



**Final 2026/2027
Integrated
Development Plan
(IDP) Review**

**Annexure P: Midvaal
Roads and
Stormwater Master
Plan 2024**



DEVELOPMENT BANK OF SOUTHERN AFRICA CONTRACT NO.: RFP 355/2022

Development of the Roads and Stormwater Master
Plan (RSWMP) of **Midvaal Local Municipality**

ROADS AND STORMWATER MASTER PLAN

FINAL SUBMISSION: NOVEMBER 2024

CLIENT 	SPONSOR 	CONSULTANT (PSP) 
Address:		
Midvaal Local Municipality 25 Mitchell Street Meyerton 1960	1258 Lever Road Headway Hill MIDRAND 1685	P.O. Box Germiston South 1411
Contact Details:		
Contact: Ms. K. Ngcane Tel. No.: (016) 360 5869 Email: KagisoN@midvaal.gov.za Website: www.midvaal.gov.za	Contact: Ms. C. Shongwe Tel. No.: (011) 313 3851 Email: ChantyleS2@dbsa.org Website: www.dbsa.org	Contact: Mr. M. Jansen / Mr. T.F. Prinsloo Tel. No.: (011) 873 – 8126/7 Email: infraconsult@infraconsult.co.za / thomasp@infraconsult.co.za Website: www.infraconsult.co.za

TABLE OF CONTENTS

CHAPTER A : EXECUTIVE SUMMARY	6
A.1 INTRODUCTION	6
A.2 BACKGROUND.....	6
A.3 STAKEHOLDER CONSULTATIONS	6
A.4 ENGAGEMENT WITH MLM AND ESTABLISHING OF A PROJECT STEERING COMMITTEE (PSC)	7
CHAPTER B : GENERAL	8
B.1 INTRODUCTION	8
B.2 GOALS	11
B.3 OBJECTIVES	11
B.4 KEY PHYSICAL FEATURES i.t.o ROADS AND STORMWATER.....	11
B.4.1 Stormwater	11
B.4.1.1 Main Rivers.....	11
B.4.1.2 Existing Bridges	13
B.4.1.3 Existing Stormwater Infrastructure	13
B.4.2 Roads.....	15
B.4.3 Area of Investigation.....	17
B.5 ENGAGEMENT OF STAKEHOLDERS.....	18
B.6 DATABASE & GRAPHICAL DATA FROM GIS	18
B.6.1 GIS: Stormwater	18
B.6.2 GIS: Roads	19
B.7 MUNICIPAL DOCUMENTS OBTAINED AND REVIEWED.	20
CHAPTER C : EXISTING SITUATION ASSESSMENT	21
C.1 Assessment of the Existing Stormwater Infrastructure	22
C.1.1 Description of Existing Urban & Rural Stormwater Infrastructure.....	22
C.1.2 Site Inspections of Existing Urban & Rural Stormwater Infrastructure.....	22
C.1.2.1 None to Basic Existing Stormwater Infrastructure (Criteria No. 3)	23
C.1.2.2 Maintenance and Insufficient Stormwater Design Leading to Failure of Roads and Stormwater Infrastructure. (Criteria No. 2 and No. 4).....	25
C.1.2.3 Critical (Life Threatening) Infrastructure, either Roads or Stormwater (Criteria No. 1)	27
C.2 Site Inspections Rural Stormwater and Bridges	31
C.3 Assessment of the Existing Roads Situation	32
C.3.1 Description of Existing Road Network	32
C.3.1.1 PROVINCIAL ROADS AND DISTRICT ROADS:	33
C.3.1.2 MUNICIPAL ROADS.....	33
C.4 Assessment of Existing Road Backlogs	36
C.4.1 Urban Asphalt Roads.....	36
C.4.2 Site Inspections Urban Roads	37
C.4.3 Rural/Farm Portion gravel roads.....	39
C.5 SUMMARY OF FINDINGS DURING EXISTING SITUATION ASSESSMENT	41
C.5.1 Stormwater	41
C.5.2 Roads.....	42
CHAPTER D : FUTURE DEMAND ASSESSMENT (ROADS).....	43
D.1 INTRODUCTION	43
D.2 FUNCTIONAL CLASSIFICATION OF EXISTING & FUTURE ROAD NETWORKS.....	43
D.3 EXISTING TRAFFIC DEMAND & TRAFFIC PATTERNS	47
D.3.1 Available Traffic Data	47
D.3.2 Traffic Patterns & Public Transport Usage.....	48
D.4 TRANSPORTATION MODEL	51

D.4.1	Model Requirements	51
D.4.1.1	Demographic and Socio-Economic Data	52
D.4.1.2	Transport Network Data	52
D.4.1.3	Travel Behaviour Data	52
D.4.2	Transport Model	53
D.4.2.1	Trip Generation	53
D.4.2.2	Trip Distribution	53
D.4.2.3	Intermodal Model (Transport Mode Choice).....	54
D.4.2.4	Trip Assignment	55
D.4.3	Constraints	55
D.4.3.1	Data Availability and Quality	55
D.4.3.2	Resource Constraints	55
D.4.3.3	Stakeholder Collaboration	55
D.4.3.4	Public Perception and Participation.....	56
D.4.4	Proposed Alternative to Transport Model.....	56
D.5	FACTORS CONSIDERED TO DETERMINE FUTURE DEMAND	56
D.5.1	Population Growth and Demographics	56
D.5.2	Vehicle Modal Split	57
D.5.3	Historic Traffic Data Comparison	58
D.6	DETERMINATION OF STATUS QUO & FUTURE TRAFFIC DEMAND	58
D.6.1	Status Quo Traffic Demand Model	58
D.6.2	Future Traffic Demand Model.....	61
D.6.3	Road Network Changes	62
D.7	ROAD & INTERSECTION CAPACITY ANALYSIS	66
D.7.1	Road R82 & Dan Pienaar Road Intersection	68
D.7.2	Hartzenbergfontein Road & Loes Road Intersection	69
D.7.3	Main Street & 4 th Street Intersection	70
D.7.4	Road R82 & Du Plessis Street Intersection	71
D.7.5	Road R82 & Boundary Road Intersection	72
D.7.6	Joan Road & Elizabeth Road Intersection	73
D.7.7	Randvaal Road & Malcolm Road Intersection	74
D.7.8	Johan Le Roux Road & Gourlay Street Intersection	75
D.7.9	Springbok Road & Meyer Road.....	76
D.7.10	Meyer Road & Joubert Street Intersection.....	77
D.7.11	Road R551 & Morris Road Intersection	78
D.7.12	Pierneef BLVD & Viljoen Avenue Intersection	79
D.7.13	Johan Le Roux Road & Galloway Street Intersection.....	80
D.7.14	Pierneef Blvd & Mimosa Drive Intersection	81
D.7.15	Pierneef Blvd & Reitz Street Intersection	82
D.7.16	Pierneef Blvd & Jim Fouche Road Intersection	83
D.7.17	Henley Road & Cleeve Road Intersection	84
D.7.18	Road R551 & Ewelme Road Intersection	85
D.7.19	Jim Fouche Road & Uitvlugt Road Intersection	86
D.7.20	Anchovy Road & Garfish Road Intersection.....	87
D.7.21	Possible Intersection Upgrades.....	88
D.8	PROJECT IDENTIFICATION & PRIORITIZATION	89
D.9	CONCLUSION AND RECOMMENDATIONS	90
D.9.1	Future Traffic Volume Forecast	90

CHAPTER E : FUTURE DEMAND ASSESSMENT (STORMWATER)	91
E.1	STORMWATER 91
E.1.1	General.....91
E.1.2	Purpose of Stormwater Management 91
E.1.3	Stormwater Infrastructure 91
E.1.3.1	Current Infrastructure Within Urban and Rural Area’s 91
E.1.4	Proposed Stormwater Infrastructure 97
E.1.4.1	Proposed Urban Stormwater Infrastructure 97
E.1.4.2	Pipe.....103
E.1.4.3	Peak Flow Attenuation.....104
E.1.4.4	Design of Attenuation Dam / Reservoir 104
E.1.4.5	Design of Open Attenuation Pond 104
E.2	RURAL STORMWATER INFRASTRUCTURE DESIGN 105
E.2.1	Proposed Culverts 107
E.2.2	Proposed Road Drainage Channels.....107
E.2.3	Proposed Discharge Point 108
E.3	STORMWATER QUALITY CONSIDERATIONS 109
E.3.1	Protection of Rivers.....109
E.3.2	Water Quality Volume 109
E.4	CONCLUSION 109
CHAPTER F : FUTURE DEMAND ASSESSMENT (FLOODLINES)	110
F.1	INTRODUCTION 110
F.2	BACKGROUND.....110
F.3	LEGAL REQUIREMENTS.....111
F.4	REGIONAL FLOODLINE DETERMINATION 112
F.4.1	Catchment and Sub-Catchment Delineation 112
F.4.2	Peak Flow Estimation Using Regional Maximum Flood Study Method.....113
F.4.3	Estimation of 50 Year To 200 Year Flood Peaks from RMF 114
F.4.4	Example of a RMF calculation 115
F.4.5	HECRAS Software Modelling.....116
F.4.6	Floodlines 117
F.4.7	Cross Section Overlay.....118
F.5	TOWNSHIP (VILLAGE) FLOODLINE DETERMINATION 119
F.5.1.1	Site Visits 119
F.5.1.2	Catchment Characteristics 119
F.5.1.3	Impact of Development on Natural Drainage Systems 119
F.6	CONCLUSIONS.....120
F.7	RECOMMENDATIONS 121
CHAPTER G : INSTITUTIONAL ARRANGEMENTS AND REQUIRED AUTHORIZATIONS	122
G.1	INTRODUCTION 122
G.1.1	Institutional Arrangements.....122
G.1.1.1	Project Steering Committee.....122
G.1.1.2	Supporting Agencies 122
G.1.1.3	Stakeholder Engagements 123
G.1.1.4	Coordination Bodies.....123
G.2	REQUIRED AUTHORIZATIONS 123
G.2.1	Environmental Impact Assessment (EIA) 123
G.2.2	Land Use and Zoning Approvals.....124
G.2.3	Road Construction Permits 124

G.2.4	Stormwater and Drainage Permits	124
G.2.5	Utility and Infrastructure Permits	124
G.2.6	Health and Safety Regulations	124
G.2.7	Public Consultation and Transparency	124
G.2.8	Public Private Partnerships Approvals	125
G.2.9	Other Considerations	125
G.3	CONCLUSION	125
CHAPTER H : PROJECT PRIORITIZATION AND COST ESTIMATES	126	
H.1	PROJECT IDENTIFICATION & PRIORITIZATION	126
H.1.1	Possible Projects From Site Visits (Road Links)	126
H.1.2	Possible Projects Based On Traffic Analyses	128
H.1.3	Possible Projects From Basic Road Model	129
H.1.4	Future Projects From SDF & Precinct Plans	129
H.1.5	General Projects	131
H.1.5.1	Transfer of Road Jurisdiction from Gautrans to Midvaal Local Municipality	131
H.1.5.2	Improving Road Safety	131
H.1.6	Summary and Priority of Projects	131
H.1.7	General Projects / Maintenance Projects (Gravel and Surfaced Roads)	140
H.1.7.1	Priority 1	140
H.1.7.2	Priority 2	140
H.1.7.3	Priority 3	140
H.1.7.4	Using GIS to Identify Priority Gravel and Surfaced Roads	145
H.1.7.5	Cost Estimate Assumptions and Rates (Gravel and Surface Roads)	148
H.1.7.6	Cost Estimate Assumptions and Rates (Surface Re-Seal Roads)	152
H.1.7.7	Cost Estimates Priority 1 Gravel Road Reshaping, Grave to Surface and Surface Including Stormwater Master Sheet	155
H.1.7.8	Cost Estimates Priority 2 Gravel Road Reshaping, Grave to Surface and Surface Including Stormwater Master Sheet	156
H.1.7.9	Cost Estimates Priority 3 Gravel Road Reshaping, Grave to Surface and Surface Including Stormwater Master Sheet	157
H.1.7.10	Cost Estimates Priority 4 Gravel Road Reshaping, Grave to Surface and Surface Including Stormwater Master Sheet	158
H.1.7.11	Cost Estimates Priority 1,2,3 and 4 Surface to Re-Seal Road Including Stormwater Master Sheet	159
H.1.8	Midvaal Local Municipality Refined Priority Projects List per Ward	161
H.1.8.1	Conclusion Urban Surfaced Roads and Stormwater Projects	165
H.1.8.2	Conclusion Urban Surfaced Roads and Stormwater Projects	165
CHAPTER I : FUNDING AND IMPLEMENTATION ARRANGEMENTS	166	
I.1	MUNICIPAL REVENUE	166
I.2	REVENUE RAISING STRATEGIES	167
I.3	CAPITAL FINANCING STRATEGIES AND PROGRAMMES	167
I.4	EXPLANATORY MEMORANDUM TO THE ALLOCATIONS SET OUT IN THE ATTACHED SCHEDULE 168	
I.5	STOPPING AND RE-ALLOCATION: SCHEDULE 4B AND 5B (DIRECT)	168
I.6	MIDVAAL LOCAL MUNICIPALITY CAPITAL EXPENDITURE AND FUNDING	168
I.7	CAPITAL EXPENDITURE	169
I.7.1.1	Analysis of capital expenditure	169
I.7.1.2	Capital Expenditure Funding	169
I.8	Challenges faced by municipalities	169
I.9	CAPITAL FUNDING SOURCES	170

I.10	POSSIBLE GRANT FUNDING AND BORROWING	171
I.10.1.1	How to apply	172
I.10.1.2	How to apply	173
I.11	Network Infrastructure Component.....	173
I.11.1.1	How to apply	174
I.11.1.2	Process for approval of business plans	174
I.12	Budget Facility for Infrastructure (BFI)	174
I.12.1.1	What Is The Budget Facility For Infrastructure (BFI)?.....	175
I.12.1.2	Budget Facility For Infrastructure Process Flow	175
I.12.1.3	Budget Facility For Infrastructure Analytical Process	176
I.12.1.4	Requirements for Submission	176
I.12.1.5	Criteria To Be Considered In The Submission Of Proposals.....	177
I.12.1.6	Format of submission.....	178
I.12.1.7	Common Reasons Why Submissions Fail To Meet The BFI Appraisal Requirements	178
I.13	CONCLUSION:	179
I.14	CONCLUSION: CAPITAL BUDGET	179
I.15	MIDVAAL LOCAL MUNICIPALITY OPERATING BUDGET	179
I.16	OPERATING EXPENDITURE	179
I.17	OPERATING REVENUE.....	180
I.18	MIDVAAL LOCAL MUNICIPALITY PROJECTED BUDGET (AS PER RSWMP)	181
I.19	RECOMMENDATIONS AND WAY FORWARD	181
I.19.1.1	STRATEGIC RECOMMENDATIONS.....	181
I.20	SUMMARY AND FURTHER RECOMMENDATIONS	183
I.21	FUNDING POSSIBILITIES FOR PROCUREMENT OF PLANT	184
I.22	LOAN REPAYMENT ANALYSIS	184
I.23	LOCAL GOVERNMENT BUDGETS AND EXPENDITURE REVIEW	185
I.24	Municipal expenditure on road infrastructure and maintenance	185
I.25	Policy and funding developments in the roads sector	185
CHAPTER J	: REGISTRATION OF MIG PROJECTS	187
J.1	INTRODUCTION	187
J.2	RECOMMENDATION	189
CHAPTER K	OPERATIONS AND MAINTENANCE PLAN	190
K.1	INTRODUCTION	190
K.2	SCOPE OF THE MAINTENANCE PLAN.....	190
K.3	ROADS MAINTENANCE PLAN IMPLEMENTATION STRATEGY.....	190
K.3.1	Introduction	190
K.3.2	Road Maintenance Types.....	190
K.3.3	Community Awareness and Road Maintenance.....	191
K.3.4	Road Maintenance Legislative Requirements	191
K.3.5	Successful Implementation of a Routine Road Maintenance Plan.....	192
K.3.5.1	Current Maintenance Situation	192
K.3.5.2	Inspections	193
K.3.5.3	Complaints	195
K.3.5.4	Emergency Works	196
K.3.5.5	Responsive Maintenance (Gravel Roads)	196
K.3.6	Successful Implementation of a Routine Stormwater Maintenance Plan.....	196
K.3.6.1	Introduction	196
K.3.6.2	Understanding the Status Quo of Midvaal LM	196
K.3.6.3	Stormwater Infrastructure inspections.....	196
K.3.6.4	Emergency Works	198

K.3.6.5	Complaints	198
CHAPTER L	IMPLEMENTING A PAVEMENT MANAGEMENT SYSTEM (PMS)	199
L.1	INTRODUCTION TO PMS.....	199
L.2	PMS AS PART OF A ROAD MANAGEMENT SYSTEM (RMS).....	199
L.3	RMS SUBSYSTEMS	200
L.4	DEFINITION OF PMS.....	200
L.5	PMS COMPONENTS	200
L.5.1	PMS Road Inventory.....	200
L.5.1.1	Segment Lengths.....	201
L.5.2	Implementing Pavement Condition Surveys	202
L.5.2.1	Procedure for pavement visual assessment	202
L.5.2.2	Training of Pavement Visual Assessors.....	203
L.5.2.3	Accreditation of Pavement Visual Assessors and Assistants	203
L.5.2.4	Procedures to be followed during Pavement Visual Assessments.....	204
L.5.2.5	Equipment and Inventory to be Used During Pavement Visual Assessment	204
L.5.2.6	Visual Assessment of Flexible Pavements	205
L.5.2.7	Visual Assessment of Unpaved Roads	210
L.5.3	Database for recording all related pavement information.	212
L.6	CONCLUSION OF PMS/RMS TO BE IMPLEMENTED	212
L.7	RECOMMENDED FUTURE ROAD DESIGN GUIDELINES	212
L.7.1	Layerworks	212
L.7.2	RECOMMENDED PAVEMENT GEOMETRY.....	213
L.7.2.1	Standards	213
L.7.2.2	Road Width	213
L.7.2.3	Crossfall.....	214
L.7.2.4	Vertical Alignment.....	214
L.7.2.5	Kerbing	214
L.7.2.6	Stormwater Drainage.....	214
L.7.2.7	PROPOSED BRIDGES.....	215
CHAPTER M	RISK MANAGEMENT	216
M.1	RISKS AND RISK MITIGATION.....	216
M.2	FUTURE AND CURRENT RISK MANAGEMENT MATRIX.....	216

LIST OF ANNEXURES

ANNEXURE A: FUNCTIONAL ROAD CLASSIFICATION	219
ANNEXURE B: EXTRACT FROM MIDVAAL LOCAL MUNICIPALITY SDF	220
ANNEXURE C: TRAFFIC DATA USED FOR TRAFFIC GROWTH	221
ANNEXURE D: BASIC ROAD MODEL (2024 CATEGORIZATION BASED ON TRAFFIC DATA).....	222
ANNEXURE E: BASIC ROAD MODEL (2044 CATEGORIZATION BASED ON TRAFFIC DATA)	223
ANNEXURE F: TRAFFIC MODEL FORECAST DATA.....	224
ANNEXURE G: LOCALITY PLAN FOR ANALYSED KEY INTERSECTIONS	225
ANNEXURE H: RESULTS OF THE PTV VISTRO INTERSECTION CAPACITY ANALYSES	226
ANNEXURE I: TYPICAL ROAD SECTION OF LAYER WORKS	227
ANNEXURE J: AERIAL VIEW: CARINA ROAD / HIBISCUS ROAD UPGRADE	228
ANNEXURE K: AERIAL VIEW: ROAD K154 ROAD UPGRADE BETWEEN WATERVAL 7 WALKERVILLE	229
ANNEXURE L: AERIAL VIEW: SOUTH ROAD & JUDE STREET ROAD UPGRADE IN SICELLO	230
ANNEXURE M: AERIAL VIEW: ORDON ROAD & EATON ROAD UPGRADE IN HENLEY-ON-KLIP	231
ANNEXURE N: AERIAL VIEW: ROAD D478 UPGRADE NEAR RUSOORD SECONDARY SCHOOL	232
ANNEXURE O: FLOODLINES	233
ANNEXURE P: MIDVAAL LOCAL MUNICIPALITY MASTER COST ESTIMATES.....	234
ANNEXURE Q: MIDVAAL LOCAL MUNICIPALITY MAPBOOK	235

LIST OF TABLES

Table 1 : Midvaal LM Spatial Elements	9
Table 2: Sedibeng Nodal Classifications.....	18
Table 3: Functional Road Classification System.....	44
Table 4: Legend Classification for Functional Roads.....	45
Table 5: Vehicle Model Split from Various Datasets	49
Table 6: 2011 vs 2022 Census Data Comparison for Midvaal Local Municipality	56
Table 7: Estimated Vehicle Modal Split in Midvaal Municipality	57
Table 8: Road Categorization Used for Network Model (Based on AADT).....	58
Table 9: Possible Capacity Upgrades at Analysed Intersections.....	88
Table 10: River Type and Location	110
Table 11 : Catchment Area of Midvaal LM	113
Table 12: Calculated Floodline Results	117
Table 13 : HECRAS Model Main Parameters.....	117
Table 14: Hydrological Soil Type	120
Table 15: Meyerton CBD Upgrades from Precinct Plans	129
Table 16: Henley on Klip Upgrades from Precinct Plans.....	130
Table 17: Sicelo Updates from Precinct Plans	131
Table 18: Costing Summary and Priority of Identified Projects.....	132
Table 19: WARDS Landmarks and Street Names.....	141
Table 20: Generic Rate - Gravel Road Refurbishment - Various Widths of Roads	149
Table 21: Concrete Steep Road Segment - Varying Road Widths - Generic Cost Estimate.....	150
Table 22: Asphalt Road Construction / Refurbishment - Generic Rates - Residential A1 with Complete BoQ Items	150
Table 23: Asphalt Road Construction / Refurbishment - Generic Rates - Residential A2 - A5.....	151
Table 24: Generic Collector Asphalt Road - Rates/m	151
Table 25: Generic Arterial Asphalt Road - Rates/m.....	151
Table 26: Generic Industrial / Business Asphalt Road - Rates/m	152
Table 27: Generic Surface Re-Seal Roads - Rates/m.....	152
Table 28: Priority 1 Gravel Re-Shaping Cost Estimate	155
Table 29: Priority 1 Gravel to Surface Master Cost Estimate	155
Table 30: Priority 1 Culverts Master Cost Estimate	155
Table 31: Priority 2 Gravel Re-Shaping Master Cost Estimate.....	156
Table 32: Priority 2 Gravel to Surfaced Master Cost Estimate	156
Table 33: Priority 2 Culverts Master Cost Estimate	156
Table 34: Priority 3 Gravel Re-Shaping Master Cost Estimate.....	157
Table 35: Priority 3 Gravel to Surfaced Master Cost Estimate	157
Table 36: Priority 3 Culverts Master Cost Estimate	157
Table 37: Priority 4 Gravel Re-Shaping Master Cost Estimate.....	158
Table 38: Priority 4 Gravel to Surfaced Master Cost Estimate	158
Table 39: Priority 4 Culverts Master Cost Estimate	158
Table 40: Priority 1 Surfaced to Re-Seal Master Cost Estimate.....	159
Table 41: Priority 2 Surfaced to Re-Seal Master Cost Estimates	159
Table 42: Priority 3 Surfaced to Re-Seal Master Cost Estimate.....	159
Table 43: Priority 4 Surfaced to Re-Seal Master Cost Estimate.....	160
Table 44: Ward 1 Refined Priority Projects.....	161
Table 45: Ward 2 Refined Priority Projects.....	161
Table 46: Ward 3 Refined Priority Projects.....	161
Table 47: Ward 4 Refined Priority Projects.....	162
Table 48: Ward 5 Refined Priority Projects.....	162

Table 49: Ward 6 Refined Priority Projects.....	162
Table 50: Ward 7 Refined Priority Projects.....	163
Table 51: Ward 8 Refined Priority Projects.....	163
Table 52: Ward 9 Refined Priority Projects.....	163
Table 53: Ward 10 Refined Priority Projects.....	163
Table 54: Ward 11 Refined Priority Projects.....	164
Table 55: Ward 12 Refined Priority Projects.....	164
Table 56: Ward 13 Refined Priority Projects.....	164
Table 57: Ward 14 Refined Priority Projects.....	164
Table 58: Ward 15 Refined Priority Projects.....	164
Table 59: Midvaal Local Municipality Capital Budget	169
Table 60: Midvaal Local Municipality Current Plant List	193
Table 61 : Priorities vs Response Times	194
Table 62 : Complaints Register Template	196
Table 63 : Stormwater System - Frequency of Inspections	197
Table 64: PMS Road Inventory items.....	201
Table 65: Segment Lengths for Different Road Pavement Types	202
Table 66: Basic Pavement Visual Assessment Equipment.....	205
Table 67: TRH 14 Codes for Different Surfacing Types	205
Table 68: Proposed Road Layerworks.....	213
Table 69: Recommended and Existing Lane Widths.....	214
Table 70: Tabulated Risk Management Matrix.....	216

LIST OF CHARTS

Chart A: Distribution of Road Categories	61
Chart B: Link Road Category Distribution for each Year Period (Gautrans Data Only)	62
Chart C: Road Network Existing and Future Categorization.....	64

LIST OF DRAWINGS

Drawing 1: Midvaal Local Municipality Functional Road Classification	46
Drawing 2: Midvaal Local Municipality Basic Road Model 2024	60
Drawing 3: Midvaal Local Municipality Basic Road Model 2044	65
Drawing 4: Extraction from Vaal Marina Urban Stormwater Infrastructure (Very Minimal to No Stormwater Infrastructure)	93
Drawing 5: Extraction from Sicelo Urban and Rural Stormwater Infrastructure (Very Minimal to No Stormwater Infrastructure)	94
Drawing 6: Extraction from Sicelo Urban Stormwater Infrastructure (Very Minimal to No Stormwater Infrastructure)	95
Drawing 7: Extraction from Meyerton Urban Stormwater Infrastructure (Very Minimal to No Stormwater Infrastructure)	96
Drawing 8: Extraction from Stormwater Provision Recommended in Urban Areas	98
Drawing 9: Extraction from Stormwater Provision Recommended in Urban Areas	99
Drawing 10: Extraction from Stormwater Provision Recommended Major System in Urban Areas.....	100
Drawing 11: Extraction from Stormwater Provision Recommended in Urban and Rural Areas.....	106
Drawing 12: Possible Road to be Upgraded Hibiscus Road	135
Drawing 13: Proposed Link Upgrade Alignment of K154	136
Drawing 14: Possible Road to be Upgraded Road D478.....	137
Drawing 15: Possible Road Upgrades (Eaton and Gordon Road)	138
Drawing 16: Possible Road Upgrades for New Developments	139

LIST OF FLOODLINE LAYOUT

Floodline Layout 1: Ward 5 Properties within Floodlines	121
---	-----

LIST OF PRIORITY PROJECTS

Priority 1: WARD 6 Lakeside Stormwater Open Channel/Culvert System	187
Priority 2: WARD 14 Meyerton Intersection at DR Malan High School	188
Priority 3: WARD 1 VAAL MARINA Entrance Road Upgrade.....	189

