMMODATION AT RAMPS

Typical traffic accommodation layout for shoulder closures shown in Figure 8-3.

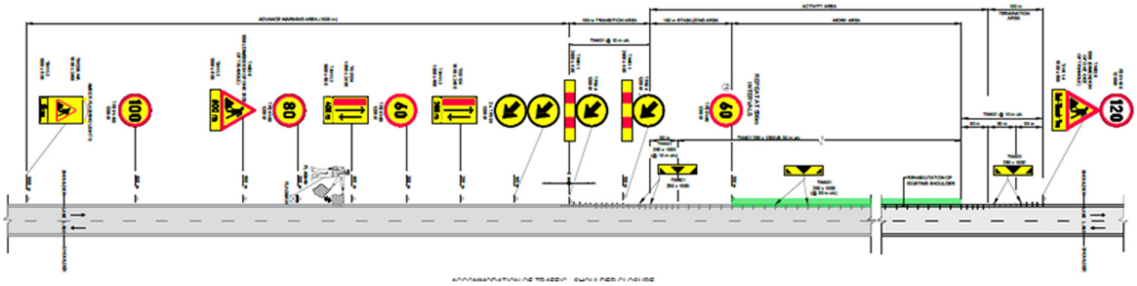


FIGURE 8-3: TYPICAL LAYOUT OF SHOULDER CLOSURE

9 PART 9: FINAL COMMENTS RELATED TO VOLUME 6

9.1 GENERAL

This volume contains all pavement and materials related test results, descriptions and related comments for the project under consideration. All information is supplied to the contractor in good faith for him to assess the nature of the project, as well as material availability and requirements, as to submit a compliant and justified tender for the project.

The contractor should assess all information contained herein in order to form his own opinion as to the nature and requirements of the project – also in line with the performance and client related requirements as clearly stipulated in the contract documentation.

Further information such as descriptions of drainage and structures, ancillary works, roadside furniture requirements, geometric features and the like are contained in the accompanying project documentation and as such are not repeated in this volume.

All further information related to the materials and material requirements are inter alia included on the relevant drawings and in the project documentation. The contractor shall ensure that he / she takes all requirements into consideration during pricing and programming of the project under consideration as to fulfil the contractual obligations as contained in the contract and the specifications.

ANNEXURES

ANNEXURE 4.1

ANNEXURE 4.2

ANNEXURE 6.1

ANNEXURE 7.1