LIST OF FIGURES

Figure 1: Sedibeng District Municipality and its surrounding Local Municipalities.....	8
Figure 2: Midvaal Local Municipality and the 15 Wards it consists of	9
Figure 3: Midvaal LM - Main Transport Corridors and Railways	10
Figure 4: Perennial Rivers in Midvaal LM.....	12
Figure 5: Catchments and Sub Catchments for Midvaal LM	13
Figure 6: Stormwater Assets in the Meyerton CBD and Surroundings	14
Figure 7: Provincial Development Corridors in Midvaal LM	15
Figure 8: Midvaal LM District Roads or Tertiary Roads	16
Figure 9: Sample of Municipal Roads in Midvaal LM (Meyerton CBD).....	17
Figure 10: Midvaal LM and the 15 Wards consist of	17
Figure 11 : Photos taken during the site visit period at a 1-second interval.....	21
Figure 12 : Lack of Kerb inlet repair leading to stormwater not effectively conveyed from road surface.	23
Figure 13 : Unlined SW Channel not maintained regularly Blocking Stormwater flow.	24
Figure 14 : Kerb inlet not raised when asphalt overlaying was done in the past.....	24
Figure 15 : Grid inlet in road surface of substandard size, prone to blocking by small debris.	24
Figure 16: Stormwater Channel blocked and Asphalt to Gravel Erosion	25
Figure 17: Lack of Maintenance to Asphalt Road and Stormwater Channels	25
Figure 18: Stormwater Channel Damaged and Ponding on Road Surface	25
Figure 19: Ponding on Roads	26
Figure 20: Stormwater Channels Blocked, Crocodile Cracks on Road Surface and Damaged Kerb Inlets .	26
Figure 21: Roads Surface Damaged Due to Ponding and Kerb Inlet Damaged	26
Figure 22: Low Point Kerb Inlet with Insufficient Capacity to Drain.....	27
Figure 23: Stormwater Outlet Pipe to Small.....	27
Figure 24: Stormwater Channel Culvert Blocked due to Lack of Maintenance.....	28
Figure 25: Stormwater Culverts Blocked due to Lack of Maintenance	28
Figure 26: Stormwater flooding Level on Existing House	28
Figure 27: Down Stream Stormwater Discharge Channel Blocked	29
Figure 28: Life Threatening Stormwater Conditions During Storm Event: Pictures Received from Midvaal LM due to Above.....	29
Figure 29: Low Point Kerb Inlet Insufficient Capacity Resulted in Overflowing	30
Figure 30: Overflowing Due to Insufficient Capacity	30
Figure 31: Lack of Stormwater Drainage	31
Figure 32: Low Water Bridges in Good Condition	32
Figure 33: Low Water Bridge in Good Condition But Side Channels Blocked	32
Figure 34: Provincial Roads and District Roads within Midvaal Local Municipality Boundaries	33
Figure 35: Municipal Roads.....	34
Figure 36: All Roads within Midvaal Local Municipality	35
Figure 37: Surface Road Deteriorating and Washing Away of Surface Road	36
Figure 38: Road Crossings Not Properly Reinstated	36
Figure 39 : Lack of Stormwater and Ageing Asphalt Surface Leading to Edge Breaks.	37



Figure 40: Lack of Stormwater and Ageing Asphalt Surface Leading to Edge Breaks.	37
Figure 41: Deteriorating of Surfaced Roads In Urban Areas	38
Figure 42: Newly Surfaced Road	38
Figure 43: Poor Road Maintenance	38
Figure 44: Damaged Surfaced Roads and Continuous Patching.....	39
Figure 45: Road Deteriorating and Broken Kerbs	39
Figure 46: Roads Not Graded Properly and No Stormwater Drainage.....	40
Figure 47: Lack of Stormwater Drainage	40
Figure 48: Well Maintained Gravel Road.....	41
Figure 49: Poorly Maintained Gravel Road.....	41
Figure 50: Extract of Functional Road Classification Near Meyerton.....	45
Figure 51: Attracted and Produced Trip Diagram.....	53
Figure 52: Trip Distribution Diagram	53
Figure 53: Extract of Basic Road Model (2024 Road Categorization Based on Traffic Data)	59
Figure 54: Typical Kerb Inlet Details	101
Figure 55: Example of Servitude and Concrete Channel	102
Figure 56: Typical Stormwater Outlet Structure with Siltation Basin.....	102
Figure 57: Typical Subsoil Drainage Detail.....	103
Figure 58: Typical Road with Dump Rock Layer.....	103
Figure 59: Example of an Attenuation Pond Design	105
Figure 60: Example of a Culvert bridge implemented at a low point.....	107
Figure 61: Two examples of Culvert bridges implemented on an internal road and provincial road respectively.	107
Figure 62: Example of a Concrete drainage channel implemented next to a surfaced road.	108
Figure 63: Typical Example of Energy Dissipation Structure	108
Figure 64: Indication of Perennial Rivers and Tributary Rivers	111
Figure 65: Methodology Flow Chart	112
Figure 66: Sub-Catchment Areas of Midvaal LM	113
Figure 67: RMF Regions	115
Figure 68: Effective Catchment Area	116
Figure 69: Floodline Methodology.....	118
Figure 70: HECRAS Typical Cross Sections Geometry Layout	118
Figure 71: Midvaal Local Municipality 15 Wards.....	141
Figure 72: Midvaal Local Municipality - Ward Gravel Roads Prioritised	142
Figure 73: Midvaal Local Municipality - Ward Surfaced Roads Prioritised.....	144
Figure 74: Wards 7 Gravel Roads Including 1 in 100 year Floodlines.....	146
Figure 75: GIS Representation of Ward 7 and Prioritised Gravel Roads	146
Figure 76: Ward 11, Lakeside Surfaced Roads - Road Selection Name and Floodline	148
Figure 77: Funding Framework	166
Figure 78: Budget Facility Process Flow Diagram	175
Figure 79: Budget Facility Analytical Process Flow Diagram	176
Figure 80: Inspection Sheet Example.....	195
Figure 81: Impact of Road condition on vehicle user costs (Sabita Info Sheet #8)	199
Figure 82: Types of Unpaved Roads.....	210



LIST OF ABBREVIATIONS/ ACRONYMS

DBSA	-	The Development Bank of Southern Africa
RSWMP	-	Roads and Stormwater Master Plan
MLM	-	Midvaal Local Municipality
PSP	-	Professional Service Provider (Appointed)
PSC	-	Project Steering Committee
LM	-	Local Municipality
ToR	-	Terms of Reference A.K.A Scope of Works
PIP	-	Project Implementation Plan
GIS	-	Geographic Information System (Software)
PMS	-	Pavement Management System
RAL	-	Roads Agency Limpopo
SANRAL	-	South African National Roads Agency Limited
MISA	-	Municipal Infrastructure Support Agency
MIG	-	Municipal Infrastructure Grant
PMU	-	Project Management Unit
IDP	-	Integrated Development Plan
SDF	-	Spatial Development Framework
SPLUMA	-	Spatial Planning and Land-use Management Act
RMF	-	Regional Maximum Flood

*The list of abbreviations/ acronyms includes but is not limited to the above.



CHAPTER A : EXECUTIVE SUMMARY

A.1 INTRODUCTION

As an introduction to this Report the Scope of Works as outlined in Infraconsult Engineering's Terms of Reference, (ToR) for the development of a Roads and Stormwater Master Plan (RSWMP) will in summary include the following Phases to be conducted:

1. Stakeholder Engagement and Establishment of the Project Steering Committee (PSC).
2. Assessment of the Existing Infrastructure Condition.
3. Future Demand Assessment.
4. Project Prioritization and Cost Estimates.
5. Funding and Implementation Arrangements.
6. Risk Management.
7. **Support for the Adoption of the Roads and Storm Water Master Plan by the Municipal Council.**
8. Registration of three Prioritized Roads and Stormwater Projects with the Municipal Infrastructure Grant (MIG).
9. Project Close Out Report.

From the above it may be concluded that the Development of the Roads and Stormwater Master Plan consists of four (4) Main Phases, which are:

1. Assessment of the Existing Infrastructure Condition,
2. Future Demand Assessment,
3. Registration of three Prioritized Roads and Stormwater Projects with the Municipal Infrastructure Grant (MIG), and
4. Support for the Adoption of the Roads and Storm Water Master Plan by the Municipal Council

A.2 BACKGROUND

In short, the Background of the Project is briefly highlighted below.

Midvaal Local Municipality (Midvaal LM) requested support from DBSA with the development of the municipality's Roads and Storm Water Master Plan (RSWMP). The RSWMP will assist the municipality to improve and align the identification, prioritization and implementation of roads and stormwater infrastructure projects towards the achievement of Government's strategic National Outcomes.

The Professional Services Provider Infraconsult Engineering (PSP) was appointed by DBSA on the 22nd of September 2023 and will be responsible for the development of the RSWMP and is expected to undertake stakeholder engagement, conduct assessments, and compile an implementation strategy, with clear goals and objectives.

A.3 STAKEHOLDER CONSULTATIONS

Where required the PSP liaised and consulted with the following stakeholders for purposes of information and data collection and collation of the projects, conditions precedent, current and future demand assessment:

- ✓ The Development Bank of Southern Africa (DBSA),
- ✓ Midvaal Local Municipality (MLM),
- ✓ Gauteng Department of Roads and Transport (Gautrans)
- ✓ Department of Public Works, Roads and Infrastructure.



A.4 ENGAGEMENT WITH MLM AND ESTABLISHING OF A PROJECT STEERING COMMITTEE (PSC)

The above engagement processes were governed by an established PSC which led to the successful development of this master plan and involved input from the Municipal Officials of Midvaal Local Municipality, political representatives, organised local businesses and the communities from the grassroots level, and utility government departments.



CHAPTER B : GENERAL

B.1 INTRODUCTION

Midvaal LM (GT422) is a Category B municipality as defined in the Municipal Structures Act (No. 117 of 1998). It comprises 15 wards and is one of three local municipalities which constitute the Sedibeng District Municipality. The other two are the Emfuleni Local Municipality (GT421) and the Lesedi Local Municipality (GT423).

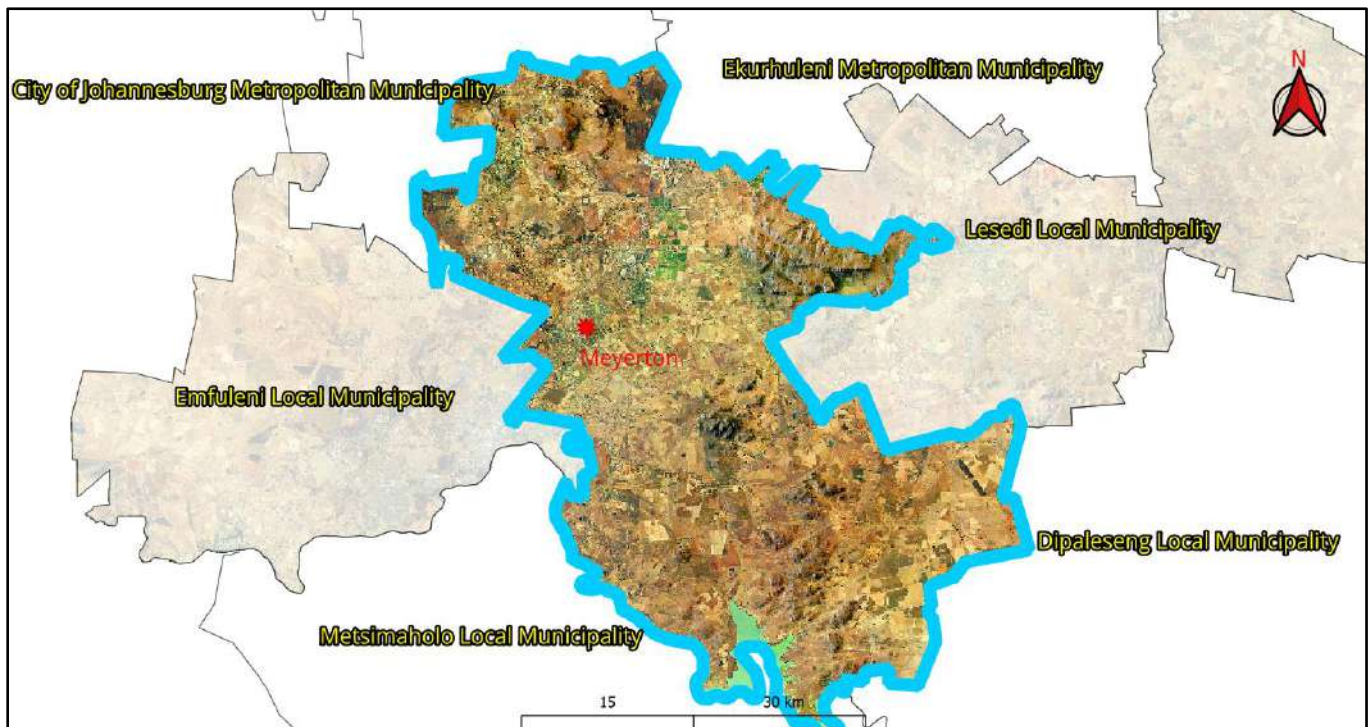


Figure 1: Sedibeng District Municipality and its surrounding Local Municipalities

Midvaal Local Municipality covers an area of approximately 1 722 km² compared to approximately 966 km² and 1484 km² respectively for the neighbouring Emfuleni Local Municipality and Lesedi Local Municipality.

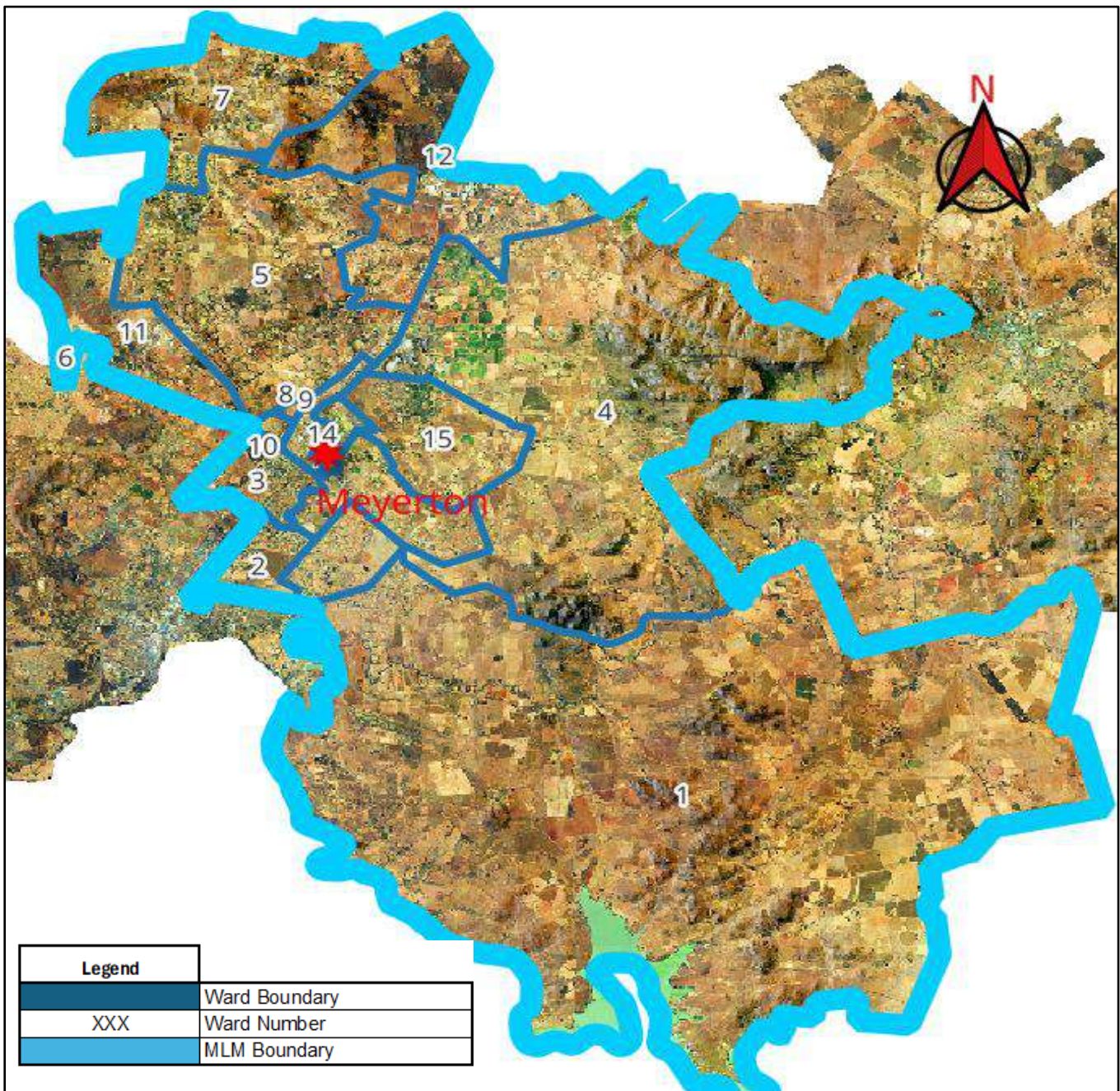


Figure 2: Midvaal Local Municipality and the 15 Wards it consists of

Midvaal Local Municipality consists of 15 wards and is characterised by the following spatial elements.

Table 1 : Midvaal LM Spatial Elements

Areas	Total number
Townships	45 (26 169 stands)
Farms	80 (3 652 portions)
Agricultural/small holdings	33 (3 943 small/agricultural holdings)
Informal settlements	29
Nature reserves	1
Conservancies	10



The R59 and R82 are the main transport corridors within Midvaal. The R59 is earmarked as a development corridor linking the City Deep logistics hub and OR Tambo International Airport in the north to the Vereeniging-Vanderbijlpark complex in the south. The R82 is a mobility corridor connecting Johannesburg in the north via Tedderfield AH, Walkerville and De Deur from Johannesburg to Vereeniging in the south.

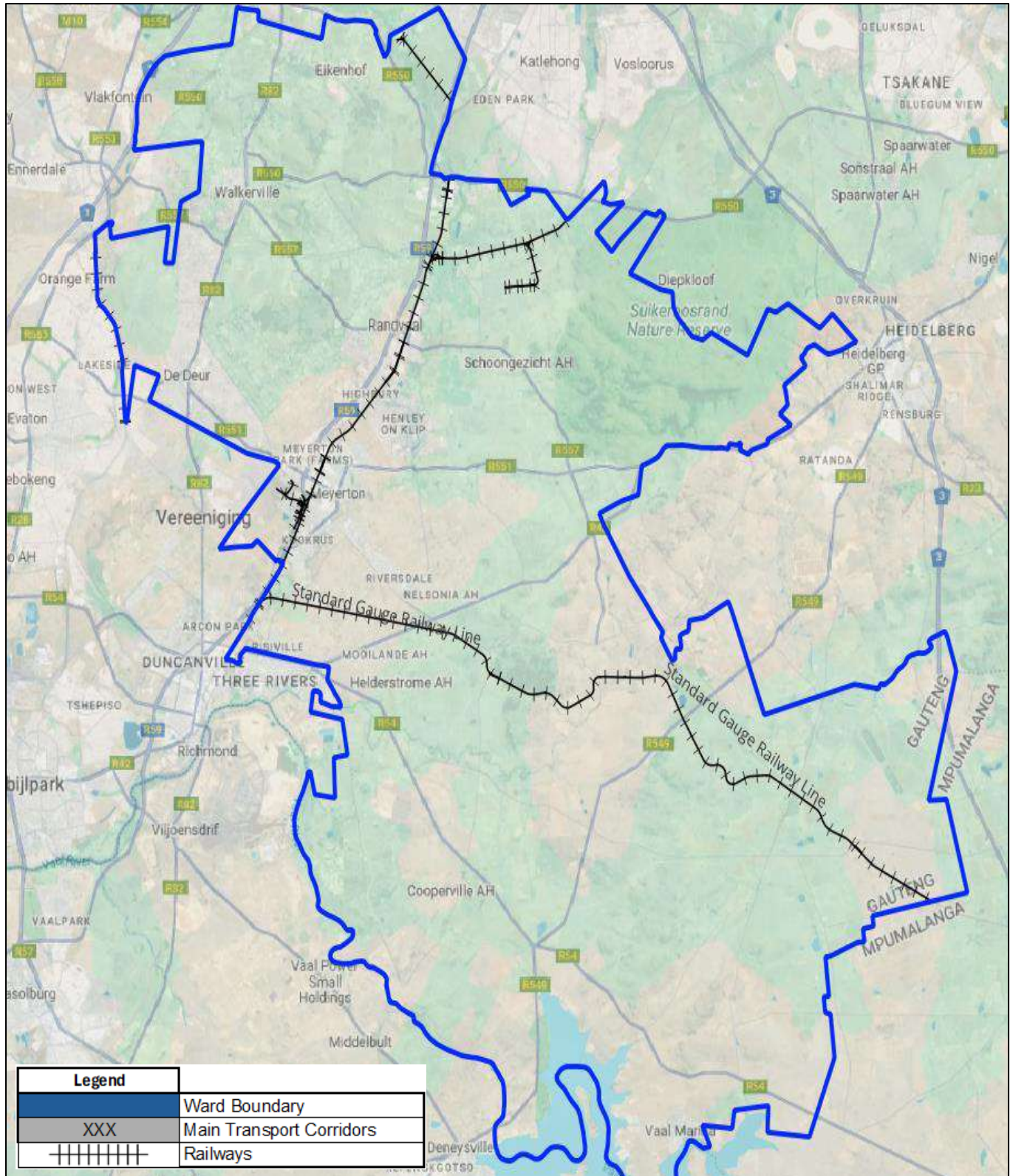


Figure 3: Midvaal LM - Main Transport Corridors and Railways



The main railway line, running parallel to the R59, is a freight line connecting Vereeniging to Germiston. Along the eastern boundary of Midvaal lies a commuter railway line from Emfuleni to the City of Johannesburg.

B.2 GOALS

The goals of the Draft Roads & Stormwater Master Plan are:

- Assessment of the Existing Situation,
- Assessment of Future Demand,
- Determination of the required elements of the Roads and Stormwater systems,
- Prioritisation of projects identified according to short, medium and long term and Cost Estimates.
- The ultimate goal of the Roads and Stormwater Master Plan is to be included as a Municipal Sector Plan in the Integrated Development Plan.

B.3 OBJECTIVES

The objectives of the Draft Roads and Stormwater Master Plan are:

- Stakeholder Engagement.
- Assessment of Existing Situation.
- Assessment of Proposed Remedial Measures.
- Project Prioritisation and Cost Estimates.
- Funding & Implementation Arrangements.
- Overall project Risk Management.
- Support of the Adaption Masterplan by Council.

B.4 KEY PHYSICAL FEATURES i.t.o ROADS AND STORMWATER

The main physical features of the Midvaal Local Municipality area are:

B.4.1 Stormwater

B.4.1.1 Main Rivers

Midvaal Local Municipality is well drained by dendritic perennial river systems including the Rietspruit, Klip River, Suikerbosrand River and Vaal River Systems. All the rivers empty their water into the Vaal River.

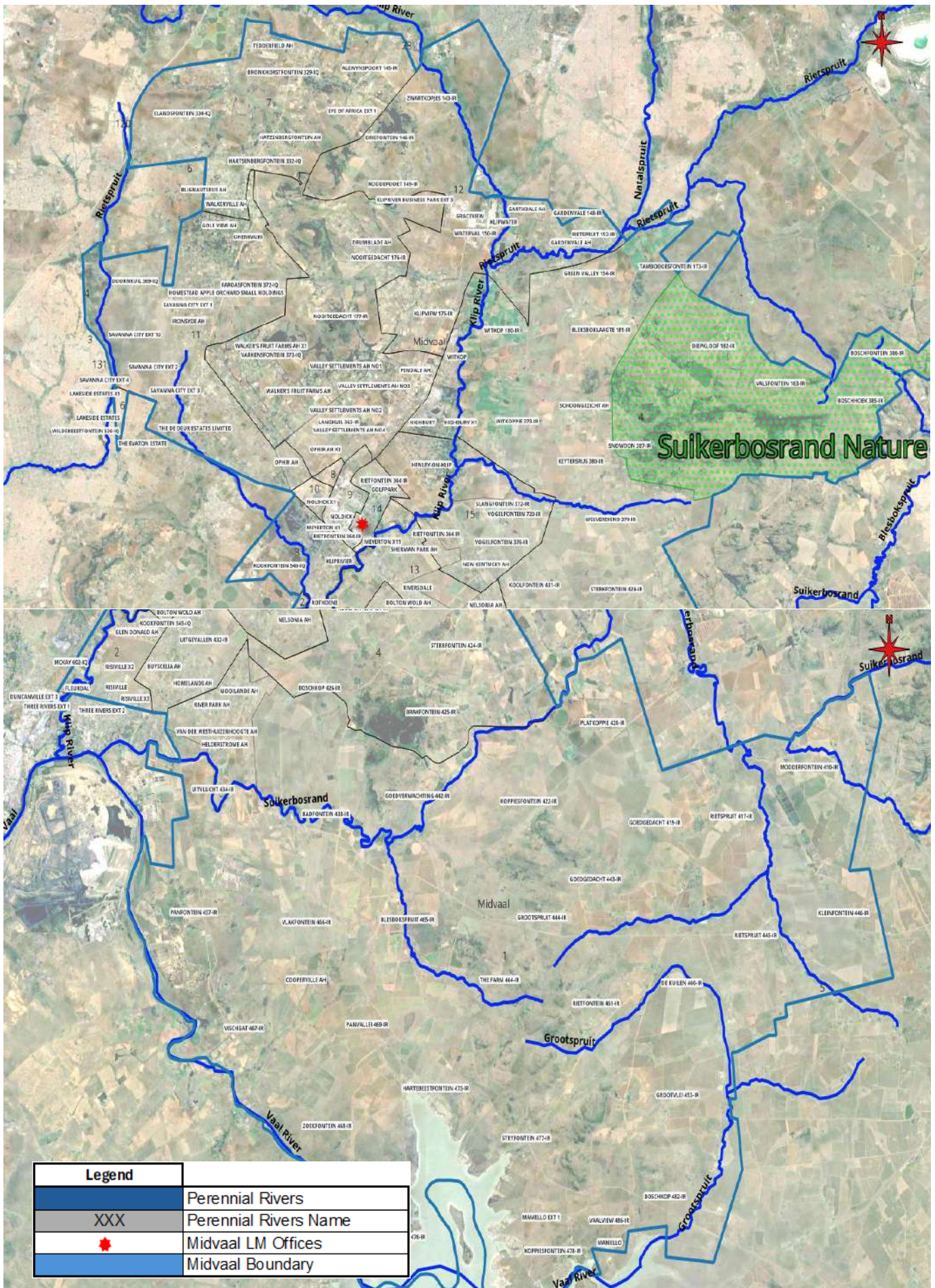


Figure 4: Perennial Rivers in Midvaal LM



The most important catchments/ sub-catchments in Midvaal are the Vaal River, Klip River and Suikerbosrand River Catchments as shown in **figure 5**, with an area of 5027km².

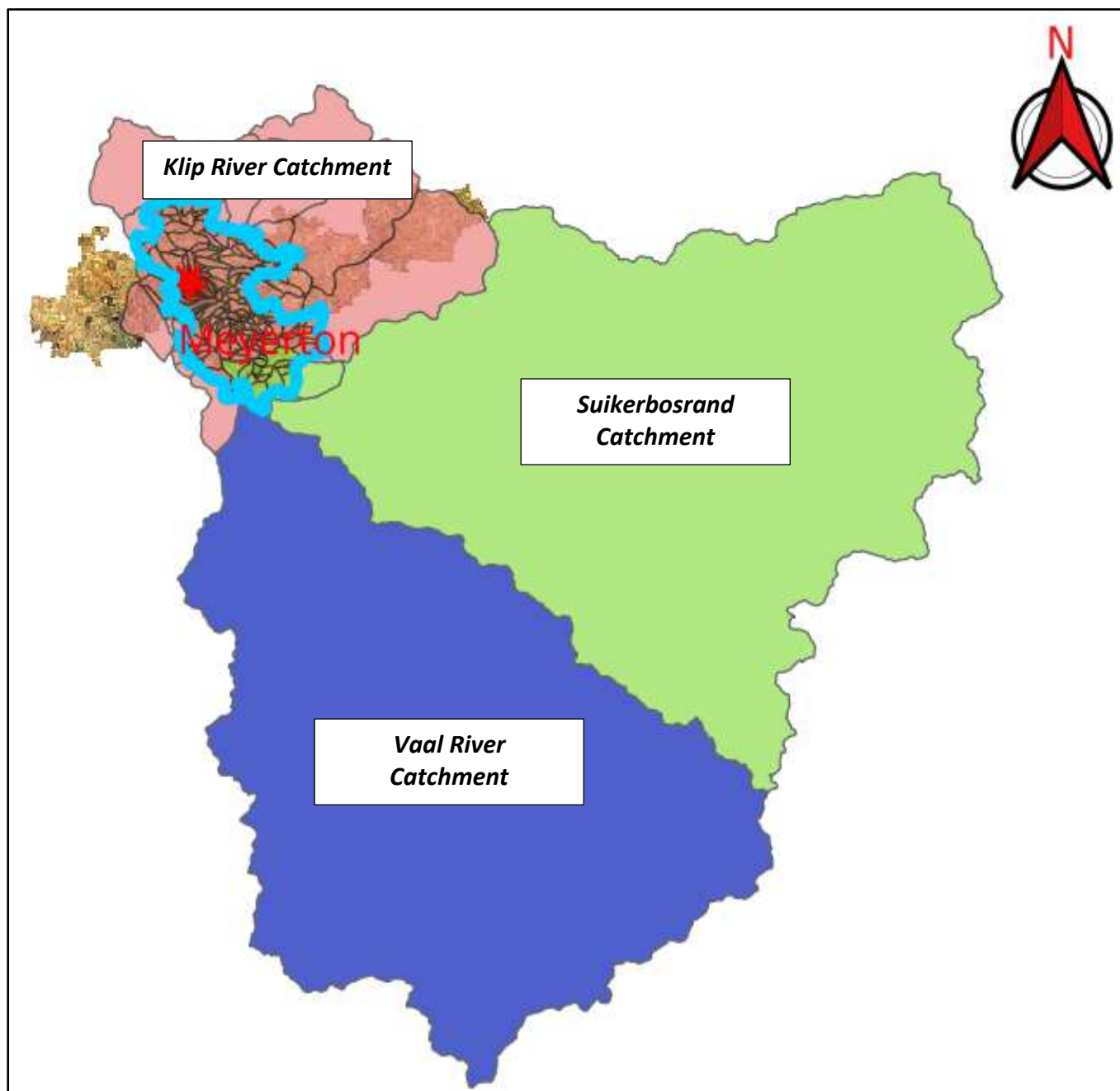


Figure 5: Catchments and Sub Catchments for Midvaal LM

B.4.1.2 Existing Bridges

The existing bridges in the MLM area include the following:

- Lower water bridges: Culverts and Drifts.
- Bridges (deck & pillars)

B.4.1.3 Existing Stormwater Infrastructure

The existing Stormwater Infrastructure in the Midvaal municipal area includes the following:

- Pipes, Culverts, Conduits.
- Drainage channels: unlined & unlined: stone pitched, concrete.
- Kerb inlets.
- Manholes.
- Wingwall In & Outlets.



Some GIS data and no As-builts of the existing stormwater were supplied by MLM. Also no stormwater layouts for planning purposes were obtained from MLM.

Figure 6 illustrates the stormwater assets contained in the Midvaal LM asset register supplied to the PSP and observed on-site.

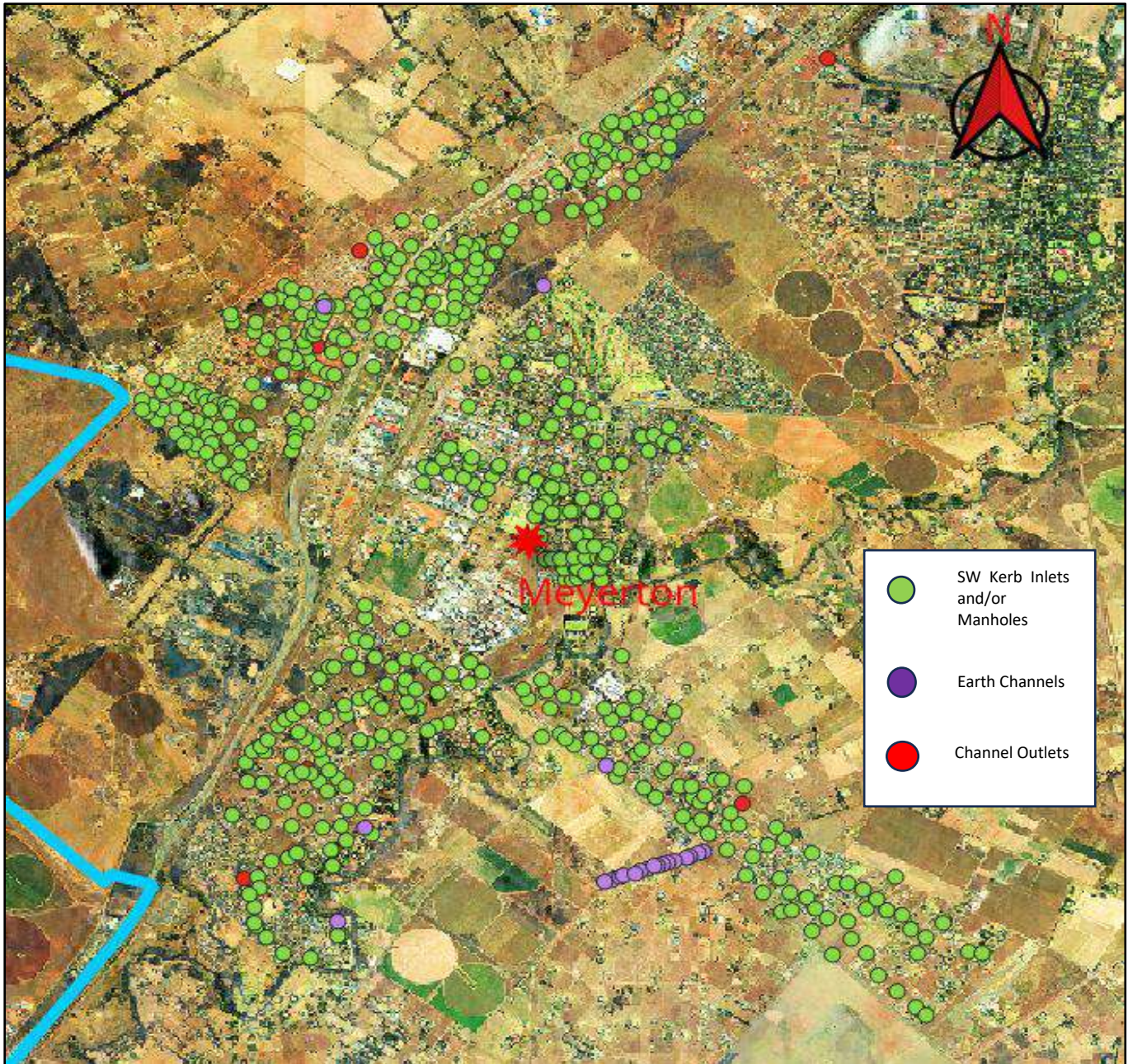


Figure 6: Stormwater Assets in the Meyerton CBD and Surroundings



B.4.2 Roads

The Midvaal Local Municipality has the following main provincial development corridors/roads:

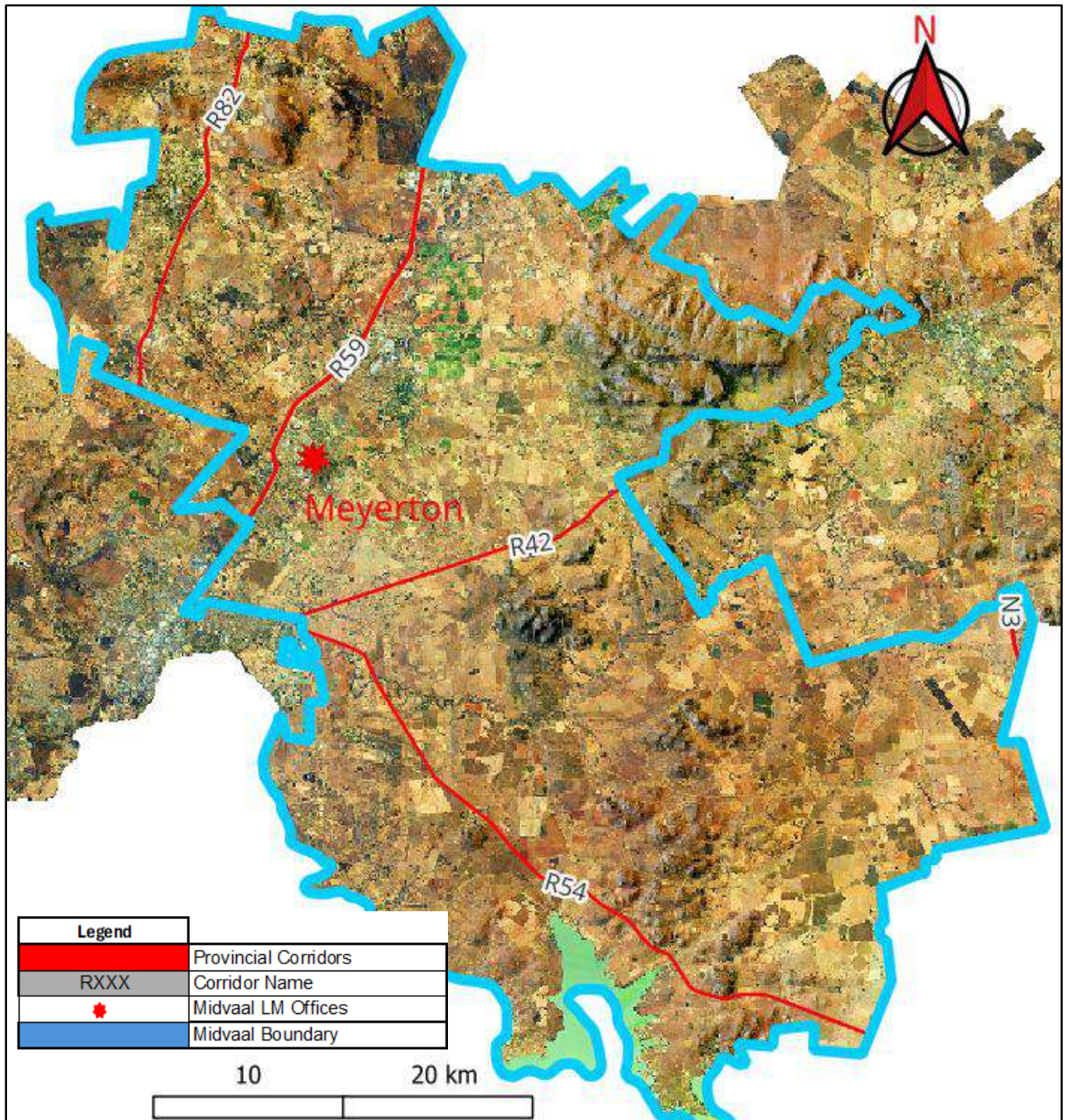


Figure 7: Provincial Development Corridors in Midvaal LM

The major economic zone is defined by the R59 and the R82 highways. Both routes, along with the N3 and the N1 highways, have been identified as development corridors according to the Midvaal Development Corridor Hierarchy. The primary development regions can be divided into three key regions, the central region, western region and eastern region.

The Central Region of the development zone is the most advanced economic region in the Midvaal, partially because it is located in close proximity to the R59 Development Corridor. Provincial Roads are maintained by Gauteng Department of Roads and Transport (GAUTRANS) and are in a good to excellent



condition. With the R59 having an approximate length of 28.82km and the R82, R42 and R54 having a combined approximate length of 100.51km. (See **Figure 7**). It offers the best mobility and distribution opportunities for goods and services and as a result plays an important role in the Midvaal local economy. It is further the region with the highest population number, population density and most diverse economic structure (as discussed above). This region, however, has very little aesthetic value and high concentrations of air pollution.

The Western Region is well situated with regard to the smaller R82 Development Corridor and as a result, shows strong economic potential. The Western region is however in close proximity to the economic powerhouses of Emfuleni and the southern part of the City of Johannesburg, creating strong competition for market investments. The Western Region has a scenic quality due to the hillock range and a middle-high income rural lifestyle type of residential development. Moreover, the presence of the Eye of Africa golf estate and equestrian estates in the region further add to the aesthetic beauty of the region.

N3 National Road is maintained by SANRAL with an approximate length of 4.92km and District/ Tertiary includes the R549, R550, R551 R553 & R557 and others as can be seen in **Figure 8**.

The Local Municipal and Residential Roads are being maintained by the Roads & Stormwater Regions of the Midvaal Local Municipality and are generally in good condition.

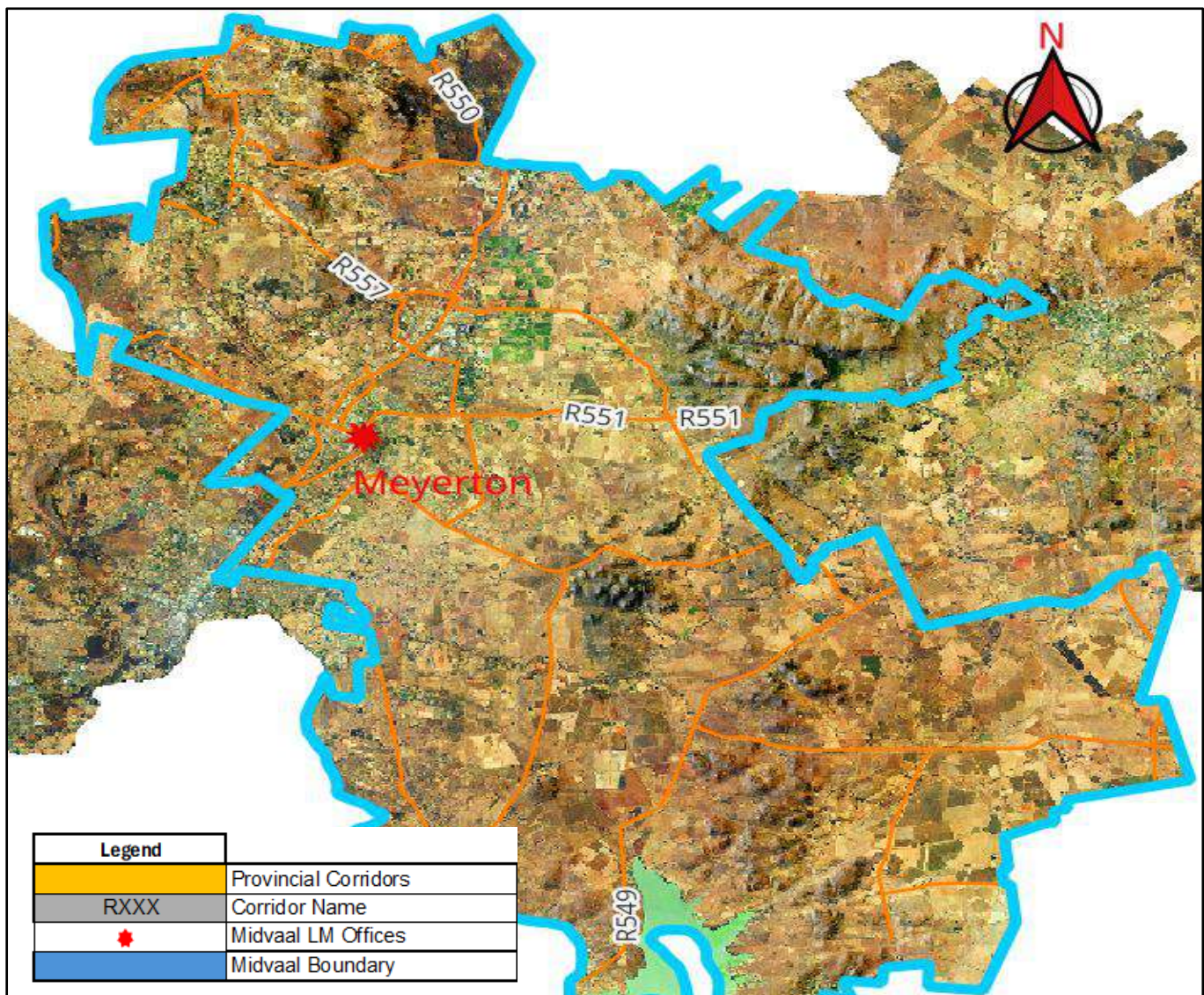


Figure 8: Midvaal LM District Roads or Tertiary Roads



The total length of the Municipal Road network is approximately 1210km. This represents the total length of Urban asphalt and gravel roads and Rural asphalt and gravel roads, including the minor residential access roads.



Figure 9: Sample of Municipal Roads in Midvaal LM (Meyerton CBD)

B.4.3 Area of Investigation

The Study Area is the whole of the Midvaal Local Municipal Area consisting of Urban Areas and Rural Areas situated inland. The Midvaal Local Municipal area covers approximately 1722 km².

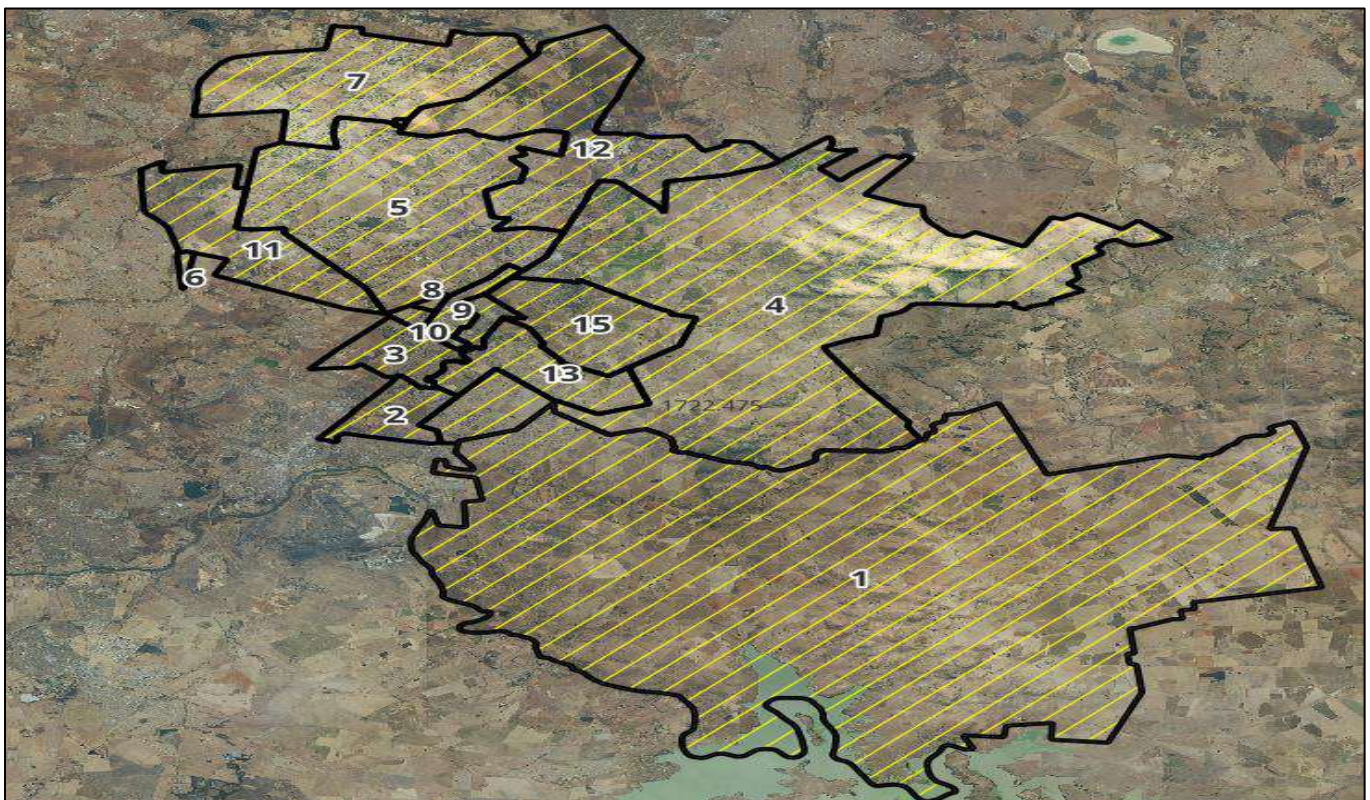


Figure 10: Midvaal LM and the 15 Wards consist of



The Municipality falls within the Sedibeng District Municipality Area and the administrative seat is in Meyerton. The Municipal area consists of 15 Wards and the Roads & Stormwater Infrastructure is maintained by Midvaal Local Municipality.

The Sedibeng district is regarded as a crucial southern gateway into the Gauteng City-Region. It is surrounded by three provinces, namely Mpumalanga, the Free State and the North West.

The district observes high inward and outward migration patterns from its neighbouring inter-provincial districts. The Sedibeng district consists of three local municipalities namely, Emfuleni, Midvaal and Lesedi LMs. Sedibeng district is historically well known as the iron and steel industrial hub of Gauteng.

The formerly state-owned Arcelor Mittal steel works is located in Vanderbijlpark. The district has experienced significant de-industrialisation due to the decline in the steel industry. The steel industry is still one of the main employers in the district within the manufacturing category. Its decline has resulted in the unemployment rate in the district to sit at 50.7%, with Emfuleni contributing a larger proportion of this figure. The district SDF identified consolidation strategies to revive the economy. Key primary, secondary and mixed-use nodes are identified for infill-developments and densification. The nodes are identified as follows across the district:

Table 2: Sedibeng Nodal Classifications

SEDIBENG DISTRICT NODAL CLASSIFICATION		
Primary Nodes	Secondary Nodes	Mixed-Use Consolidation
Vanderbijlpark	Evaton	Heidelberg
Vereeniging	Sebokeng	Ratanda
Meyerton	Savanna City	Jameson Park
	Waterval	
	Elandsfontein	

B.5 ENGAGEMENT OF STAKEHOLDERS

In the process of developing the Roads & Stormwater Master Plan the following Stakeholders were engaged:

- Gauteng Department of Roads and Transport (GAUTRANS),
- Sedibeng District Municipality,
- Midvaal LM Technical Department (Roads and Stormwater),
- Midvaal LM Operations and Maintenance officials.

Various meetings, verbal and written correspondence were held with the above Stakeholders throughout the Project Life Cycle.

B.6 DATABASE & GRAPHICAL DATA FROM GIS

B.6.1 GIS: Stormwater

An important part of the deliverables of the Roads & Stormwater Management Plan is the creation of a spatial Graphical Information System (GIS) database. Minimal records or GIS database records could be obtained from the existing stormwater system. This was highlighted to the Municipality.



The GIS database of the Stormwater Infrastructure will facilitate the Location, and associated parameters such as maintenance records and costing, asset value, and infrastructure to be upgraded. It would be of assistance with the assessment, design, assignment of new projects and costing of the new stormwater system.

The GIS database will also facilitate:

- The updating of a Municipal Asset Register.
- The updating of a Pavement Management System (PMS), which includes a Maintenance Plan and Strategy.
- Integration of information, policies and strategies between Provincial, District Municipal and Local Municipal departments and the Technical, Administrative and Financial Departments.

It is recommended as part of the steps of implementation and construction of new stormwater systems that all the existing stormwater infrastructure must be measured on site and recorded on the GIS database.

****Note: This Appointment does not make allowance for any implementation or construction works.***

B.6.2 GIS: Roads

An important part of the deliverables of the Roads & Stormwater Management Plan is the creation of a spatial Graphical Information System (GIS) database.

The GIS database represents a geographical presentation with associated data such as Asset value, Condition, Costs of maintenance and upgrades etc.

The GIS database will facilitate:

- The updating of a Municipal Asset Register.
- The updating of a Pavement Management System (PMS), which includes a Maintenance Plan and Strategy.
- Integration of information, policies, and strategies between Provincial, District Municipal and Local Municipal departments and the Technical, Administrative and Financial Departments.

The following GIS data was obtained from the Department of National Geospatial Institute and Midvaal Local Municipality:

Shape Files (.shp):

- Cadastral boundaries,
- Road centrelines of all the roads per the current database,
- Location of Schools, Hospitals, Clinics, Courts, Police Stations, etc.
- Municipal Boundary, and Ward Boundaries.
- 2018 Ortho Photos

Database (.dbf) files:

- Roads. The database covers all the roads:
 - National Roads.
 - Provincial Roads.
 - District Roads.
 - All other Local roads grouped together in one category, such as:
 - Urban Asphalted Roads.



- Urban Gravel Roads.
- Rural Collector Roads.

It should be noted that:

- Minimal GIS information was received from MLM for the existing stormwater infrastructure. The PSP made use of the limited information provided by Midvaal Local Municipality and formulated a more extensive GIS Model (Database) using data retrieved during our Existing Situation Investigations.
- No GIS information was received from the Sedibeng District Municipality.
- Please note, that the database of the municipal roads needed to be refined by the municipality according to urban/rural and gravel/asphalt categories. Road names of gravel roads are currently not reflected in the database.

See **ANNEXURE Q** for the updated GIS data.

B.7 MUNICIPAL DOCUMENTS OBTAINED AND REVIEWED.

The following documents have been used as a source of information for the compilation of the Roads & Stormwater Master Plan:

- **Tender Document** Tender No. RFP 355/2022: PSP's Terms of Reference
- 2022/23-2026/27 Spatial Development Framework (**SDF**), Draft, Compiled 2020 prepared by Midvaal Local Municipality.
- 2017-2022 Final Draft Integrated Development Plan (**IDP**) prepared by Midvaal Local Municipality.
- 2023 Complaints Cases Road and Stormwater
- Midvaal Local Municipality Traffic Counts Technical Report.
- January – March 2024 Midvaal Local Municipality Quarterly Programme.
- Midvaal Local Municipality Vehicle Status Report.
- Midvaal Local Municipality Yellow Plant List.
- Midvaal Local Municipality Proposed Organisational Structure – Public Safety and Roads (2023 – 2024).



CHAPTER C : EXISTING SITUATION ASSESSMENT

During the existing Situation Assessment both the Urban and Rural Areas of Midvaal LM were investigated, in terms of the Roads and Stormwater Infrastructure.

The status quo of the Stormwater Infrastructure and the Road Infrastructure will be assessed and summarised below.

It should be noted that Site Inspections were done during the period of 26 February to 8 March 2024 and were done independently by Infraconsult Engineering.

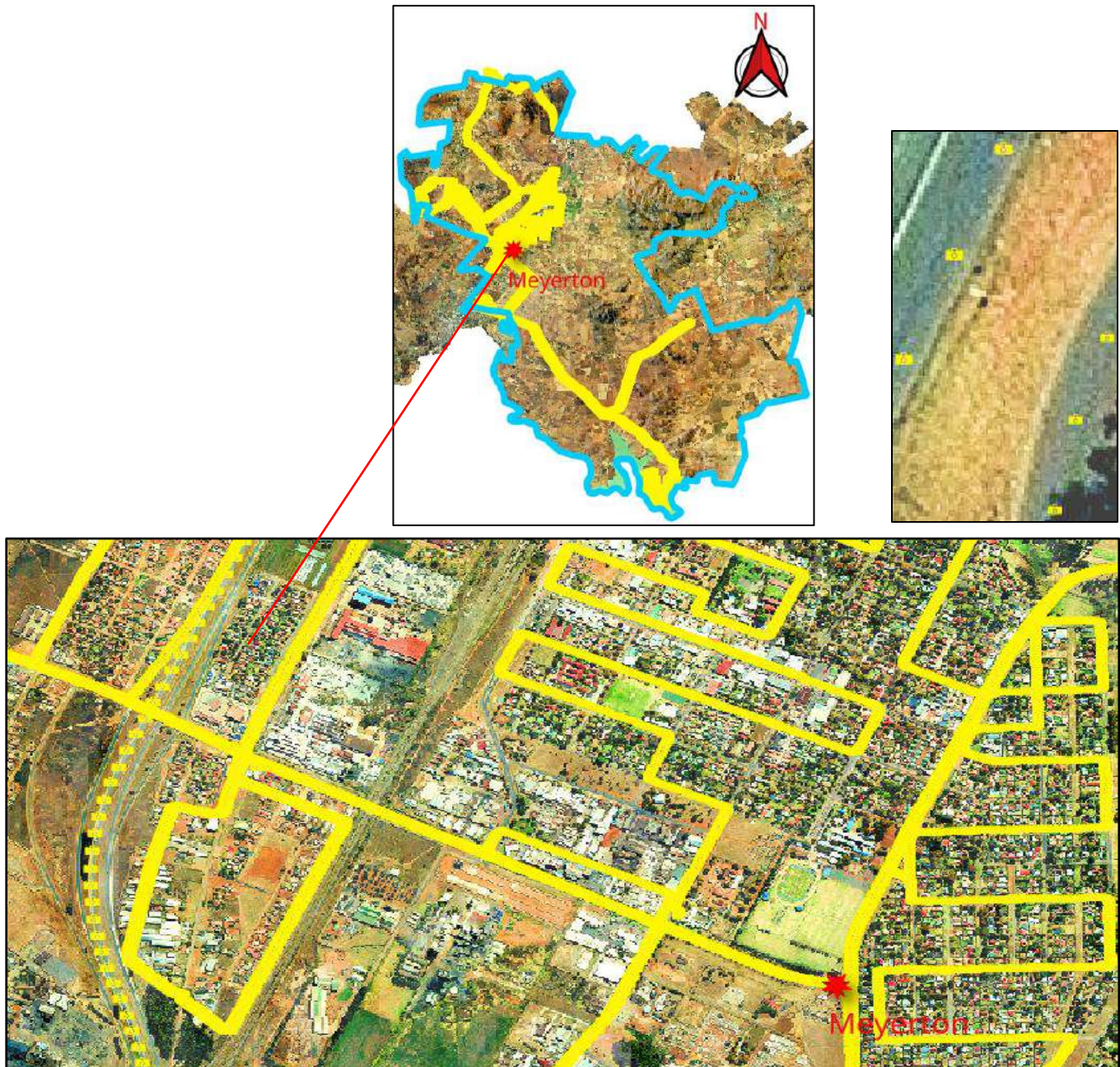


Figure 11 : Photos taken during the site visit period at a 1-second interval

Due to the extent of the Midvaal Local Municipality, the vast amounts of Infrastructure to be assessed and the timeframe of the Contract, a sample investigation was done to build the existing situation model. This first stage model may be further refined, however, during the subsequent phases of the project, furthermore, future input from the Ward Councillors and Communities were taken into account which leads to a more accurate model.



During this stage of the project the assistance of the Midvaal LM Technical Department and GIS Department were consulted via a formal meeting held on the 07th December 2023 where the assistance of Ward Councillors was requested to identify critical areas within each ward to be identified and assessed. The PSP requested a complaints register from Midvaal Local Municipality that was provided to assist in the existing situation assessment.

C.1 Assessment of the Existing Stormwater Infrastructure

C.1.1 Description of Existing Urban & Rural Stormwater Infrastructure

Below are the observations made during the Assessment of the Urban and Rural Stormwater Infrastructure:

- The existing urban stormwater system is an Urban Dual System, where the surfaced roads are kerbed with formal stormwater infrastructure present.
- The Urban Asphalt roads in the residential areas and Central Business Districts (CBD's) have vast amounts of associated stormwater infrastructure i.e., Kerb Inlets, pipes and concrete channels.
- It was observed that minimal Rural roads had Stormwater Infrastructure such as concrete stormwater channels assisting with the flow of stormwater leading to the mitigation of gravel road degradation.
- Secondly, in the rural areas it was observed that a major effort was and is given to river crossings and streams with the implementation of Culverts or low level bridge structures.

C.1.2 Site Inspections of Existing Urban & Rural Stormwater Infrastructure

Site Inspections of the critical areas of the Urban Stormwater Infrastructure were conducted from the 26th to the 08th of March 2024. The critical areas were identified and only the areas which were regarded as critical from a Stormwater Priority point of view and other than regular maintenance issues were inspected.

Following the observations made above, the following conclusions may be made in general with regard to the Urban and Rural Stormwater Infrastructure:

- The existing Urban Stormwater Infrastructure was generally found to be in a good to average condition.
- The Stormwater structures such as kerb inlets were showing signs of ageing and a lack of maintenance was evident i.e., they were blocked by soil, debris and general waste.
- The urban concrete channels ranged from excellent to average, mainly due to unpaved residential access roads and lack of periodical cleaning.
- A lack of drainage of local low points was found to be a common problem.
- The lack of stormwater infrastructure in the Rural Areas leads to a poor road surface, especially in roads with a steep gradient.
- The residential areas in the rural areas are close to major rivers, causing the road infrastructure (and residential infrastructure) to be built in floodlines and therefore are at a high risk of flooding, together with the lack of formal stormwater infrastructure, it may lead to injury and/or even loss of life to residents.

Further assessing the risk of average to poor conditions or even the lack of Stormwater Infrastructure may lead to the following future problems and dangers:



- **Flooding** of adjacent properties causing damage and potential loss of life.
- **Collapse** of Road and Stormwater Infrastructure causing inconvenience to Road Users and possible loss of life.
- **Damage** to Roads and Stormwater Infrastructure posing a danger to road users and residents and resulting in financial loss.
- **Ponding** of Roads at low points during rainstorms causing inconvenience to road users and posing a safety risk to traffic.

Summarising the Stormwater Infrastructure Existing Situation Assessment, a first phase model was built, leading Infraconsult Engineering to categorise the Existing Situation into various categories using specific criteria.

The Existing Situation Model discussed hereafter will highlight both the Urban and Rural areas. The criteria are as follows and will be visualised in more detail under the sub-headings below:

1. The identification of **critical/life-threatening** Roads and Stormwater Infrastructure that will be prioritised.
2. The identification of areas with **average to poor maintenance** which lead to failure of Roads and Stormwater infrastructure.
3. The identification of areas with existing **none to basic** existing Stormwater infrastructure.
4. Urban Areas with poor maintenance of Stormwater infrastructure.

C.1.2.1 None to Basic Existing Stormwater Infrastructure (Criteria No. 3)



Figure 12 : Lack of Kerb inlet repair leading to stormwater not effectively conveyed from road surface.



Figure 13 : Unlined SW Channel not maintained regularly Blocking Stormwater flow.



Figure 14 : Kerb inlet not raised when asphalt overlaying was done in the past.



Figure 15 : Grid inlet in road surface of substandard size, prone to blocking by small debris.

C.1.2.2 Maintenance and Insufficient Stormwater Design Leading to Failure of Roads and Stormwater Infrastructure. (Criteria No. 2 and No. 4)



Figure 16: Stormwater Channel blocked and Asphalt to Gravel Erosion



Figure 17: Lack of Maintenance to Asphalt Road and Stormwater Channels



Figure 18: Stormwater Channel Damaged and Ponding on Road Surface



Figure 19: Ponding on Roads



Figure 20: Stormwater Channels Blocked, Crocodile Cracks on Road Surface and Damaged Kerb Inlets



Figure 21: Roads Surface Damaged Due to Ponding and Kerb Inlet Damaged

C.1.2.3 Critical (Life Threatening) Infrastructure, either Roads or Stormwater (Criteria No. 1)

The PSP (Infraconsult Engineering) discussed life-threatening areas with the PSC and requested that these areas need to be identified where they have received complaints. Midvaal Local Municipality indicated that they have a huge problem in the Lakeside residential township and requested a site visit with the PSP (Infraconsult Engineering).

The PSP (Infraconsult Engineering) together with Midvaal LM and the Midvaal maintenance team visited the site and the following was discovered:



Figure 22: Low Point Kerb Inlet with Insufficient Capacity to Drain



Figure 23: Stormwater Outlet Pipe to Small



Figure 24: Stormwater Channel Culvert Blocked due to Lack of Maintenance



Figure 25: Stormwater Culverts Blocked due to Lack of Maintenance



Figure 26: Stormwater flooding Level on Existing House



Figure 27: Down Stream Stormwater Discharge Channel Blocked



Figure 28: Life Threatening Stormwater Conditions During Storm Event: Pictures Received from Midvaal LM due to Above



Figure 29: Low Point Kerb Inlet Insufficient Capacity Resulted in Overflowing



Figure 30: Overflowing Due to Insufficient Capacity



C.2 Site Inspections Rural Stormwater and Bridges

Site Inspections of the critical areas of the Rural Roads were held from 26 February to 8 March 2024. The critical areas which were regarded as problems to be dealt with beyond regular maintenance were selected for inspection. It was noted that many of the items on the complaints lists referred to the maintenance of gravel roads. No descriptions of the problems or lengths and widths were listed.

The following issues seem to dominate the complaints expressed by the residents:

- Grading of Roads
 - Roads need to be filled and graded.
 - Grass growing over the road.
 - Stormwater Manholes Blocked.
 - Stormwater Not Draining at outlets.
-
- Unsafe river crossings. Mostly low-water bridges have been provided but it was observed in some areas that the school children are crossing the riverbeds where no, or only very basic, provisions have been made. Although most of the low-water bridges can withstand large floods it was observed that some structural damage occurred, such as partially washed away concrete surfacing and walls and undermining of the bridge deck. However, the most common problem was the washing away of the embankments of the approaching roads.
-
- Roads which are not navigable during rainstorms. This is due to the steep gradients, formation of dongas by erosion and the wrong wearing course material being used or Lack of vehicular bridges which offer access roads to schools and residential areas.



Figure 31: Lack of Stormwater Drainage



Figure 32: Low Water Bridges in Good Condition



Figure 33: Low Water Bridge in Good Condition But Side Channels Blocked

C.3 Assessment of the Existing Roads Situation

C.3.1 Description of Existing Road Network

It should be noted that a Pavement Management System is being developed by the Sedibeng District Municipality for all of its Local Municipalities including Midvaal LM. Therefore, the PSP as part of this assessment only looked at the impact of stormwater infrastructure or the lack thereof on the condition of the roads. Although the PSP will provide a PMS to be used as a guide only.

Overall, the Municipal Roads are deteriorating at a fast pace due to age and in some cases minimal stormwater infrastructure or lack of stormwater infrastructure maintenance.

Suburbs/Towns such as Henley on Klip and Randvaal has no formal stormwater infrastructure, i.e. Kerb inlets and pipe systems or concrete lined channels, they carry stormwater runoff on the road surface this will result in the deterioration of the road surface if the vertical alignment design/construction of the roads is not properly executed.

C.3.1.1 PROVINCIAL ROADS AND DISTRICT ROADS:

The Provincial Roads are managed by Gauteng Department Roads and Transport (GAUTRANS) the Asphalt Roads are generally in good condition and regular maintenance is being done.

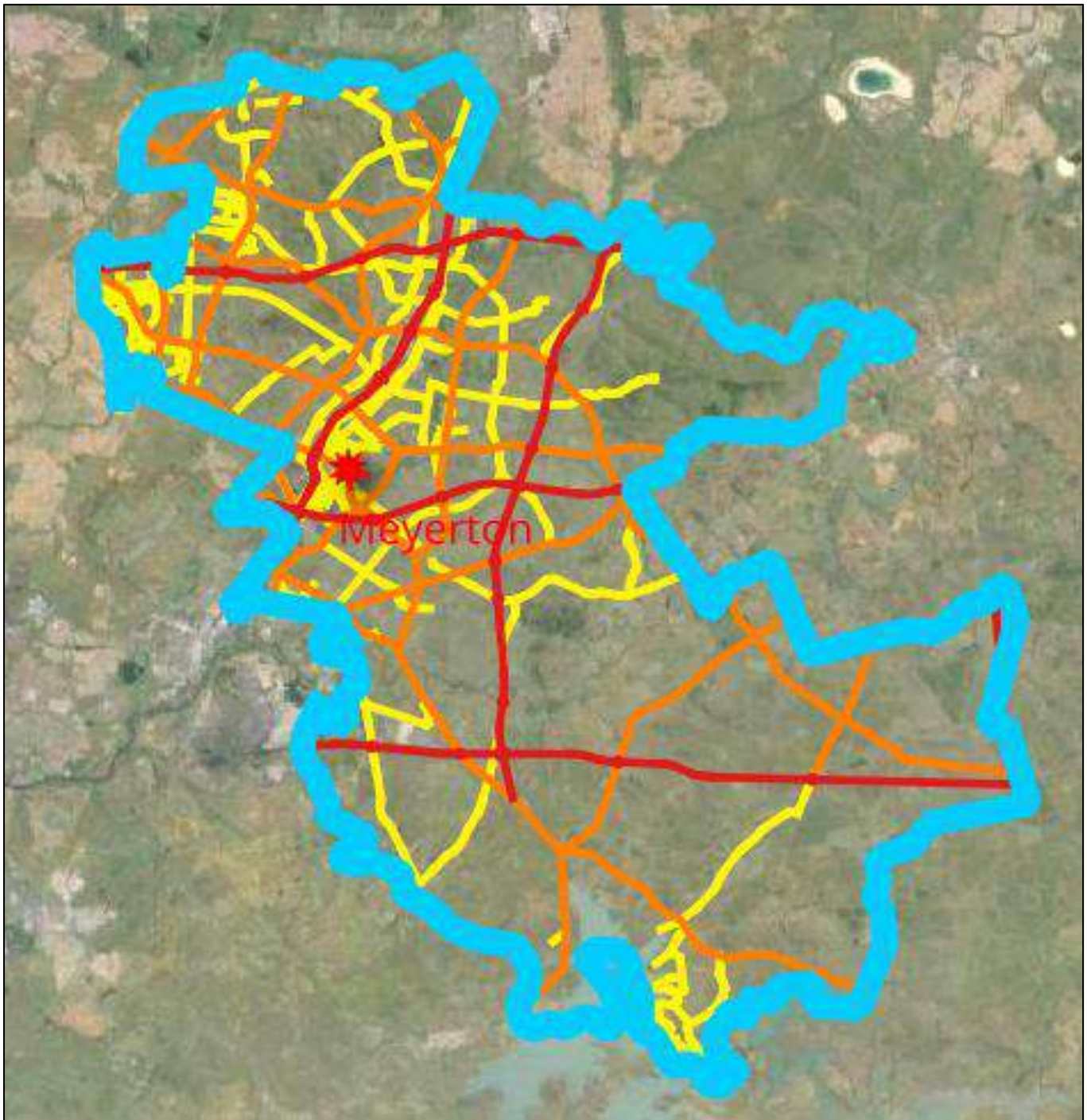


Figure 34: Provincial Roads and District Roads within Midvaal Local Municipality Boundaries

C.3.1.2 MUNICIPAL ROADS

The municipal roads are managed by Midvaal Local Municipality. The municipal asphalt and gravel roads are in a fair condition.

- **Local Urban Municipal Roads:**
 - **Arterial** Roads connecting different residential areas or townships.
 - **Collector** Roads provide access to residential areas or townships.



- **Urban Community Roads:**
 - **Residential Access** Roads provide access to driveways of properties.
- **Local Rural Roads, mostly Gravel, some Asphalted:**
 - **Arterial** Roads connecting different residential areas or townships.
 - **Collector** Roads provide access to residential areas or townships.
- **Rural Community Roads, Gravel:**
 - **Residential Access** Roads provide access to residential dwellings.

The information was obtained from the GIS database as compiled by Midvaal Local Municipality and Gauteng Department of Roads and Transport. The database will be refined according to the following categories: Urban or rural and surfaced or non-surfaced.

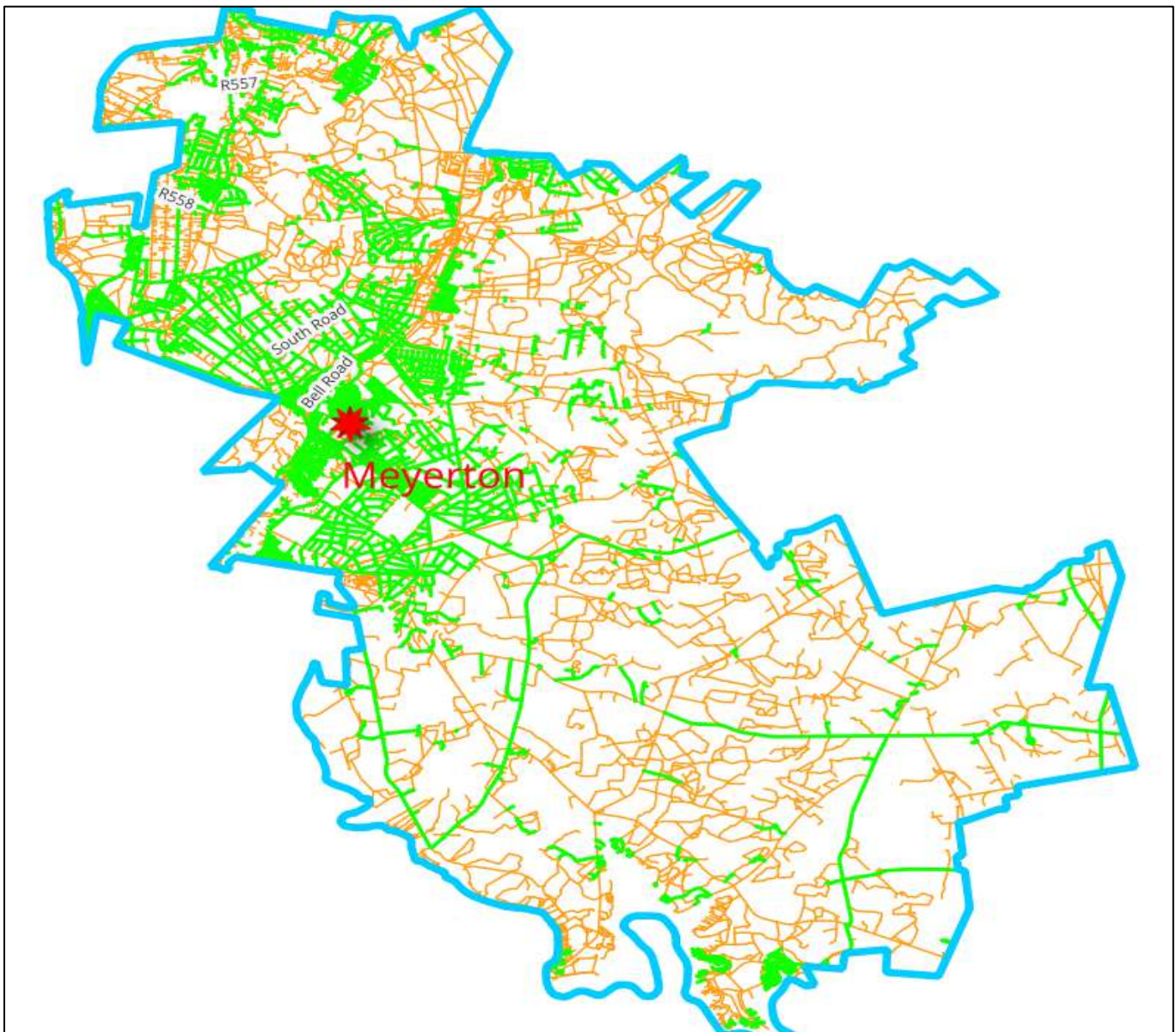


Figure 35: Municipal Roads

Legend	
Municipal Surfaced Roads	-----
Municipal Gravel Roads	-----
Midvaal Local Municipality Boundary	-----



It should be noted that most of the Rural roads are gravel roads. The rural gravel roads vary from District roads connecting different rural towns to roads providing access to schools, and community halls, to single lane residential access roads.

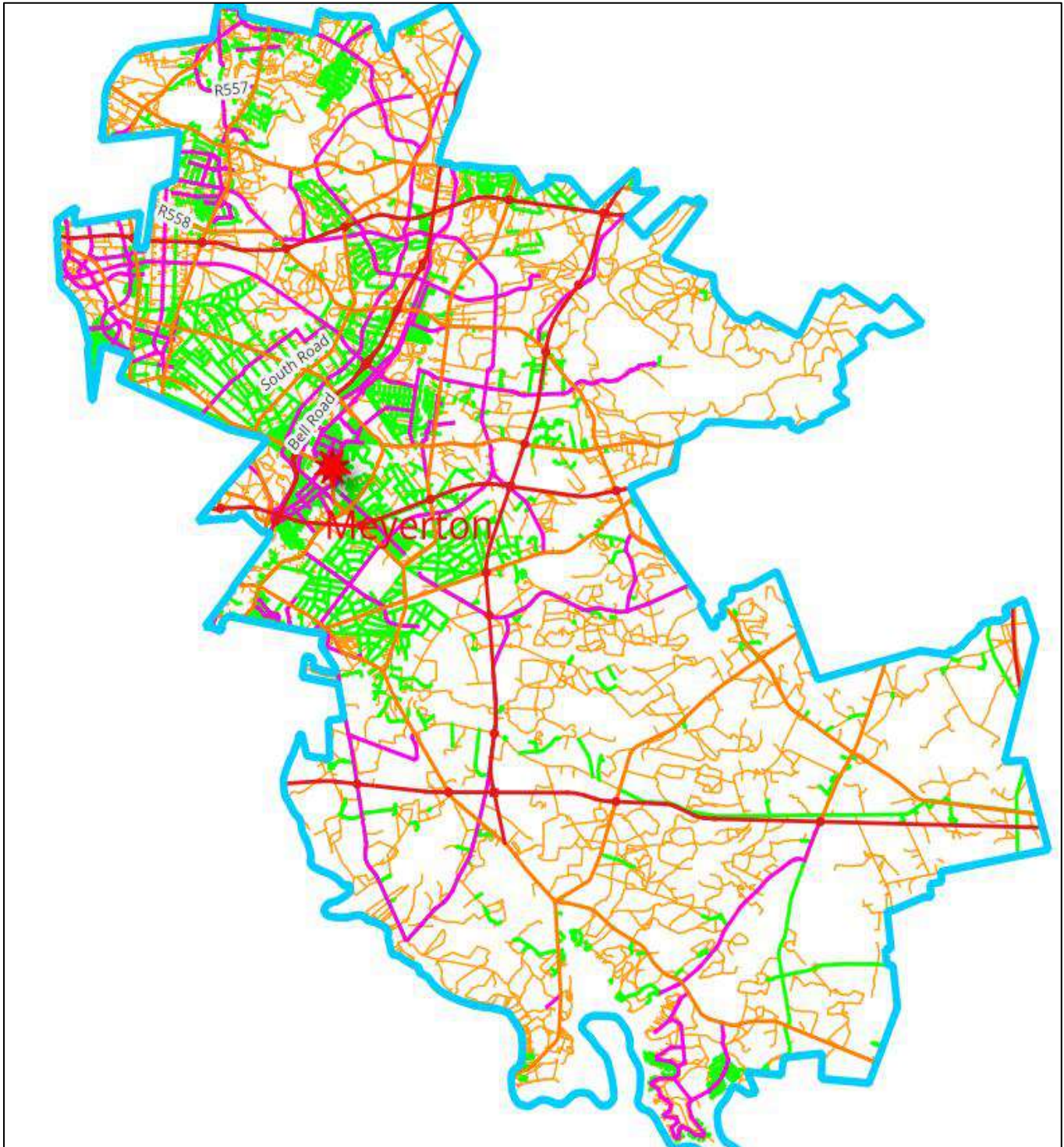


Figure 36: All Roads within Midvaal Local Municipality

Legend	
Municipal Surfaced Roads	-----
Municipal Gravel Roads	-----
Provincial Roads	-----
District/Tertiary Roads	-----

C.4 Assessment of Existing Road Backlogs

C.4.1 Urban Asphalt Roads

The Site Inspections of the Urban Roads were done to identify the backlogs with the maintenance, and rehabilitation of the Municipal Roads.

It was found that all the urban asphalt roads are generally in a fair/good condition, besides the roads which were listed and inspected.

Typical Pavement Defects were observed:

- Potholes.
- Depressions & Mounds.
- Undulations.
- Disintegration of asphalt surfacing.
- Washing away of asphalt surfacing.
- Signs of repeated and failing rehabilitation measures such as Extensive Patching, Overlays and Slurry Seals.



Figure 37: Surface Road Deteriorating and Washing Away of Surface Road



Figure 38: Road Crossings Not Properly Reinstated



C.4.2 Site Inspections Urban Roads

The existing Roads Infrastructure was generally found to be in Fair/ Good condition. Most roads show extensive signs of distress and failure such as potholes, cracking, unevenness, disintegration of the asphalt surfacing and sometimes asphalt surfacing which was washed away completely.

The poor state of some urban asphalted roads can be attributed to the following factors:

- Aging asphalt surfacing which has reached the end of its lifespan.
- Inadequate or a lack of Stormwater Infrastructure.
- Wet climate and wet ground conditions, especially in the wetlands.
- Insufficient Maintenance and repair.



Figure 39 : Lack of Stormwater and Ageing Asphalt Surface Leading to Edge Breaks.



Figure 40: Lack of Stormwater and Ageing Asphalt Surface Leading to Edge Breaks.

It should be noted that there are still urban areas with only gravel roads. Apart from the fact that the gravel roads are not maintained regularly, it was also noted that these roads are being washed away completely during major rainstorms.



Figure 41: Deteriorating of Surfaced Roads In Urban Areas



Figure 42: Newly Surfaced Road



Figure 43: Poor Road Maintenance



Figure 44: Damaged Surfaced Roads and Continuous Patching



Figure 45: Road Deteriorating and Broken Kerbs

C.4.3 Rural/Farm Portion gravel roads

The condition of gravel roads is periodical as gravel roads are regraded, reshaped and re-gravelled regularly as part of routine maintenance procedures.

Gravel roads pose an inconvenience to road users as compared to surfaced roads for the following reasons:

- Increased wear and tear to vehicles.
- Increased unevenness of the road.
- Reduced skid resistance.
- Generation of airborne dust by vehicles.
- Slipperiness during rainstorms.
- Unsafe driving conditions

Although a well-designed and maintained gravel road can provide an acceptable level of service, it is therefore desirable for road users and residents to surface all the gravel roads at some stage in the future.

The Regular maintenance and implementation of formal stormwater infrastructure of Gravel roads may be mitigated by the following:

Erosion of gravel roads can be minimised by:

- Use of proper wearing course material:
- Proper grading envelope:
 - Not too much fine material which will cause very slippery conditions during rainstorms.
 - Enough fine material for cohesion and shape ability of the of the wearing course.
 - Enough large aggregate for skid resistance and trackability.
- Proper cross-sectional shape with sufficient crossfall increasing to the edges.
- Shaping of drainage ditches at both sides of the roads.

A lack of proper stormwater infrastructure causes:

- Formation of gullies.
- Excessive erosion of unlined side ditches.
- Complete wash aways of the whole road.



Figure 46: Roads Not Graded Properly and No Stormwater Drainage



Figure 47: Lack of Stormwater Drainage



Figure 48: Well Maintained Gravel Road



Figure 49: Poorly Maintained Gravel Road

C.5 SUMMARY OF FINDINGS DURING EXISTING SITUATION ASSESSMENT

C.5.1 Stormwater

- The existing urban stormwater system is an Urban Dual System, where the surfaced roads are kerbed with formal stormwater infrastructure present.
- The Urban Asphalt roads, included in the residential areas and Central Business Districts roads have vast amounts of stormwater infrastructure i.e., Kerb Inlets and concrete channels.
- It was observed that minimal Rural roads had Stormwater Infrastructure such as concrete stormwater channels assisting with the flow of stormwater leading to the mitigation of gravel road degradation.
- Secondly, in the rural areas it was observed that a major effort was and is given to river crossings and streams with the implementation of Culverts or low-level bridge structures.
- The existing Urban Stormwater Infrastructure was generally found to be in poor condition.
- The Stormwater structures such as kerb inlets, pipe culverts and large in and outlet wingwall structures were showing signs of aging and a lack of maintenance.
- Some stormwater pipes and culverts were found to be blocked or missing between the manholes.
- A lack of drainage of local low points was found to be a common problem.



- The urban concrete channels ranged from excellent to average, mainly due to unpaved residential access roads and lack of periodical cleaning.
- The lack of stormwater infrastructure in the Rural Areas leads to a poor road surface, this is especially evident in roads with a steep gradient.
- The residential areas in the rural areas are close to major rivers, causing the road infrastructure (and residential infrastructure) to be built in floodlines and therefore are at a high risk of flooding, together with the lack of formal stormwater infrastructure may lead to injury loss of life to residents.

C.5.2 Roads

Typical Pavement Defects were observed on urban roads:

- Potholes.
- Some Disintegration of asphalt surfacing.
- Some washing away of asphalt surfacing.
- Signs of repeated and failing rehabilitation measures such as Extensive Patching, Overlays and Slurry Seals.

Typical Pavement Defects were observed on rural roads:

- Time it was lastly reshaped and re-gravelled
- Defects shown are regarded as maintenance issues
- Problems with the main rural gravel roads and residential gravel roads leading to the schools and community halls were inaccessible during rainstorms.
- The aspect of inaccessibility is particularly evident on sections of roads with a steep gradient and with roads with a wearing course consisting of a lot of fine material.
- Rural residential access roads were the formation of dongas, washing away of the road during major rainstorms and the lack of accessibility for cars due to the disintegration of the wearing course.
- Unsafe river crossings. Mostly low water bridges have been provided in the form of a culvert bridge crossing.
- Lack of vehicular access roads to schools which often cross rivers/streams.
- Rocky road surface is mainly attributed to the natural geology of these areas. This leads to extremely difficult driving conditions and resulting in excessive travel times.



CHAPTER D : FUTURE DEMAND ASSESSMENT (ROADS)

D.1 INTRODUCTION

In order to do a future demand assessment for the Midvaal Local Municipality (MLM), the status quo of traffic demand had to be determined first to establish the base traffic in the area. Traffic data sourced from the Midvaal Local Municipality, recent TIA's as well as the provincial authority, namely Gautrans (GPDRT) had been used for this purpose. The traffic data comprises intersection counts as well as link counts undertaken in key areas within the municipality.

To further assist with the future demand assessment for the MLM, information received from other sources such as the SDF, IDP, Precinct Plans, National Census Data as well as information received directly from the MLM had been used.

Once the status quo traffic demand had been determined, a future demand was calculated through the application of an average annual growth rate determined using the available data discussed further in this document.

A functional road classification of the existing road network within the municipality, which includes all the local (MLM), provincial (GPDRT) and national (SANRAL) roads traversing the study area was undertaken. Apart from the existing road network, the future provincial road network (i.e., future K-routes and PWV freeways) as well as potential Class 3 roads identified by the municipality have been included in this plan.

Furthermore, using the information presented in this document, possible projects relating to road infrastructure upgrades have been identified and categorized as either short-term, medium-term, long-term or general projects which may be used by the municipality to assist with decision-making processes. These projects have been identified based on-site visits, traffic analyses and reviewing recent traffic engineering literature, such as TIA's that were undertaken within the municipality.

D.2 FUNCTIONAL CLASSIFICATION OF EXISTING & FUTURE ROAD NETWORKS

To have a proper functional road classification in place assists the municipality with decision making processes such as deciding the priority of which gravel roads should become paved in the future i.e., higher priority should be given to the higher order roads which are unpaved. The functional classification of roads stands out as a cornerstone in the road provision industry. This principle acknowledges the impracticality of constructing an entire road network solely comprised of moderate-speed (higher order) mobility roads.

In close proximity to trip origins and destinations (i.e., along access roads), it becomes essential to limit vehicle traveling speeds to ensure secure and safe access to individual properties. Conversely, as one moves away from these points, the road network should facilitate travel along mobility roads that can accommodate higher speeds.

A road network designed with functionality in mind acknowledges that journeys unfold in a hierarchical fashion, encompassing distinct travel stages that span from access to mobility.

A road network is typically classified according to the *COTO TRH 26 South African Road Classification and Access Management Manual*. The aforementioned manual proposes a six-class rural (R) and urban (U) road classification system as per **Table 3** below.



The first three classes in the system consist of mobility roads while the second three classes are access/ activity roads or streets. In general, Class 1 & 2 roads would be viewed as national & provincial roads while the remaining Class 3-6 network would be fall under the jurisdiction of the local municipality. In this case, many typical Class 3 roads within the study area are actually provincial GPDRT district roads.

The functional road classification system is as follows:

Table 3: Functional Road Classification System

Road Class	Function	Description
Class 1	Mobility	Principal Arterial
Class 2		Major Arterial
Class 3		Minor Arterial
Class 4	Access / Activity	Collector Street
Class 5		Local Street
Class 6		Pedestrian Walkway

(Sourced from COTO TRH 26 South African Road Classification and Access Management Manual)

According to the *TRH 26* there are three primary criteria that are used to distinguish the various functional road classes, namely:

- **Size and strategic importance of the trip generator:** Mobility roads play a crucial role in connecting significant trip generators and development hubs, whether in rural or urban areas. Access streets, on the other hand, serve the purpose of providing direct or indirect access to individual properties, facilitating the collection and distribution of traffic between these properties and the broader network of mobility roads.
- **Reach of connectivity (travel distance):** The necessity for mobility roads arises when covering longer travel distances, ensuring they cater to traffic between major destinations. Access roads, conversely, are designed for local traffic within a much smaller target area.
- **Travel Stage:** The process of undertaking a trip involves three distinct stages: local at the origin, travel between the origin and destination, and local at the destination. The local nature of travel characterizes departures from the origin or arrivals at the destination. As the journey extends beyond the immediate origin or destination, the travel transitions to a 'through' nature.

Access roads are ideally suited for serving the local portions of a trip, while mobility roads efficiently cater to the 'through' portions.

A typical extract of the functional road classification is shown in **Figure 50** below in the vicinity of Meyerton. The full model can be found in **Annexure A** and will also be provided electronically so that the municipality may continuously update this plan as they see it. Each road segment has been categorized based on its functionality according to the various different road classes listed in **Table 3**.



The following colours are used to represent the five (5) different road classes as follows:

- Class 1 (Principal Arterial)
- Class 2 (Major Arterial)
- Class 3 (Minor Arterial)
- Class 4 (Collector Street)
- Class 5 (Local Street)



The Class 1-3 road classification is in accordance with **Figure 50**. This includes the existing roads as well as the future planned roads found within the Midvaal Local Municipality. The future Class 1 roads are all the planned provincial PWV routes, the future Class 2 roads are all the planned provincial K-routes and the future Class 3 roads are all the planned minor arterials. The classification presented in **Figure 50** therefore incorporates the local Class 4 and Class 5 roads as well.

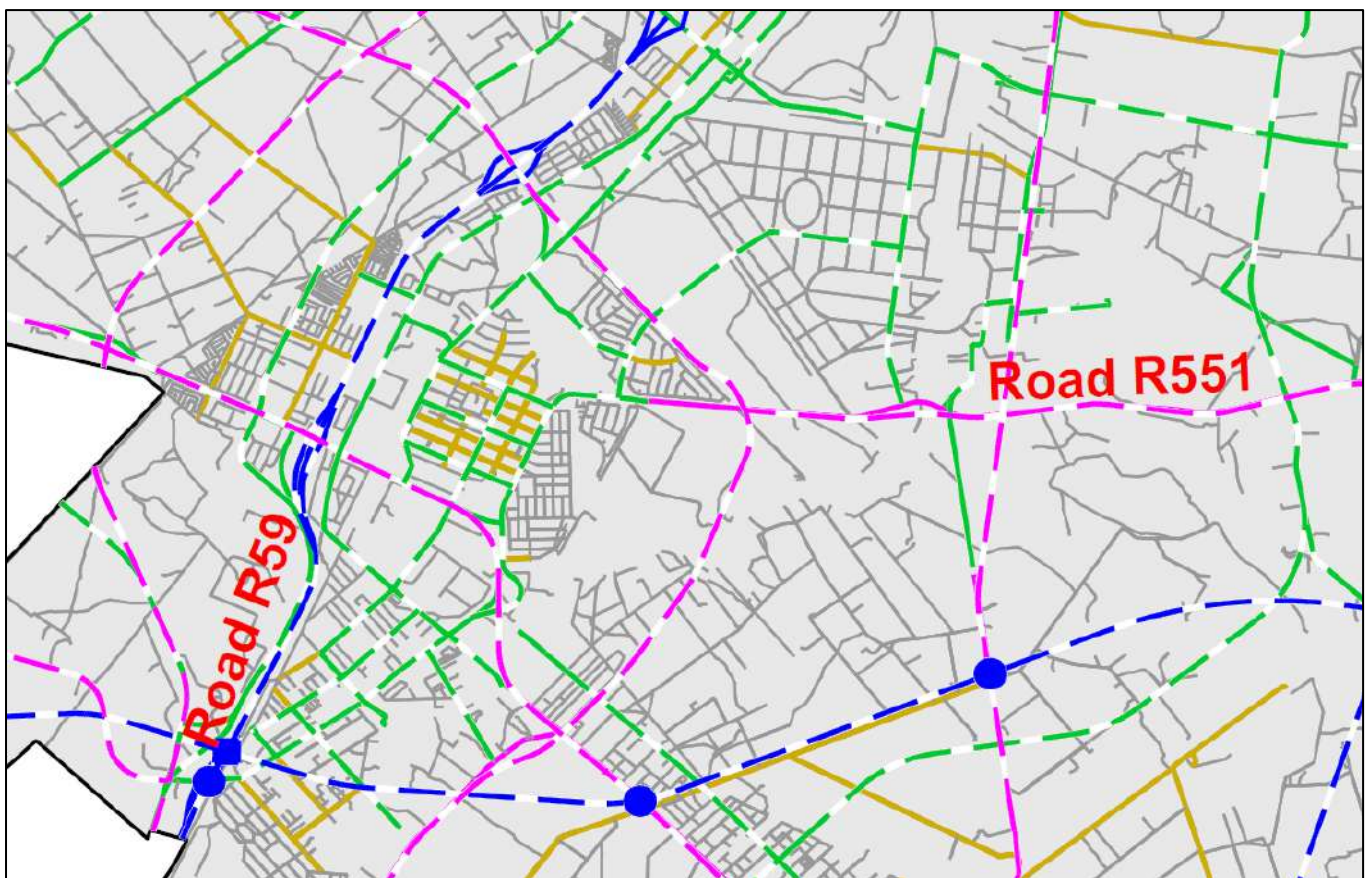


Figure 50: Extract of Functional Road Classification Near Meyerton

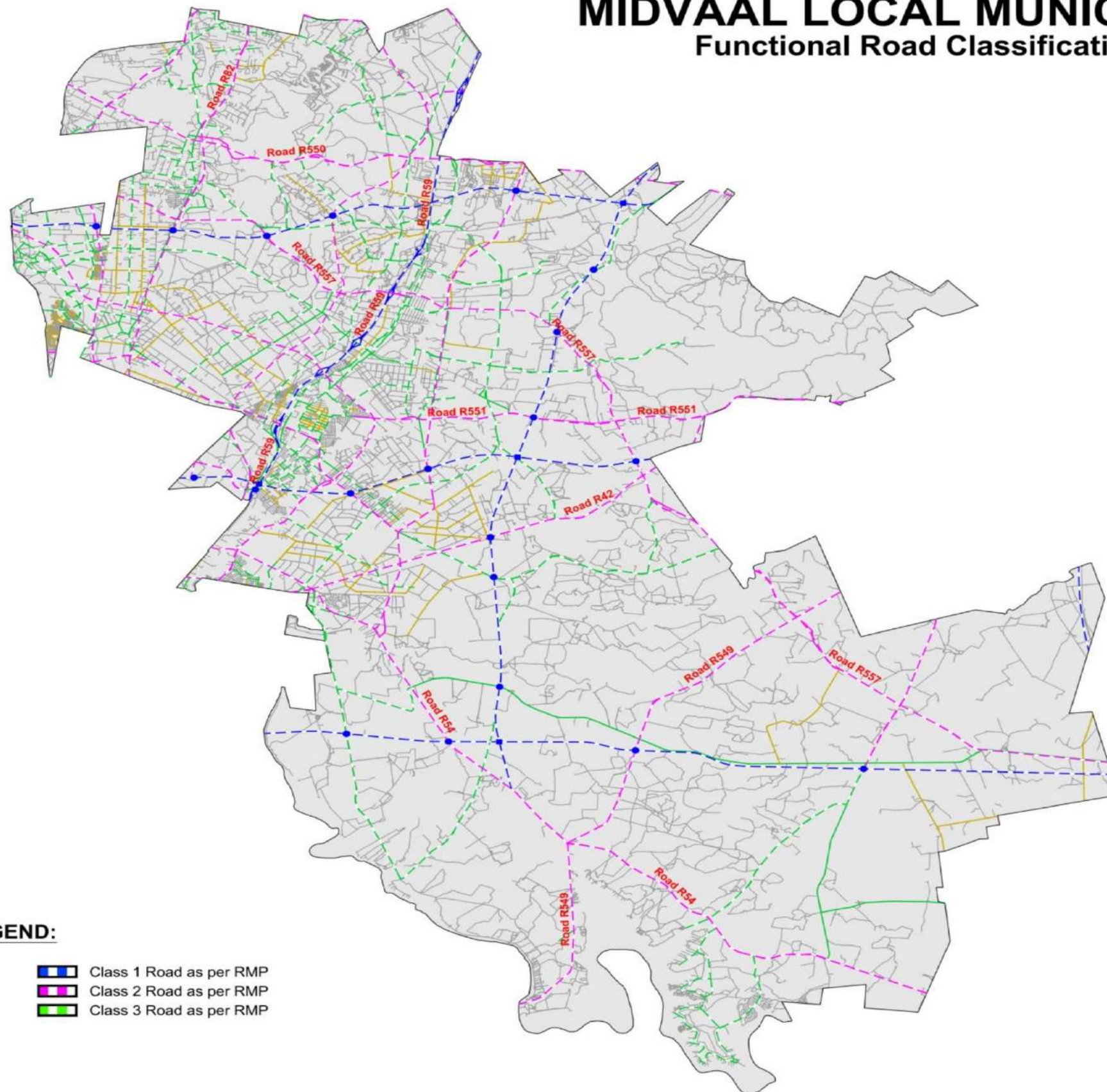
Table 4: Legend Classification for Functional Roads

LEGEND:			
	Class 1 Road		Class 1 Road as per RMP
	Class 2 Road		Class 2 Road as per RMP
	Class 3 Road		Class 3 Road as per RMP
	Class 4 Road		
	Class 5 Road		



MIDVAAL LOCAL MUNICIPALITY

Functional Road Classification



LEGEND:

 Class 1 Road	 Class 1 Road as per RMP
 Class 2 Road	 Class 2 Road as per RMP
 Class 3 Road	 Class 3 Road as per RMP
 Class 4 Road	
 Class 5 Road	

Drawing 1: Midvaal Local Municipality Functional Road Classification



D.3 EXISTING TRAFFIC DEMAND & TRAFFIC PATTERNS

D.3.1 Available Traffic Data

Valuable traffic datasets were provided by the Gauteng Province Department of Roads & Transport (GPDRT) and Midvaal Local Municipality. The aforementioned institutions have jurisdiction over the provincial and local road networks traversing the municipality, respectively. These datasets have provided valuable traffic flow information to assist with the understanding of vehicular movement along the municipality's development corridors. The various data sets are listed below.

Intersection Traffic Data from Various Sources (TIA's & Precinct Plans):

2019 Weekday AM & PM Counts:

- Meyer Street & Joubert Street
- Meyer Street & Loch Street
- Pierneef Boulevard & Loch Street
- Reitz Street & Galloway Street

2022 Weekday AM & PM Counts:

- Morris Road (M61) & Meyer Road
- R59 & Meyer Road Eastern Terminal
- R59 & Meyer Road Western Terminal
- R59 & Johan Le Roux Road (R551) Eastern Terminal
- R59 & Johan Le Roux Road (R551) Western Terminal
- Morris Road (M61) & Meyer Road
- R59 & Meyer Road Eastern Terminal
- R59 & Meyer Road Western Terminal
- R59 & Johan Le Roux Road (R551) Eastern Terminal
- R59 & Johan Le Roux Road (R551) Western Terminal

Intersection Traffic Data from Midvaal Local Municipality:

Data obtained from the Midvaal Local Municipality included intersection counts undertaken near the end of 2023/ beginning of 2024 in the vicinity of the following 20 intersections:

- Road R82 & Dan Pienaar Drive
- Hartzenbergfontein Road & Loes Road
- Main Street & 4th Street
- Road R82 & Du Plessis Street
- Road R82 & Boundary Road
- Joan Road & Elizabeth Road
- Randvaal Road & Malcolm Road
- Johan Le Roux Road & Gourlay Street
- Springbok Road & Meyer Road
- Meyer Road & Joubert Street
- R551 & Morris Road
- Pierneef Blvd & Viljoen Avenue
- Johan Le Roux Road & Galloway Street
- Pierneef Blvd & Mimosa Drive
- Pierneef Blvd & Reitz Street
- Pierneef Blvd & Jim Fouche Road
- Henley Road & Cleeve Road
- Road R551 & Ewelme Road
- Jim Fouche Road & Garfish Road
- Anchovy Road & Uitvlugt Road



Link Traffic Data from Gautrans (GPDRT)

Data obtained from Gautrans included link counts undertaken between 2019-2023 for specific links on the following provincial roads:

- | | |
|----------|---------------------|
| • P1/1 | • D2150 |
| • P25/1 | • D2182 |
| • P41/2 | • D2222 |
| • P156/2 | • D2310 |
| • P167/1 | • D2364 |
| • P243/1 | • D2529 |
| • D1073 | • D2811 |
| • D1220 | • D359 |
| • D1240 | • D427 |
| • D1289 | • D478 |
| • D1313 | • D64 |
| • D1321 | • D67 |
| • D1322 | • D766 |
| • D1422 | • D786 |
| • D1463 | • D83 |
| • D1490 | • D871 |
| • D1576 | • D878 |
| • D1607 | • D904 |
| • D1729 | • D905 |
| • D1781 | • D64 – P156 N Ramp |
| • D1884 | • D766 |
| • D2062 | • D817 |
| • D2065 | • P156 N – D64 Ramp |
| • D2079 | • P46/1 |

D.3.2 Traffic Patterns & Public Transport Usage

Within the Midvaal Local Municipality, traffic patterns exhibit a unique blend of inter-nodal and intra-nodal dynamics, reflecting the diverse land uses and connectivity between various towns and within local communities. Inter-nodal trips involve transportation between distinct towns situated mainly along the municipality's main development corridors such as the R59 and R82.

These trips often occur along major roadways, facilitating the movement of goods, services, and commuters between different economic hubs and residential areas. In contrast, intra-nodal trips encompass travel within towns, navigating through different land uses such as commercial districts, industrial areas, residential neighbourhoods, and recreational spaces. These journeys depict the intricate network of smaller roads and streets accommodating local traffic, facilitating daily activities, social interactions, and access to amenities within the municipality.



The road carrying the highest number of daily traffic volumes is the R59 freeway (Class 1 Road) since this is the main freeway connecting Midvaal with various other areas such as Alrode /Alberton to the north and Sasolburg (Free State Province) to the south among others. Due to the mobility that this road provides, it attracts the most traffic volumes. Furthermore, most of the traffic volumes/ economic activity within the municipality are concentrated around the north-western region of the municipality in and around the town of Meyerton which is predominantly considered urban in nature.

As one moves away from Meyerton into the more rural/ agricultural areas, especially in a south-eastern direction towards Vaal Marina, the traffic volumes decrease significantly with the majority of the asphalted road network in these areas being the provincial roads traversing the area. In the south-eastern regions of the municipality, Vaal Marina is considered to be the only urban area in this region with the rest being rural/ agricultural areas.

In terms of public transport usage, according to the SDF, minibus taxis are the most popular of form of public transport in Midvaal with buses being the second most popular. The following roads are utilized by taxis in particular:

- Road R59
- Road R82
- Road R551 from Road R82 via Meyerton towards Henley-on-Klip
- Road R550 west from Tedderfield towards Orange Farm
- The R550 east from Road R59 (Waterval) towards the N3
- Road R42, Road R54 and the road to Bantu Bonke in the south

The traffic data sets from Gautrans and Midvaal respectively also confirms the presence of these services. As summarized in **Table 5** below, the vehicle modal splits that were determined are very similar for both datasets. Although the data does not represent all the traffic within the entire municipality, it does cover a significant portion of the major roads in the MLM and therefore it provides a good indication of the type of vehicles found within the study area.

Table 5: Vehicle Model Split from Various Datasets

Vehicle Class	Midvaal Dataset	Gautrans Dataset
Light Vehicles	82%	83%
Minibus Taxis	6%	5%
Buses	1%	1%
Heavy Vehicles	11%	11%

An extract from the Midvaal Local Municipality's SDF is included as **Annexure B** to this report. With reference to **Annexure B**, which shows a key plan of the entire municipality in terms of its nodal hierarchy, the following insights are relevant:



The various settlements within the municipality have been divided into three main categories comprising 14 individual nodes in total: Primary Urban Nodes (highest order), Secondary Urban Nodes and Rural Nodes (lowest order). The settlements within MLM have been categorized as follows:

Primary Urban Node:

1. Meyerton Town

Secondary Urban Nodes:

2. De Deur (Future CBD)
3. Savanna City
4. Waterval (Future CBD)
5. Daleside
6. Henley-on-Klip
7. Risiville
8. Eye of Africa
9. Tedderfield
10. Elandsfontein
11. Walkerville
12. Vaal Marina
13. Mamello

Rural Node:

14. Bantu Bonke

Investment is required in these aforementioned areas in order to progress the economy of the municipality as a whole. However, to make the area attractive for investment, the provision of a transport network that forms the backbone of the economy is crucial.

A primary urban node, which in this case is Meyerton, has the highest potential for growth and should also already have an established and diverse economy which is accompanied with functional engineering infrastructure. With the expansion of Meyerton, the nearby residential settlement, Sicelo, is also expected to grow in population thus requiring more engineering infrastructure, such as paved/ asphalted roads to be provided.

The secondary urban nodes are considered areas which are well located in relation to national/ provincial roads (i.e., mobility routes) and plays an important role in the local economy of the study area. These areas tend to have a high potential for future developments. The local economies of these nodes are



smaller than that of the primary urban node i.e., Meyerton and the engineering infrastructure in these nodes are also lacking in some areas.

Rural Nodes, which are the lowest order nodes found within the municipality, are characterized as small rural settlements with very small populations that are typically isolated from the mobility road network, which also makes it difficult to provide efficient service delivery areas. Another form of these service points are small villages located along mobility routes near agricultural land and which only serves a small number of local farming communities. Local service points tend to have minimal economic potential and the main goal for these areas is to provide adequate engineering infrastructure, such as paved roads, to cater to the residents' basic needs. Bantu Bonke has been identified as local service points within the municipality. For an economy to function effectively, the identified growth points need to be complemented by transport corridors to facilitate the efficient movement of goods and people.

In the case of Midvaal Local Municipality, the following higher order roads are viewed as transport corridors:

- **The R59 Corridor:** The R59 is of significant importance since it connects the municipality with the City of Ekurhuleni and City of Johannesburg to the north as well the N1 to the south-west in the Free State province. The road is therefore part of an extensive network at both regional and national levels This is the highest order road within the municipality that also passes the highest order urban node in the municipality i.e., Meyerton.
- **The R82 Corridor:** The R82 is located to the west the R59 and is an alternative route to the N1 highway, providing a toll-free option for travellers. This road connects the municipality with the southern parts of Johannesburg to the north and Kroonstad, passing through Vereeniging and Sasolburg along the way, in a south-western direction.

It is expected that developments in the vicinity of these corridors would be prioritized before any other corridors would be identified and developed. Thus, as development along these corridors are stimulated, the traffic along these roads as well as the local traffic would increase.

With capital investment in the area, the identified growth points are expected to experience growth in terms of both population size and local economic development. The expanding population sizes, coupled with the potential for local economic development, are envisioned to foster the economic progression of these settlements. This, in turn, could lay the groundwork for sustained, long-term growth and development.

D.4 TRANSPORTATION MODEL

D.4.1 Model Requirements

The ideal transport model for assessing future demand in the road network of Midvaal Municipality would typically involve a comprehensive Transportation Demand Model (TDM) designed to forecast travel patterns, evaluate existing transportation systems, and project future demands based on various factors. Listed below are the critical factors required for such a model:

1. Demographic and Socio-Economic Data
2. Transport Network Data
3. Travel Behaviour Data



D.4.1.1 Demographic and Socio-Economic Data

Acquiring this data for the future traffic demand assessment is a collaborative effort drawing from multiple sources. The municipality's Spatial Development Framework (SDF) serves as a fundamental resource, containing crucial information on population growth, employment trends, household incomes, land-use patterns, and planned future developments. Detailed insights and updates regarding these factors can be obtained through considerable collaboration with the municipal council.

This information plays a pivotal role in anticipating and determining future traffic demand. Population growth trends offer insights into potential increases in commuters, influencing traffic volume projections. Employment trends aid in understanding commuting patterns and peak travel times.

Household income levels are indicative of vehicle ownership rates and preferences for transportation modes. Land-use patterns and development plans provide essential cues for predicting changes in travel patterns, identifying potential areas of congestion, and assessing the need for infrastructure upgrades.

D.4.1.2 Transport Network Data

Acquiring this data for forecasting future traffic demand relies on a mixed approach involving extensive traffic data surveys, public transport use surveys, and collaborative efforts with the municipal council. These surveys entail meticulous data collection on various aspects of the existing transportation infrastructure, including details on road networks, traffic flow data, road capacities, public transport routes, and rail lines. Collaboration with the municipal council will allow access to official records, plans, and updates concerning transportation infrastructure. This important source of information plays a pivotal role in gauging future traffic demands.

Accurate data on road networks and traffic flow helps in understanding current congestion points and traffic patterns, aiding in the projection of future traffic volumes and identifying areas prone to bottlenecks or increased demand. Information on road capacities, and public transport routes assists in evaluating the efficiency of existing transportation modes and infrastructure which will in turn inform decisions regarding upgrades or modifications necessary to accommodate anticipated future demands. The comprehensive Transport Network Data acquired through these surveys and collaborations is instrumental in formulating strategies and plans to optimize the road network, enhance transportation efficiency, and meet the evolving needs of commuters and travellers within Midvaal Municipality.

D.4.1.3 Travel Behaviour Data

Obtaining this essential data involves a comprehensive approach that integrates extensive public surveys, collaboration with the municipal council to assess public transit ridership, and the use of an intermodal model to determine preferred modes of transport. Public surveys meticulously collect data on travel patterns, trip origins, destinations, purposes, and the modes of transport utilized, including travel times and distances covered. Collaborative efforts with the council provide insights into public transit ridership trends and patterns.

This data provides a detailed understanding of how people move within the municipality. Insights derived from travel behaviour data facilitate the prediction of future travel patterns, modal preferences, and anticipated changes in commuter behaviours. This information serves as a critical foundation for transportation planners to develop effective strategies, optimize infrastructure, and tailor transportation solutions that align with the evolving needs and preferences of travellers in Midvaal Municipality, thus enhancing the overall efficiency of the transportation network.



D.4.2 Transport Model

The ideal transport model would use the above inputs to determine zones within the study area that would act as trip origins and destinations, and inform the following key procedures:

1. Trip Generation: Determine how many trips each zone would produce and attract;
2. Trip Distribution: Distribute these trips between the other zones;
3. Transport Mode Choice: Determine the transport mode choice; and
4. Trip Assignment: Assign these trips to the relevant transport networks.

D.4.2.1 Trip Generation

The aim of this procedure is to determine the number of trips generated by and attracted to each zone. This is typically done using regression equations calibrated according to the gathered data described in the previous section, specifically data acquired which provide insights into trip rates and trip origins and destinations. The trips generated are total trips which is the sum of all the trips made by various modes of transport, the modal split is discussed in the following sub-sections.

Figure 51 below illustrates the attracted and generated trips for Zone A as an example.

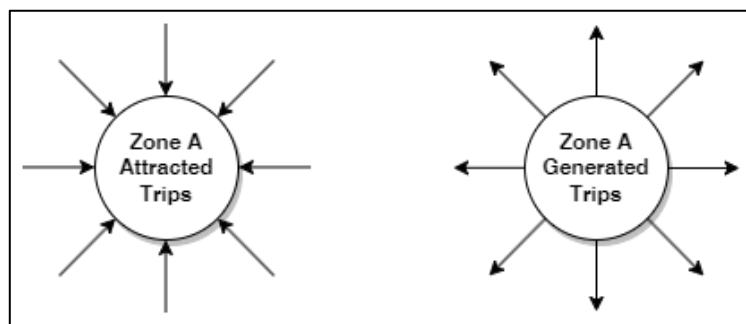


Figure 51: Attracted and Produced Trip Diagram

D.4.2.2 Trip Distribution

With each zone's attracted and generated trips determined, the following procedure is to distribute the trips between each zone. Continuing on the example in **Figure 51**, the trips generated from zoned A are then proportioned and distributed to Zone B, Zone C, etc. The same is done for each zone which results in a finished model that resembles **Figure 52** depicted below.

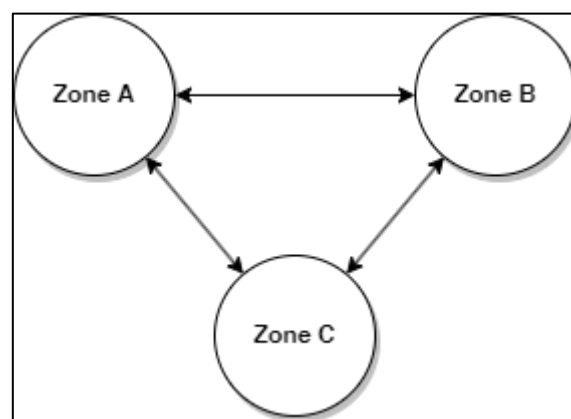


Figure 52: Trip Distribution Diagram

There are different ways to decide how many trips are distributed from each zone to every other zone. One method is to create a choice model, such as a logit model, where each zone is a destination, and



people's choice of destination is based on factors like distance or cost of travelling between two zones. This method requires a lot of data, so an alternative is to treat people at a group level instead of the individual level by using the gravity model.

The gravity model is based on the physics equation used to determine the gravitational force of attraction between planets. The principle of this equation is that larger planets have a higher force of attraction to other planets. Similarly, zones with a high number of attracted trips will attract a large portion of every other zone's generated trips.

D.4.2.3 Intermodal Model (Transport Mode Choice)

The ideal transportation model would account for the different modes of transport using an intermodal model. This intermodal model is essentially a choice model that makes use of utility functions which determine the preferred mode of transport by assigning weights to variables like travel time, distance travelled, cost of travel such as fuel or bus/taxi fare, convenience, and other factors influencing traveller decisions.

Typically, specialist transportation software is used to construct such a choice model; however, the general principle is to determine the utility functions for each choice which will inform the probabilities of each mode choice. The typical linear utility function is shown below.

$$U_{m_1} = \beta_0 + \beta_1 \cdot (A_1) + \beta_2 \cdot (A_2) + \beta_3 \cdot (A_3) + \dots + \beta_n \cdot (A_n)$$

Whereas:

U_{m_1} = Utility function for transport mode " m_1 " such as car, bus, taxi, etc.

A_n = n^{th} Attribute such as travel time, cost, convenience, etc.

β_n = Estimated weight for the n^{th} Attribute

The utility functions for each mode of transport then inform the probability of individual selecting that mode. An example of the equation used to determine these probabilities is presented below. This equation shows the probability that mode m_1 will be chosen out of a total of n transport mode choices.

$$P_{m_1} = \frac{e^{U_{m_1}}}{e^{U_{m_1}} + e^{U_{m_2}} + e^{U_{m_3}} + e^{U_{m_4}} + \dots + e^{U_n}}$$

Whereas:

P_{m_1} = Probability of choosing transport mode " m_1 "

U_{m_1} = Utility function for transport mode " m_1 "

e = Euler's constant

The utility functions for each mode of transport then inform the probability of individual selecting that mode. An example of the equation used to determine these probabilities is presented below. This equation shows the probability that mode m_1 will be chosen out of a total of n transport mode choices.

$$P_{m_1} = \frac{e^{U_{m_1}}}{e^{U_{m_1}} + e^{U_{m_2}} + e^{U_{m_3}} + e^{U_{m_4}} + \dots + e^{U_n}}$$

Whereas:

P_{m_1} = Probability of choosing transport mode " m_1 "

U_{m_1} = Utility function for transport mode " m_1 "

e = Euler's constant



For instance, if an individual can choose between driving their car, taking a bus or taxi, walking or taking the train the probability that they would take a taxi can be calculated as follows:

$$P_{taxi} = \frac{e^{U_{taxi}}}{e^{U_{taxi}} + e^{U_{bus}} + e^{U_{walk}} + e^{U_{train}} + e^{U_{car}}}$$

D.4.2.4 Trip Assignment

With the number of trips to and from each zone and the modal split of these trips known, these trips can then be assigned to their respective transport networks.

Simply put, vehicle trips are assigned to the road network, and passenger trips are assigned to the public transport network. Trips for cars and taxis/buses would be assigned to the same road network (taxi/bus trips would be assigned to their specific routes), while the trips for train passengers would be assigned to the railway network.

In reality, there are typically multiple routes between any two zones. To solve for the traffic counts on each route, user equilibrium can be used. The assumption is that users want to minimise their travel time and cost by using shorter/cheaper routes.

With the determined trips assigned to their respective networks, the supporting infrastructure can then be analysed to determine any capacity issues.

D.4.3 Constraints

While the model described above would be ideal for forecasting future demand as it can be easily updated and calibrated on a continuous basis, in reality this is a costly exercise that would require extensive collaboration between stakeholders. In order to create such a model, the following issues will need to be addressed.

D.4.3.1 Data Availability and Quality

Access to comprehensive, accurate, and updated data concerning demographics, land use, transport networks, and travel behaviours is crucial. Inadequate or inconsistent data can impact the accuracy and reliability of the model's predictions.

Extensive traffic surveys will need to be conducted on local municipal roads to get an accurate idea of the traffic conditions.

D.4.3.2 Resource Constraints

Developing and implementing a traffic demand model requires significant resources, including financial, technical expertise, and time. Constraints in these areas might limit the scope or sophistication of the model.

D.4.3.3 Stakeholder Collaboration

Effective implementation of the model often requires collaboration and data-sharing among various stakeholders, including municipal authorities, transport agencies, and other relevant bodies. Establishing such collaboration might face challenges due to conflicting interests.



D.4.3.4 Public Perception and Participation

Engaging and obtaining buy-in from the public for the model's implementation and potential outcomes is crucial. Addressing concerns or perceptions about data privacy or potential disruptions due to transportation changes is essential. Given the need for surveys on the public's travel patterns, their cooperation is essential.

D.4.4 Proposed Alternative to Transport Model

Due to the constraints and challenges outlined earlier, it is not feasible to implement an intricate and comprehensive transport model with the available resources. Consequently, an alternative and more simplified model showing the status quo traffic demand and future traffic demand is proposed as outlined in the following sections.

This alternative model aims to streamline the data requirements, focusing on essential factors and readily available information to make reasonable projections regarding future traffic demands. By simplifying the model, it allows for a more practical and feasible approach while still providing valuable insights into anticipated traffic patterns and potential transportation needs within the Midvaal Local Municipality. In addition to the aforementioned model, 20 key intersections within the municipality for which recent traffic data has been provided by Midvaal Local Municipality, have been modelled using PTV Vistro traffic engineering analysis software to determine whether any capacity upgrades are required at these intersections in the short-, medium- or long-term.

D.5 FACTORS CONSIDERED TO DETERMINE FUTURE DEMAND

Determining the future traffic demand in a study area as large as the Midvaal Local Municipality involves a combination of data analysis and consideration of various factors that may influence traffic patterns. The following factors have been taken into consideration to determine an average traffic growth rate per annum for the Midvaal Local Municipality:

- Population Growth and Demographics
- Vehicle Modal Split
- Historic Traffic Data Comparison

D.5.1 Population Growth and Demographics

Using the latest 2022 national census data as well as the previous 2011 census data, a comparison can be drawn up in terms of the population and demographic trends that could potentially influence the future traffic demand. The relevant factors are listed in **Table 6** below:

Table 6: 2011 vs 2022 Census Data Comparison for Midvaal Local Municipality

Census Item	2011	2022	% change from years 2011-2022
Total Population	95 301	112 254	+1.5% p.a.
Young Children (0-14 years)	23.2%	22.3%	-0.9%
Working Age Population (15-64 years)	70.5%	70.4%	-0.1%
Elderly (65+ years)	6.3%	7.3%	+1%
Dependency ratio	41.9%	42%	+0.1%

(Sourced from StatsSa, Department of Statistics South Africa)



Based on the 2022 census data, it was determined that the population has grown at a rate of $\pm 1.5\%$ per annum since the previous 2011 census was done. In general terms, an increase in the population alone does not necessarily imply a higher traffic demand. An increased traffic demand would more likely be due to an increase in the working age population that is accompanied by the provision of more job opportunities that forms the backbone of the economy. The census data does, however, show that the working age population percentage and dependency ratio percentage has remained roughly the same between 2011-2022. This suggests that traffic growth could be possible since the population has grown and the working age population has remained the same.

D.5.2 Vehicle Modal Split

Determining the vehicle modal split using traffic data can provide an indication of the favoured mode of transport in the area which would also prove useful in possibly determining the future traffic demand. If for example, there is a high reliance on minibus taxis as the primary mode of transport in an area, an increased demand for transport would result in more taxis providing services in the area. As taxis can transport more individuals per vehicle as opposed to light vehicles, the number of additional vehicles would in fact be less if this additional demand is met by private light vehicle usage instead of minibus taxis. Using the available daily traffic data (expressed in terms of Average Annual Daily Traffic (AADT)), a vehicle modal split between minibus taxi's, buses, light vehicles and heavy vehicles could be established. The estimated vehicle modal split is summarised in **Table 7** below and takes into account the traffic data that was provided by Gautrans as well as Midvaal.

The data presented in **Table 7** suggests that there is indeed a significant reliance on public transport, particularly minibus taxis, in the Midvaal Local Municipality. The available traffic data indicated that 5% of all the surveyed vehicles were in fact minibus taxis. Light vehicles constitute the majority of the vehicles on the roads at about 83%, but if one takes into account the number of people transported in a minibus taxi, it can be determined that a large number of people actually travel by means of minibus taxis within the study area.

With more development occurring within the municipality, the demand for transport will also increase as a result. Given the demographics and vehicle modal split of the area, it is expected that particularly minibus taxis and light vehicles will be the favoured mode of transport that would be utilized by the new vehicle trips generated by any future new developments.

Table 7: Estimated Vehicle Modal Split in Midvaal Municipality

Vehicle Class	AADT (Midvaal Data)	AADT (Gautrans Data)	AADT (All Data)	Percentage of Total AADT (%)
Light Vehicles	115 352	387 864	503 216	$\pm 83\%$
Heavy Vehicles	14 744	50 890	65 634	$\pm 11\%$
Taxis	9 053	22 985	32 038	$\pm 5\%$
Buses	1 136	2 779	3 915	$\pm 1\%$
TOTAL	140 285	464 518	604 803	100%



D.5.3 Historic Traffic Data Comparison

The link traffic data received from Gautrans also included older counts for the same road links for the years 2019 to 2023. Since multiple data entries from different periods were available for these links, the traffic volume change over time could be determined and subsequently, an annual average growth rate (%) was calculated using the available data. The data used to determine the growth rate discussed below is provided in **Annexure C**.

Using the compound growth formula, the average traffic growth based on the available historic traffic data was determined as follows:

$$AADT_{Future} = AADT_{Present}(1 + i)^n$$

Whereas:

$AADT_{Future}$ = Average Annual Daily Traffic for Future Year

$AADT_{Present}$ = Average Annual Daily Traffic for Base Year

i = Growth Rate per Annum

n = Time Period (Years)

Solving for i :

$$i = \sqrt[n]{\frac{AADT_{Future}}{AADT_{Present}}} - 1$$

Using the data presented in **Annexure C**, based on the Historic Gautrans data that was received, an average growth rate of 2.0% p.a. was calculated.

D.6 DETERMINATION OF STATUS QUO & FUTURE TRAFFIC DEMAND

The basic road model illustrates the status quo traffic demand for the road links for which data is available and can be continuously updated as more traffic data becomes available in the study area.

Along with site visits to the study area, it was further required to work closely with the Spatial Development Framework (SDF) of Midvaal Local Municipality to obtain more information on the study area as a whole. The expected average annual traffic growth rate as determined in this document for the municipality could then be applied to the basic road network model in order to determine an estimation of the future traffic demand.

D.6.1 Status Quo Traffic Demand Model

For the status quo traffic basic road network model, a road categorization was done for the network model solely based on the available traffic volume data (AADT). The road categorization is summarized in **Table 8** below.

Table 8: Road Categorization Used for Network Model (Based on AADT)

Road Category	AADT Range
Category A (High Volume)	>5000
Category B (Medium Volume)	1500-4999
Category C (Low Volume)	300-1499
Category D (Very Low Volume)	0-299



A typical extract of the basic road model is shown in **Figure 53** below in the vicinity of Meyerton.

The full model can be found in **Annexure D** and will also be provided electronically. For ease of reference within the dataset (provided separately in Excel format as well), each traffic volume entry on the relevant roads has been assigned a unique ID denoted by Midvaal Local Municipality and followed by a number e.g., MLM_0. Subsequently, each road segment has also been categorized according to the criteria specified in **Table 8**.

The following colours are used to represent the four (4) different road categories as follows:

- Category A (High Volume) RED
- Category B (Medium Volume) BLUE
- Category C (Low Volume) ORANGE
- Category D (Very Low Volume) GREEN

Using the basic road model, **Chart A** below shows the number of road links that fall into each category. Category A has the fewest roads while Category C has the most roads which is expected given that any functional road network comprises few high-order, mobility roads that serve many road users, and many local access roads that serve a significantly lower amount of road users.

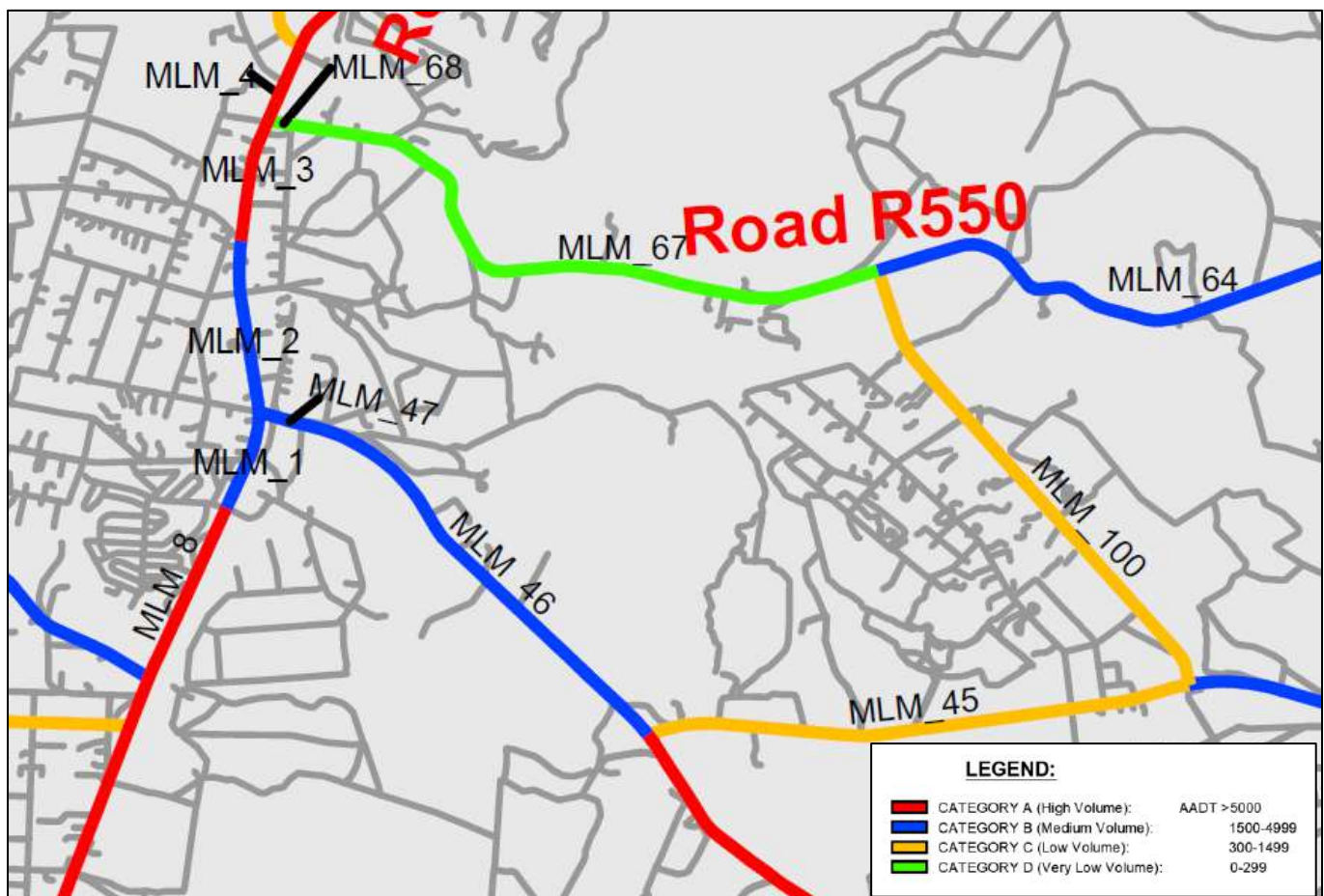
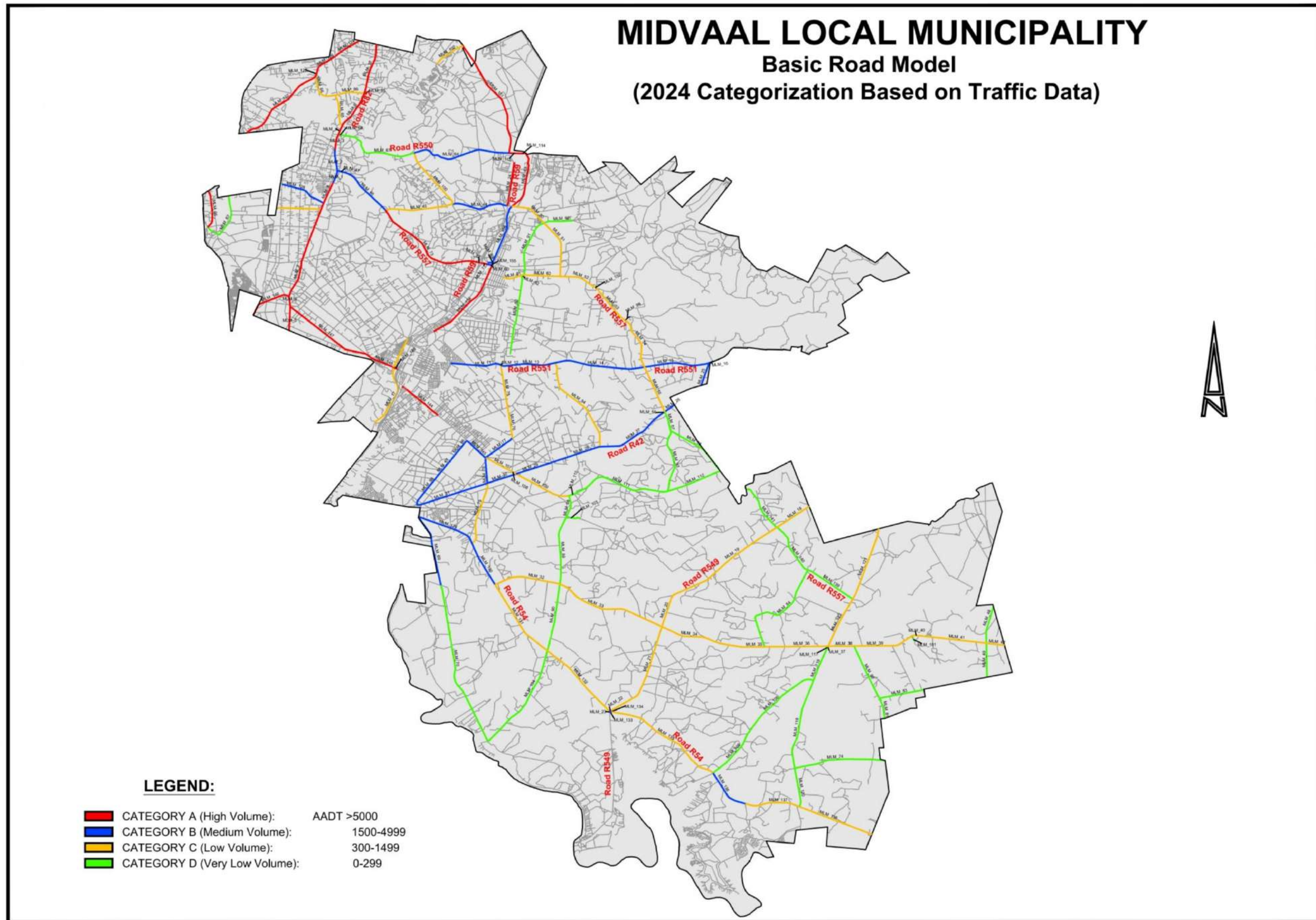
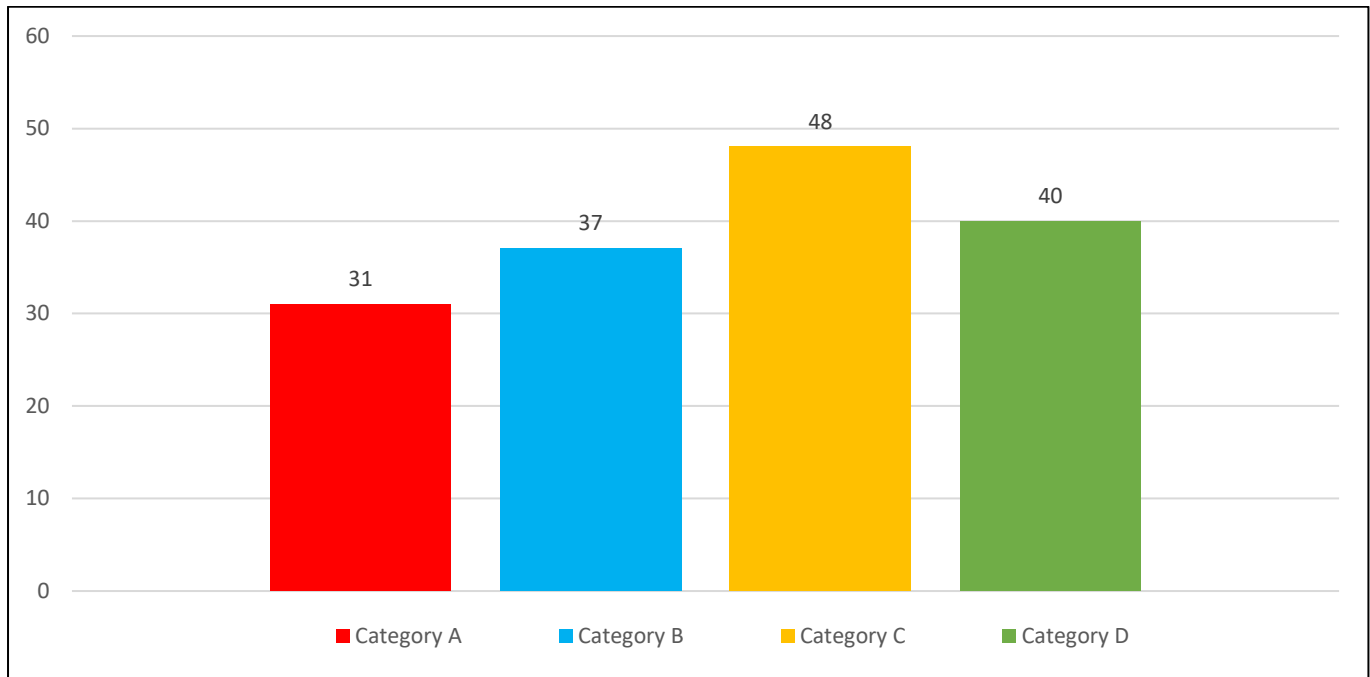


Figure 53: Extract of Basic Road Model (2024 Road Categorization Based on Traffic Data)



Drawing 2: Midvaal Local Municipality Basic Road Model 2024

**Chart A: Distribution of Road Categories**

D.6.2 Future Traffic Demand Model

The analysis of the traffic data that was available suggests that the traffic within the Midvaal Local Municipality as a whole **is increasing at a rate of approximately 2% per annum**. Considering that the population is steadily increasing as shown by the census data, it is reasonable to assume that the traffic will continue to escalate annually as well. If development along the identified transport corridors as well as within the identified key growth points such as Meyerton can be stimulated, then a stable traffic growth may be expected within the area.

The population which is steadily increasing further suggests that the demand for basic facilities such as new schools, clinics, hospitals, police stations, shopping centres etc. would also increase and would therefore in turn contribute to a growth in the future traffic demand.

Thus, after taking the aforementioned factors into consideration, for the purposes of determining the future demand, an average annual traffic growth rate of 2% has been assumed, which can be used to conservatively estimate the future traffic demand for the study area.

For the traffic forecast model, the following year periods stretching over a period of 20 years, in five-year intervals, were considered as part of the traffic forecast model:

- Estimated 2024 Status Quo Traffic Volumes
- Estimated 2029 Future Base Traffic Volumes
- Estimated 2034 Future Base Traffic Volumes
- Estimated 2039 Future Base Traffic Volumes
- Estimated 2044 Future Base Traffic Volumes

The future estimated model for the year 2044 is provided in **Annexure E** and would also be provided separately in an electronic format. Additionally, the future forecast data, for the aforementioned five-year intervals is included in table format as **Annexure F**. This represents the data used to prepare the



existing status quo 2024 traffic volume model and future 2044 traffic volume model shown in **Annexure D & E**, respectively.

D.6.3 Road Network Changes

To determine the effect of the traffic growth rate on the status quo demand, the distribution of the road categories for each of the above year periods were determined. These distributions are found in **Chart B** below.

With reference to **Chart B**, it can be seen that with each 5-year interval, Category A marginally increases while Category D experiences a marginal downward trend which was expected. Given that if a road experience sustained traffic growth, it will eventually exceed the threshold of its current category and graduate to the next category.

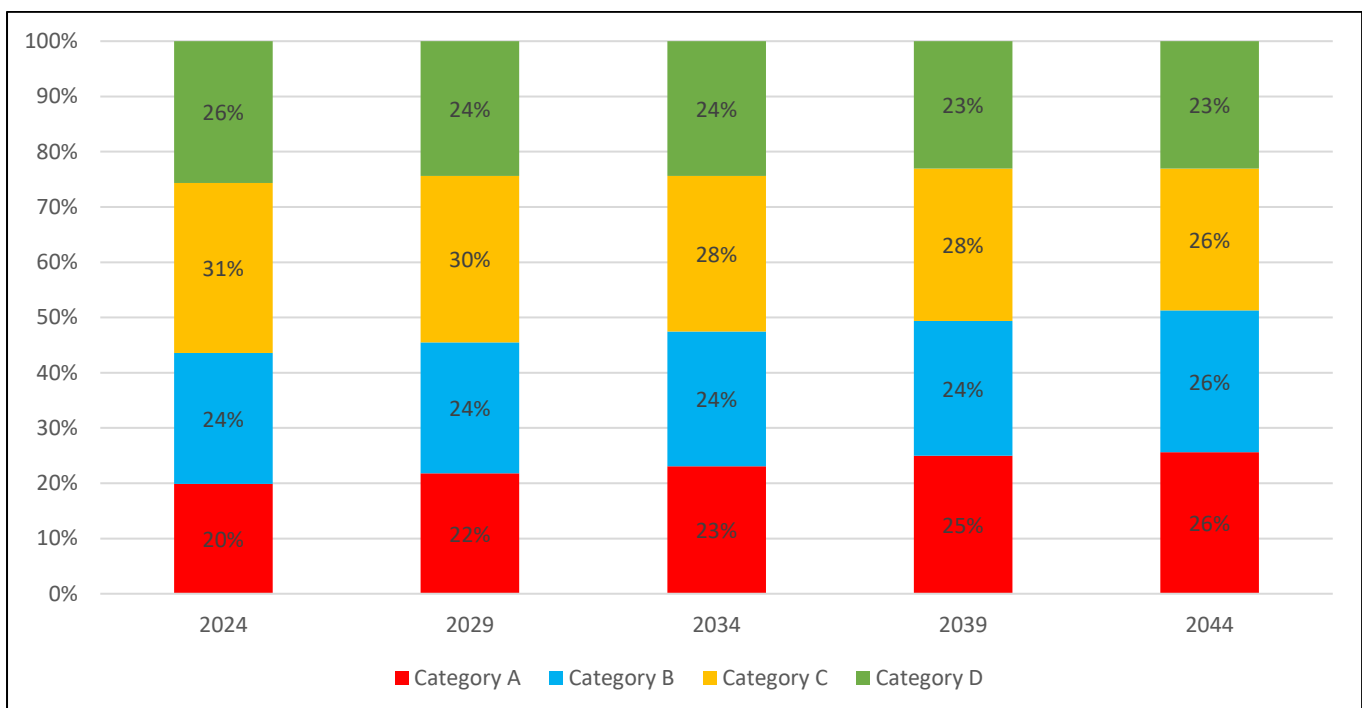
The downward trend experienced by category D is explained by the same phenomenon, the roads in this category experience growth and graduate into the category above (i.e., Category C). Additionally, Category D represents the roads with the lowest traffic volumes (i.e., 0-299 AADT), thus the only way for this Category to increase in size is for new, low order roads to be constructed or for existing roads to experience a decline in traffic volumes.

Based on **Chart B** below, the following insights can be seen for the estimated data ranging for the periods of 2024 - 2044:

- The Category A link roads will increase the most with approximately 6% from 20% to 26%
- The Category B link roads will increase with approximately 2% from 24% to 26%
- The Category C link roads will decrease the most with approximately 5% from 31% to 26%

The Category D link roads would decrease marginally with approximately 3% from 26% to 23%.

Chart B: Link Road Category Distribution for each Year Period (Gautrans Data Only)





Furthermore, the link road traffic data provided comprises a total of 156 links. Distinguishment is further made between whether the specific link is paved or a gravel road. Out of the 156 links which represents $\pm 493\text{km}$ of the provincial road network traversing the municipality, 34 of the links are gravel roads (140km) with the remaining 122 links (353km) being paved roads.

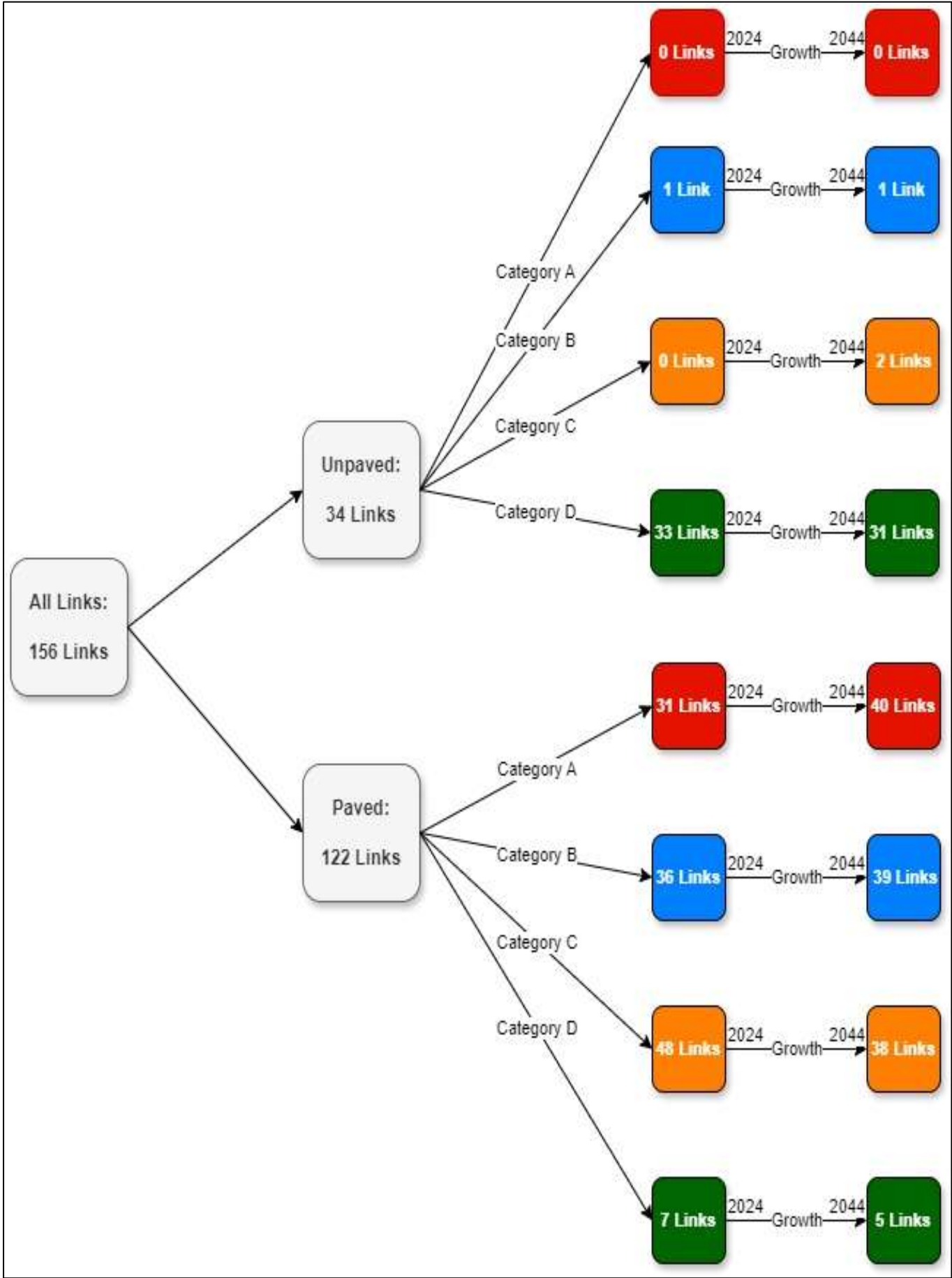
Chart C below illustrates the change in the road network categorization based on the change in the Basic Road Model into the Future Demand Model i.e., the effect the future traffic growth on the road categorization is summarised in this chart.

Such a model may be used to assist in decision making processes with regard to project prioritization of paving existing unpaved roads within the municipality. If the municipality intends to formalize a select few roads located within the area, the future categorization of the specific road under scrutiny can be used to determine which roads need to be prioritized first based on the estimated traffic volume demand.

The most logical course of action would be to choose projects in a hierarchical fashion based on its road category. This essentially implies that starting with Category A, any unpaved road that falls within this category should take precedence over an unpaved Category B Road and the same is applicable for the other road categories as well. The unpaved Category D roads in 2024 which are still estimated to be Category D in 2044 should therefore have the lowest priority due to its lowest traffic volumes.



Chart C: Road Network Existing and Future Categorization

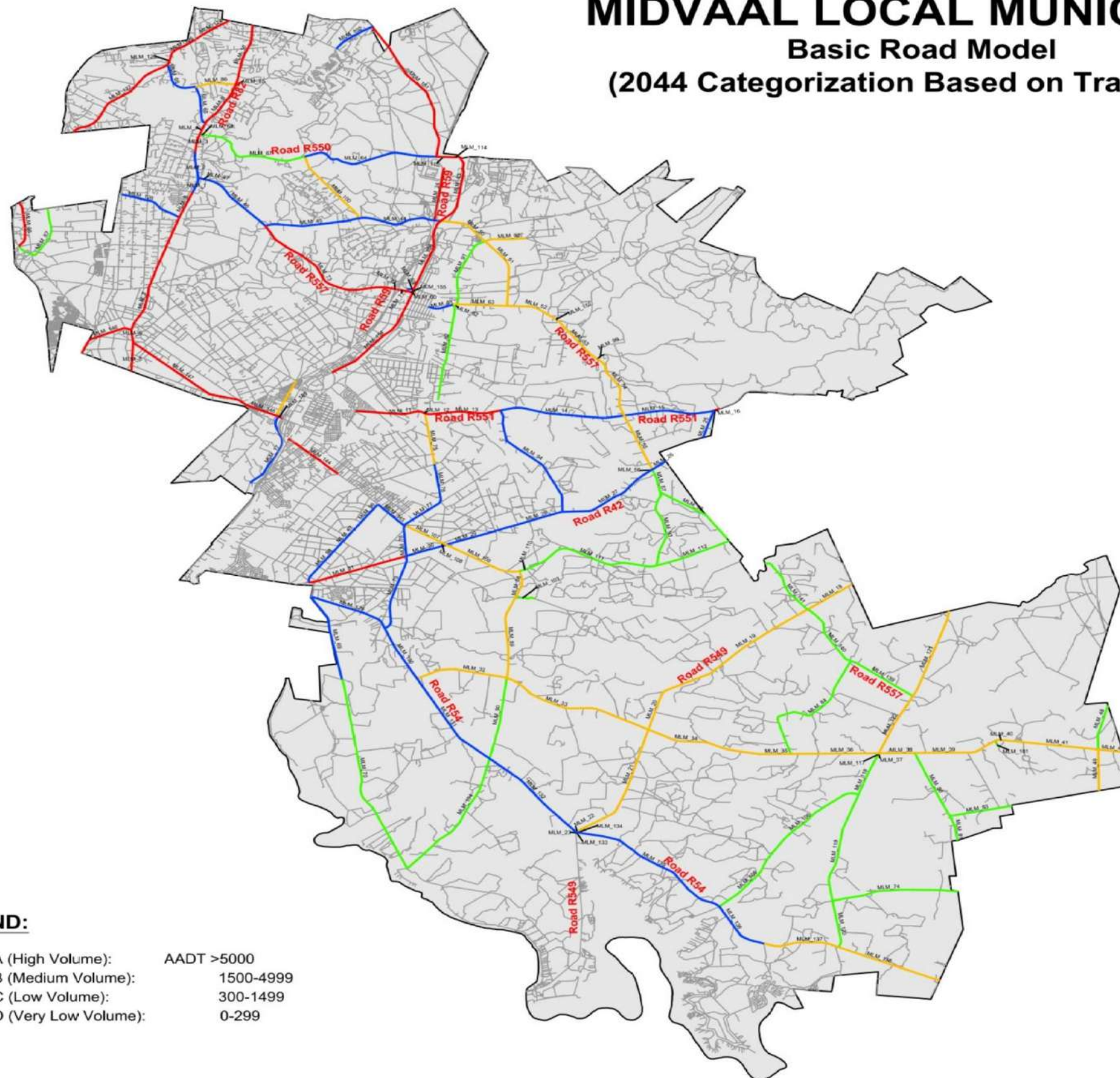




MIDVAAL LOCAL MUNICIPALITY

Basic Road Model

(2044 Categorization Based on Traffic Data)



LEGEND:

■	CATEGORY A (High Volume):	AADT >5000
■	CATEGORY B (Medium Volume):	1500-4999
■	CATEGORY C (Low Volume):	300-1499
■	CATEGORY D (Very Low Volume):	0-299

Drawing 3: Midvaal Local Municipality Basic Road Model 2044



D.7 ROAD & INTERSECTION CAPACITY ANALYSIS

Road and/ or intersection upgrades are typically identified based on the Level of Service (LOS) of the specific road/intersection. The level of service for an intersection is usually dependent on two variables, namely the average delay (in seconds) as well as the v/c (volume over capacity) ratio experienced at the intersection. The different levels of service are defined in the Highway Capacity Manual (HCM) and can briefly be described as follows:

- **LOS A:** Very good level of operation in terms of delay and capacity
- **LOS B:** Good level of operation in terms of delay and capacity
- **LOS C:** Acceptable level of operation in terms of delay and capacity
- **LOS D:** Acceptable level of operation in terms of delay and capacity
- **LOS E:** Poor level of operation in terms of delay and capacity
- **LOS F:** Very poor level of operation in terms of delay and capacity

In general, the v/c ratio should not exceed 1 as this suggests that the demand volume estimates the capacity of the road/intersection. Intersections operating at a LOS F usually either have a v/c exceeding 1, a high average delay or a combination of both.

For this document, using the intersection traffic data sourced from Midvaal Local Municipality, intersection capacity analyses were undertaken at the 20x key intersections located within the Midvaal municipality for which traffic data was available. For this purpose, the latest *PTV Vistro* traffic engineering software was used to model these intersections to determine where road & intersection upgrades could possibly be required. With reference to the analyses of the various scenarios mentioned below, this section comments on the traffic operations of these intersections.

Where necessary and feasible, intersection improvements have been identified that would mitigate the likely traffic impact and/or improve current traffic flow conditions. The following key intersections have been analysed, namely:

Note: The reference number provided after each intersection corresponds with the same reference number from the *Traffic Counts Technical Report* by ROMH Consulting and Nessa Solutions

- | | |
|---|---|
| • Road R82 & Dan Pienaar Drive (M001) | • R551 & Morris Road (M012) |
| • Hartzenbergfontein Road & Loes Road (M002) | • Pierneef Blvd & Viljoen Avenue (M013) |
| • Main Street & 4 th Street (M003) | • Johan Le Roux Road & Galloway Street (M014) |
| • Road R82 & Du Plessis Street (M004) | • Pierneef Blvd & Mimosa Drive (M015) |
| • Road R82 & Boundary Road (M005) | • Pierneef Blvd & Reitz Street (M016) |
| • Joan Road & Elizabeth Road (M006) | • Pierneef Blvd & Jim Fouche Road (M017) |
| • Randvaal Road & Malcolm Road (M008) | • Henley Road & Cleeve Road (M018) |
| • Johan Le Roux Road & Gourlay Street (M009) | • Road R551 & Ewelme Road (M019) |
| • Springbok Road & Meyer Road (M010) | • Jim Fouche Road & Uitvlugt Road (M020) |
| • Meyer Road & Joubert Street (M011) | • Anchovy Road & Garfish Road (M021) |



A locality plan showing these intersections is provided as **Annexure G**. The following scenarios were analysed, namely:

- **Status Quo Scenario:** Estimated year 2024 peak hour traffic volumes;
- **Short Term Scenario:** Estimated year 2029 peak hour traffic volumes;
- **Medium Term Scenario:** Estimated year 2039 peak hour traffic volumes; and
- **Long Term Scenario:** Estimated year 2044 peak hour traffic volumes.

The weekday AM and PM peak hours were analysed for each scenario. The results of the PTV Vistro capacity analyses at the various intersections for the two peaks are summarized in the following sections, with the details of the outputs included in **Annexure H**.

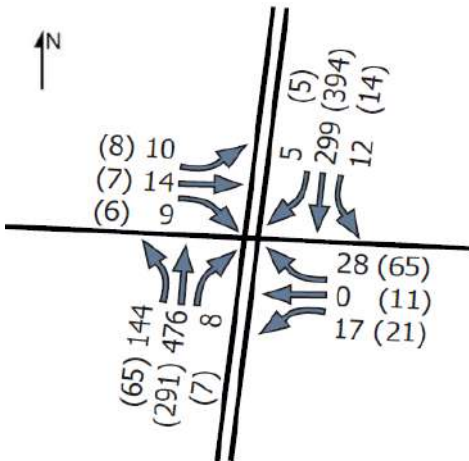


D.7.1 Road R82 & Dan Pienaar Road Intersection

Existing Geometry & Control:

- 4-Legged Priority Stop Controlled Intersection with free-flow conditions along Road 82;
- **North (R82):** Two through lanes with a short right turning lane and a short left turning lane;
- **South (R82):** Two through lanes with a short right turning lane and a short left turning lane;
- **East (Dan Pienaar Road):** One shared through, left turning and right turning lane;
- **West (Dan Pienaar Road):** One shared through, left turning and right turning lane;

Status Quo Peak Hour Volumes:



Legend

150 : Weekday AM Peak hr
(200) : Weekday PM Peak hr

Intersection Aerial View:



Analysis Results & Conclusion

Intersection: **Road R82 & Dan Pienaar Road**

Detailed Results: **Annexures H1 – H4 & H6 – H9**

Scenario	Geometry & Control	Peak	Stop Approach			Comment
			LOS	Delay(s)	v/C_{max}	
Scenario 1	Existing Geometry	AM	C	18	0.05	Acceptable overall level of operation
Scenario 2	Existing Geometry	AM	C	20	0.06	Acceptable overall level of operation
Scenario 3	Existing Geometry	AM	D	27	0.10	Acceptable overall level of operation
Scenario 4	Existing Geometry	AM	D	32	0.14	Acceptable overall level of operation
Scenario 1	Existing Geometry	PM	C	20	0.04	Acceptable overall level of operation
Scenario 2	Existing Geometry	PM	C	22	0.05	Acceptable overall level of operation
Scenario 3	Existing Geometry	PM	D	33	0.08	Acceptable overall level of operation
Scenario 4	Existing Geometry	PM	E	45	0.10	Acceptable level of operation in terms of capacity
Improvements Required (Yes/No)				No		

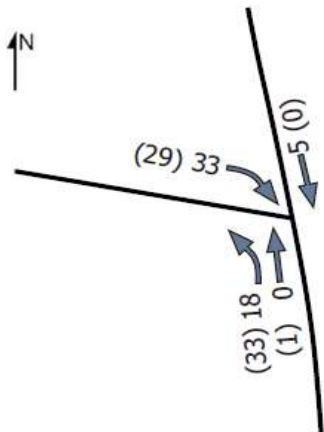


D.7.2 Hartzenbergfontein Road & Loes Road Intersection

Existing Geometry & Control:

- 3-Legged Priority Stop Controlled T-Intersection with free-flow conditions along south & west approaches;
- **North (Loes Road):** One shared through and right turning lane;
- **South (Loes Road):** One shared through and left turning lane;
- **West (Hartzenbergfontein Road):** One shared left turning and right turning lane and one right turning lane;

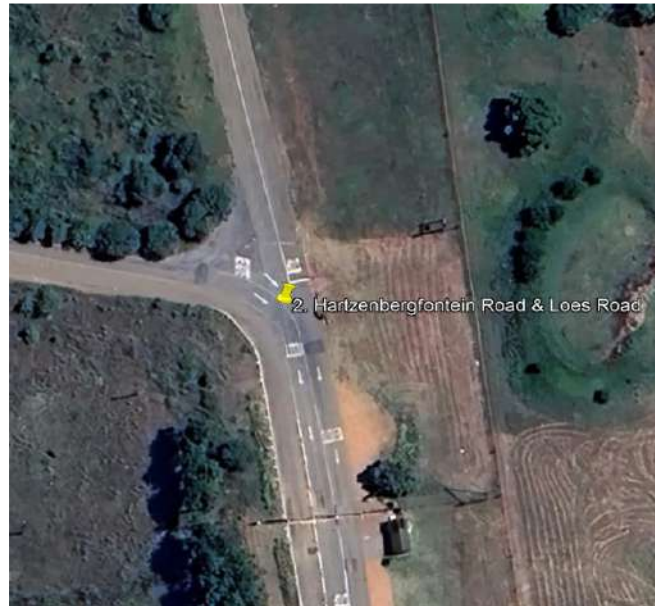
Status Quo Peak Hour Volumes:



Legend

150 : Weekday AM Peak hr
(200) : Weekday PM Peak hr

Intersection Aerial View:



Analysis Results & Conclusion

Intersection: **Hartzenbergfontein Rd & Loes Road**

Detailed Results: **Annexures H1 – H4 & H6 – H9**

Scenario	Geometry & Control	Peak	Stop Approach			Comment
			LOS	Delay(s)	v/c_{max}	
Scenario 1	Existing Geometry	AM	A	9	0.01	Very good overall level of operation
Scenario 2	Existing Geometry	AM	A	9	0.01	Very good overall level of operation
Scenario 3	Existing Geometry	AM	A	9	0.01	Very good overall level of operation
Scenario 4	Existing Geometry	AM	A	9	0.01	Very good overall level of operation
Scenario 1	Existing Geometry	PM	A	7	0.01	Very good overall level of operation
Scenario 2	Existing Geometry	PM	A	7	0.01	Very good overall level of operation
Scenario 3	Existing Geometry	PM	A	7	0.01	Very good overall level of operation
Scenario 4	Existing Geometry	PM	A	7	0.01	Very good overall level of operation
Improvements Required (Yes/No)				No		

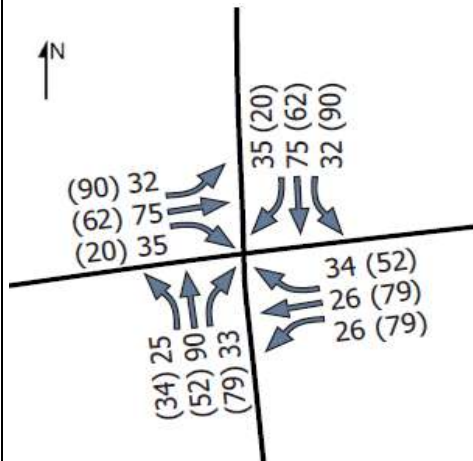


D.7.3 Main Street & 4th Street Intersection

Existing Geometry & Control:

- 4-Legged All-way Stop Controlled Intersection;
- **North (Main Street):** One shared through and right turning lane and one short left turning lane;
- **South (Main Street):** One shared through and right turning lane and one short left turning lane;
- **East (4th Street):** One shared through, left turning and right turning lane;
- **West (4th Street):** One shared through, left turning and right turning lane;

Status Quo Peak Hour Volumes:



Legend

150 : Weekday AM Peak hr
(200) : Weekday PM Peak hr

Intersection Aerial View:



Analysis Results & Conclusion

Intersection: **Main Street & 4th Street**

Detailed Results: **Annexures H1 – H4 & H6 – H9**

Scenario	Geometry & Control	Peak	Overall			Comment
			LOS	Delay(s)	v/c _{max}	
Scenario 1	Existing Geometry	AM	A	9	0.20	Very good overall level of operation
Scenario 2	Existing Geometry	AM	A	9	0.22	Very good overall level of operation
Scenario 3	Existing Geometry	AM	A	10	0.28	Very good overall level of operation
Scenario 4	Existing Geometry	AM	B	11	0.33	Good overall level of operation
Scenario 1	Existing Geometry	PM	A	10	0.28	Very good overall level of operation
Scenario 2	Existing Geometry	PM	B	10	0.32	Good overall level of operation
Scenario 3	Existing Geometry	PM	B	12	0.43	Good overall level of operation
Scenario 4	Existing Geometry	PM	B	13	0.50	Good overall level of operation
Improvements Required (Yes/No)				No		

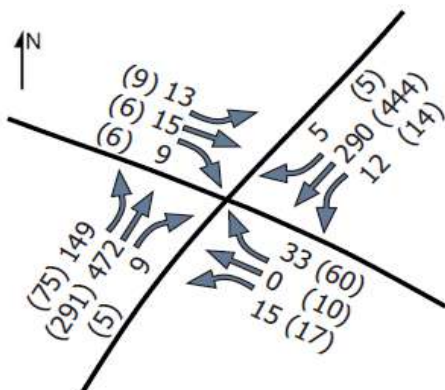


D.7.4 Road R82 & Du Plessis Street Intersection

Existing Geometry & Control:

- 4-Legged Priority Stop Controlled Intersection with free-flow along Road R82;
- **North (R82):** One shared through and right turning lane and one short left turning lane;
- **South (R82):** One shared through and right turning lane, one through lane and one short left turning lane;
- **East (Du Plessis St):** One shared through, left turning and right turning lane;
- **West (Du Plessis St):** One shared through, left turning and right turning lane;

Status Quo Peak Hour Volumes:



Legend

150 : Weekday AM Peak hr
(200) : Weekday PM Peak hr

Intersection Aerial View:



Analysis Results & Conclusion

Intersection: **Road R82 & Du Plessis St**

Detailed Results: **Annexures H1 – H4 & H6 – H9**

Scenario	Geometry & Control	Peak	Stop Approach			Comment
			LOS	Delay(s)	v/C _{max}	
Scenario 1	Existing Geometry	AM	C	18	0.05	Acceptable overall level of operation
Scenario 2	Existing Geometry	AM	C	20	0.07	Acceptable overall level of operation
Scenario 3	Existing Geometry	AM	D	27	0.11	Acceptable overall level of operation
Scenario 4	Existing Geometry	AM	D	32	0.14	Acceptable overall level of operation
Scenario 1	Existing Geometry	PM	C	21	0.04	Acceptable overall level of operation
Scenario 2	Existing Geometry	PM	C	24	0.05	Acceptable overall level of operation
Scenario 3	Existing Geometry	PM	E	37	0.08	Acceptable level of operation in terms of capacity
Scenario 4	Existing Geometry	PM	F	52	0.10	Acceptable level of operation in terms of capacity
Improvements Required (Yes/No)				No		

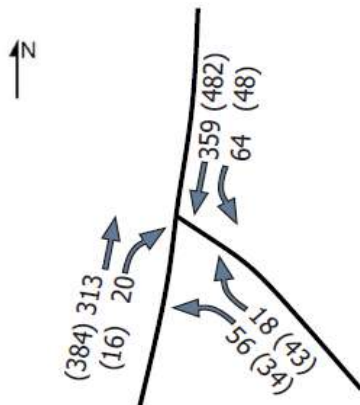


D.7.5 Road R82 & Boundary Road Intersection

Existing Geometry & Control:

- Priority Stop Controlled T-Intersection with free-flow along Road R82;
- **North (R82):** One shared through and left turning lane;
- **South (R82):** One shared through and right turning lane;
- **East (Boundary Road):** One shared left turning and right turning lane;

Status Quo Peak Hour Volumes:



Legend

150 : Weekday AM Peak hr
(200) : Weekday PM Peak hr

Intersection Aerial View:



Analysis Results & Conclusion

Intersection: **Road R82 & Boundary Road**

Detailed Results: **Annexures H1 – H4 & H6 – H9**

Scenario	Geometry & Control	Peak	Stop Approach			Comment
			LOS	Delay(s)	v/c _{max}	
Scenario 1	Existing Geometry	AM	C	16	0.05	Acceptable overall level of operation
Scenario 2	Existing Geometry	AM	C	18	0.07	Acceptable overall level of operation
Scenario 3	Existing Geometry	AM	C	23	0.10	Acceptable overall level of operation
Scenario 4	Existing Geometry	AM	D	27	0.14	Acceptable overall level of operation
Scenario 1	Existing Geometry	PM	C	21	0.16	Acceptable overall level of operation
Scenario 2	Existing Geometry	PM	C	25	0.21	Acceptable overall level of operation
Scenario 3	Existing Geometry	PM	E	39	0.36	Acceptable overall level of operation in terms of capacity
Scenario 4	Existing Geometry	PM	F	57	0.48	Acceptable overall level of operation in terms of capacity
Improvements Required (Yes/No)				No		

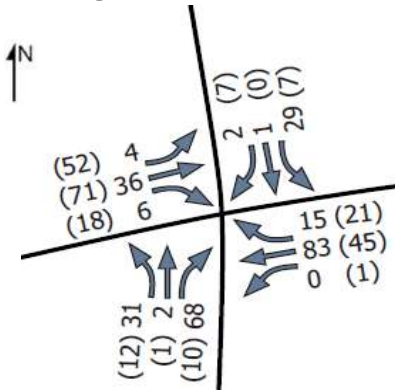


D.7.6 Joan Road & Elizabeth Road Intersection

Existing Geometry & Control:

- Priority Stop Controlled T-Intersection with free-flow along Joan Road;
- **North (Elizabeth Road):** One shared through, left turning and right turning lane;
- **South (Elizabeth Road):** One shared through, left turning and right turning lane;
- **East (Joan Road):** One shared through and right turning lane and a short left turning lane;
- **West (Joan Road):** One shared through and right turning lane and a short left turning lane;

Status Quo Peak Hour Volumes:



Legend

150 : Weekday AM Peak hr
(200) : Weekday PM Peak hr

Intersection Aerial View:



Analysis Results & Conclusion

Intersection: **Joan Road & Elizabeth Road**

Detailed Results: **Annexures H1 – H4 & H6 – H9**

Scenario	Geometry & Control	Peak	Stop Approach			Comment
			LOS	Delay(s)	v/c_{max}	
Scenario 1	Existing Geometry	AM	B	11	0.01	Good overall level of operation
Scenario 2	Existing Geometry	AM	B	11	0.01	Good overall level of operation
Scenario 3	Existing Geometry	AM	B	12	0.01	Good overall level of operation
Scenario 4	Existing Geometry	AM	B	12	0.01	Good overall level of operation
Scenario 1	Existing Geometry	PM	B	11	0.01	Good overall level of operation
Scenario 2	Existing Geometry	PM	B	11	0.01	Good overall level of operation
Scenario 3	Existing Geometry	PM	B	12	0.01	Good overall level of operation
Scenario 4	Existing Geometry	PM	B	12	0.01	Good overall level of operation
Improvements Required (Yes/No)				No		

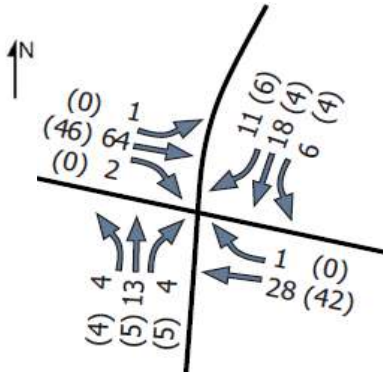


D.7.7 Randvaal Road & Malcolm Road Intersection

Existing Geometry & Control:

- Priority Stop Controlled T-Intersection with free-flow along Randvaal Road;
- **North (Malcolm Road):** One shared through, left turning and right turning lane;
- **South (Malcolm Road):** One shared through, left turning and right turning lane;
- **East (Randvaal Road):** One through and left turning slip-way and one shared through and right turning lane;
- **West (Randvaal Road):** One shared through, left turning and right turning lane;

Status Quo Peak Hour Volumes:



Legend

150 : Weekday AM Peak hr
(200) : Weekday PM Peak hr

Intersection Aerial View:



Analysis Results & Conclusion

Intersection: **Randvaal Road & Malcolm Road**

Detailed Results: **Annexures H1 – H4 & H6 – H9**

Scenario	Geometry & Control	Peak	Stop Approach			Comment
			LOS	Delay(s)	v/C _{max}	
Scenario 1	Existing Geometry	AM	A	10	0.02	Very good overall level of operation
Scenario 2	Existing Geometry	AM	A	10	0.03	Very good overall level of operation
Scenario 3	Existing Geometry	AM	B	10	0.03	Good overall level of operation
Scenario 4	Existing Geometry	AM	B	10	0.04	Good overall level of operation
Scenario 1	Existing Geometry	PM	A	10	0.01	Very good overall level of operation
Scenario 2	Existing Geometry	PM	A	10	0.01	Very good overall level of operation
Scenario 3	Existing Geometry	PM	A	10	0.01	Very good overall level of operation
Scenario 4	Existing Geometry	PM	A	10	0.01	Very good overall level of operation
Improvements Required (Yes/No)				No		

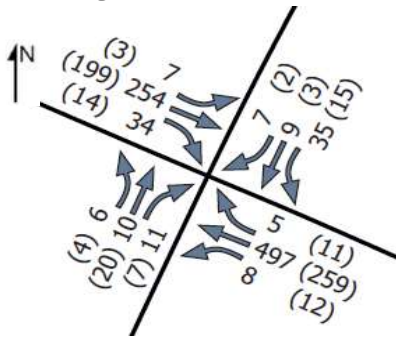


D.7.8 Johan Le Roux Road & Gourlay Street Intersection

Existing Geometry & Control:

- All-way Stop Controlled Intersection;
- **North (Gourlay Street):** One shared through, left turning and right turning lane;
- **South (Gourlay Street):** One shared through, left turning and right turning lane;
- **East (Johan Le Roux Road):** One shared through, left turning and right turning lane;
- **West (Johan Le Roux Road):** One shared through, left turning and right turning lane;

Status Quo Peak Hour Volumes:



Legend

150 : Weekday AM Peak hr
(200) : Weekday PM Peak hr

Intersection Aerial View:



Analysis Results & Conclusion

Intersection: **Johan Le Roux Road & Gourlay Street**

Detailed Results: **Annexures H1 – H10**

Scenario	Geometry & Control	Peak	Overall			Comment
			LOS	Delay(s)	v/C_{max}	
Scenario 1	Existing Geometry	AM	B	14	0.67	Good overall level of operation
Scenario 2	Existing Geometry	AM	C	17	0.76	Acceptable overall level of operation
Scenario 3	Existing Geometry	AM	D	34	0.97	Acceptable overall level of operation
Scenario 4	Existing Geometry	AM	F	57	1.1	Very poor overall level of operation
Scenario 4	Possible Upgrades	AM	A	9	0.64	Very good overall level of operation
Scenario 1	Existing Geometry	PM	A	9	0.36	Very good overall level of operation
Scenario 2	Existing Geometry	PM	A	10	0.40	Very good overall level of operation
Scenario 3	Existing Geometry	PM	B	11	0.49	Good overall level of operation
Scenario 4	Existing Geometry	PM	B	12	0.55	Good overall level of operation
Scenario 4	Possible Upgrades	PM	A	5	0.34	Very good overall level of operation
Improvements Required (Yes/No)				Yes		

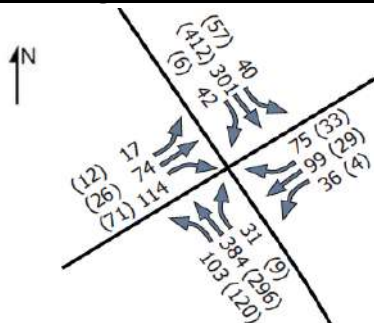


D.7.9 Springbok Road & Meyer Road.

Existing Geometry & Control:

- All-way Stop Controlled Intersection;
- **North-West (Springbok Road):** One shared through and right turning lane and one short left turning lane;
- **South-East (Springbok Road):** One shared through and right turning lane and one short left turning lane;
- **North-East (Meyer Road):** One shared through and right turning lane and one short left turning lane;
- **South-West (Meyer Road):** One shared through and right turning lane and one short left turning lane;

Status Quo Peak Hour Volumes:



Legend

150 : Weekday AM Peak hr
(200) : Weekday PM Peak hr

Intersection Aerial View:



Analysis Results & Conclusion

Intersection: **Springbok Road & Meyer Road**

Detailed Results: **Annexures H1 – H10**

Scenario	Geometry & Control	Peak	Overall			Comment
			LOS	Delay(s)	v/c _{max}	
Scenario 1	Existing Geometry	AM	D	26	0.86	Acceptable overall level of operation
Scenario 2	Existing Geometry	AM	E	40	1.01	Poor overall level of operation
Scenario 3	Existing Geometry	AM	F	96	1.33	Very poor overall level of operation
Scenario 4	Existing Geometry	AM	F	140	1.53	Very poor overall level of operation
Scenario 4	Possible Upgrades	AM	A	8	0.41	Very good overall level of operation
Scenario 1	Existing Geometry	PM	C	16	0.70	Acceptable overall level of operation
Scenario 2	Existing Geometry	PM	C	19	0.80	Acceptable overall level of operation
Scenario 3	Existing Geometry	PM	E	42	1.05	Poor overall level of operation
Scenario 4	Existing Geometry	PM	F	67	1.21	Very poor overall level of operation
Scenario 4	Possible Upgrades	PM	A	6	0.33	Very good overall level of operation
Improvements Required (Yes/No)				Yes		

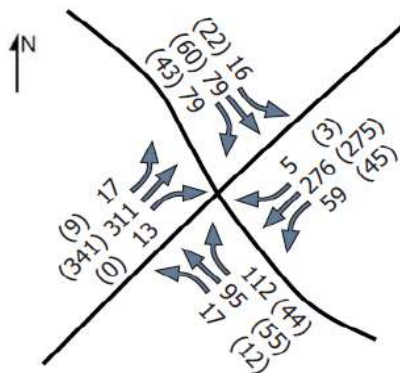


D.7.10 Meyer Road & Joubert Street Intersection

Existing Geometry & Control:

- All-way Stop Controlled Intersection;
- **North-West (Joubert Street):** One shared through, left turning slip-way and right turning lane;
- **South-East (Joubert Street):** One shared through and right turning lane and one left turning slip-way lane;
- **North-East (Meyer Road):** One shared through and right turning lane and one shared through and left turning slip-way;
- **South-West (Meyer Road):** One shared through and right turning lane and one shared through and left turning lane;

Status Quo Peak Hour Volumes:



Legend

150 : Weekday AM Peak hr
(200) : Weekday PM Peak hr

Intersection Aerial View:



Analysis Results & Conclusion

Intersection: **Meyer Road & Joubert Street**

Detailed Results: **Annexures H1 – H4 & H6 – H9**

Scenario	Geometry & Control	Peak	Overall			Comment
			LOS	Delay(s)	v/C _{max}	
Scenario 1	Existing Geometry	AM	B	13	0.43	Good overall level of operation
Scenario 2	Existing Geometry	AM	B	15	0.51	Good overall level of operation
Scenario 3	Existing Geometry	AM	C	21	0.69	Acceptable overall level of operation
Scenario 4	Existing Geometry	AM	D	28	0.80	Acceptable overall level of operation
Scenario 1	Existing Geometry	PM	B	11	0.30	Good overall level of operation
Scenario 2	Existing Geometry	PM	B	12	0.34	Good overall level of operation
Scenario 3	Existing Geometry	PM	B	14	0.45	Good overall level of operation
Scenario 4	Existing Geometry	PM	C	16	0.52	Acceptable overall level of operation
Improvements Required (Yes/No)				No		

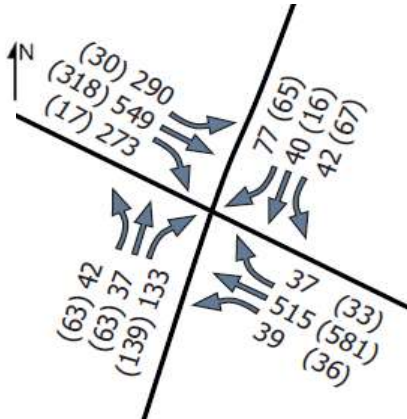


D.7.11 Road R551 & Morris Road Intersection

Existing Geometry & Control:

- All-way Stop Controlled Intersection;
- **North (Morris Road):** One shared through and right turning lane and one short left turning lane;
- **South (Morris Road):** One shared through and right turning lane and one short left turning lane;
- **East (R551):** One shared through and right turning lane and one shared through and left turning lane;
- **West (R551):** One shared through and right turning lane and one shared through and left turning lane;

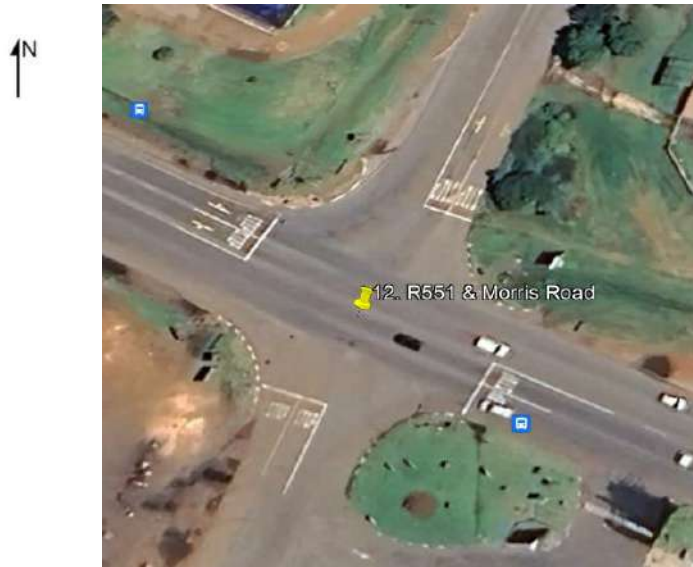
Status Quo Peak Hour Volumes:



Legend

150 : Weekday AM Peak hr
(200) : Weekday PM Peak hr

Intersection Aerial View:



Analysis Results & Conclusion

Intersection: **Road R551 & Morris Road**

Detailed Results: **Annexures H1 – H10**

Scenario	Geometry & Control	Peak	Overall			Comment
			LOS	Delay(s)	v/c _{max}	
Scenario 1	Existing Geometry	AM	F	74	1.21	Very poor overall level of operation
Scenario 2	Existing Geometry	AM	F	114	1.40	Very poor overall level of operation
Scenario 3	Existing Geometry	AM	F	>150	>1.50	Very poor overall level of operation
Scenario 4	Existing Geometry	AM	F	>150	>1.50	Very poor overall level of operation
Scenario 4	Possible Upgrades	AM	C	31	0.74	Acceptable overall level of operation
Scenario 1	Existing Geometry	PM	C	17	0.64	Acceptable overall level of operation
Scenario 2	Existing Geometry	PM	C	21	0.74	Acceptable overall level of operation
Scenario 3	Existing Geometry	PM	E	43	1.00	Poor overall level of operation
Scenario 4	Existing Geometry	PM	F	69	1.16	Very poor overall level of operation
Scenario 4	Possible Upgrades	PM	C	28	0.55	Acceptable overall level of operation

Improvements Required (Yes/No)

Yes

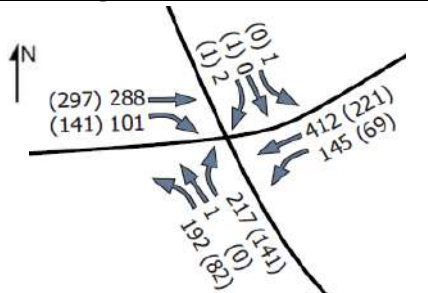


D.7.12 Pierneef BLVD & Viljoen Avenue Intersection

Existing Geometry & Control:

- All-way Stop Controlled Intersection;
- **North (Viljoen Avenue):** One shared through, left turning and right turning lane;
- **South (Viljoen Avenue):** One left turning lane and one very short through and right turning lane;
- **East (Pierneef Blvd):** One shared through and right turning lane and one left turning lane;
- **West (Pierneef Blvd):** One shared through, left turning and right turning lane;

Status Quo Peak Hour Volumes:



Legend

150 : Weekday AM Peak hr
(200) : Weekday PM Peak hr

Intersection Aerial View:



Analysis Results & Conclusion

Intersection: **Pierneef Blvd & Viljoen Ave**

Detailed Results: **Annexures H1 – H10**

Scenario	Geometry & Control	Peak	Overall			Comment
			LOS	Delay(s)	v/c _{max}	
Scenario 1	Existing Geometry	AM	C	24	0.81	Acceptable overall level of operation
Scenario 2	Existing Geometry	AM	E	36	0.94	Poor overall level of operation
Scenario 3	Existing Geometry	AM	F	78	1.19	Very poor overall level of operation
Scenario 4	Existing Geometry	AM	F	112	1.34	Very poor overall level of operation
Scenario 4	Possible Geometry	AM	C	23	0.93	Acceptable overall level of operation
Scenario 1	Existing Geometry	PM	C	17	0.74	Acceptable overall level of operation
Scenario 2	Existing Geometry	PM	C	22	0.84	Acceptable overall level of operation
Scenario 3	Existing Geometry	PM	E	49	1.09	Poor overall level of operation
Scenario 4	Existing Geometry	PM	F	75	1.24	Very poor overall level of operation
Scenario 4	Possible Geometry	PM	A	10	0.64	Very good overall level of operation
Improvements Required (Yes/No)				Yes		

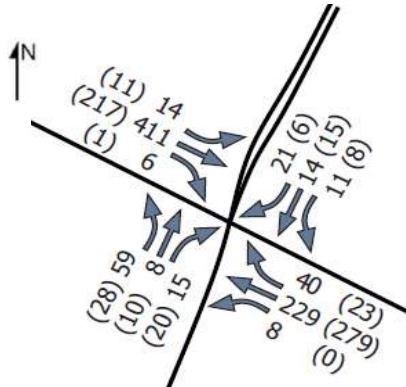


D.7.13 Johan Le Roux Road & Galloway Street Intersection

Existing Geometry & Control:

- All-way Stop Controlled Intersection;
- **North (Galloway Street):** One shared through and left turning lane and one right turning lane;
- **South (Galloway Street):** One shared through, left turning lane and one right turning lane;
- **East (Johan Le Roux Road):** One shared through, left turning and right turning lane;
- **West (Johan Le Roux Road):** One through lane, one right turning lane and a short left turning slip-way;

Status Quo Peak Hour Volumes:



Legend

150 : Weekday AM Peak hr
(200) : Weekday PM Peak hr

Intersection Aerial View:



Analysis Results & Conclusion

Intersection: **Johan Le Roux Road & Galloway Street**

Detailed Results: **Annexures H1 – H10**

Scenario	Geometry & Control	Peak	Overall			Comment
			LOS	Delay(s)	v/c _{max}	
Scenario 1	Existing Geometry	AM	C	15	0.64	Acceptable overall level of operation
Scenario 2	Existing Geometry	AM	C	18	0.73	Acceptable overall level of operation
Scenario 3	Existing Geometry	AM	D	35	0.95	Acceptable overall level of operation
Scenario 4	Existing Geometry	AM	F	56	1.08	Very poor overall level of operation
Scenario 4	Possible Geometry	AM	A	9	0.41	Very good overall level of operation
Scenario 1	Existing Geometry	PM	B	11	0.47	Good overall level of operation
Scenario 2	Existing Geometry	PM	B	12	0.53	Good overall level of operation
Scenario 3	Existing Geometry	PM	C	16	0.69	Acceptable overall level of operation
Scenario 4	Existing Geometry	PM	C	20	0.78	Acceptable overall level of operation
Scenario 4	Possible Geometry	PM	A	8	0.31	Very good overall level of operation
Improvements Required (Yes/No)				Yes		

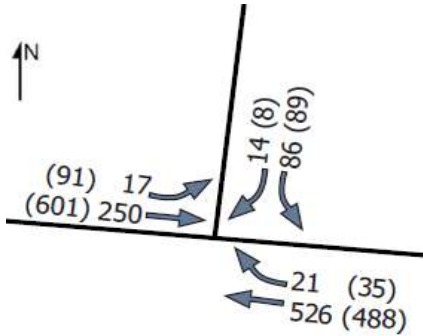


D.7.14 Pierneef Blvd & Mimosa Drive Intersection

Existing Geometry & Control:

- All-way Stop Controlled T-Intersection;
- **North (Mimosa Drive):** One right turning lane and one left turning slip-way;
- **East (Pierneef Blvd):** One shared through and right turning lane and one through lane;
- **West (Pierneef Blvd):** One shared through and left turning slip-way and through lane;

Status Quo Peak Hour Volumes:



Legend

150 : Weekday AM Peak hr
(200) : Weekday PM Peak hr

Intersection Aerial View:



Analysis Results & Conclusion

Intersection: **Pierneef Blvd & Mimosa Drive**

Detailed Results: **Annexures H1 – H10**

Scenario	Geometry & Control	Peak	Overall			Comment
			LOS	Delay(s)	v/C _{max}	
Scenario 1	Existing Geometry	AM	B	11	0.41	Good overall level of operation
Scenario 2	Existing Geometry	AM	B	11	0.46	Good overall level of operation
Scenario 3	Existing Geometry	AM	B	14	0.59	Good overall level of operation
Scenario 4	Existing Geometry	AM	C	16	0.67	Acceptable overall level of operation
Scenario 4	Possible Geometry	AM	B	11	0.25	Good overall level of operation
Scenario 1	Existing Geometry	PM	B	14	0.56	Good overall level of operation
Scenario 2	Existing Geometry	PM	C	16	0.63	Acceptable overall level of operation
Scenario 3	Existing Geometry	PM	C	25	0.83	Acceptable overall level of operation
Scenario 4	Existing Geometry	PM	E	38	0.96	Poor overall level of operation
Scenario 4	Possible Geometry	PM	B	12	0.30	Good overall level of operation
Improvements Required (Yes/No)				Yes		

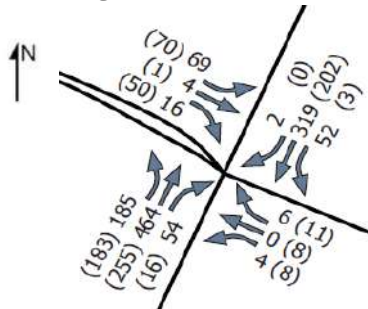


D.7.15 Pierneef Blvd & Reitz Street Intersection

Existing Geometry & Control:

- Priority Stop Controlled Intersection with free-flow along Pierneef Blvd;
- **North (Pierneef Blvd):** One shared through and left turning lane and one shared through and right turning lane;
- **South (Pierneef Blvd):** One shared through and left turning lane and one shared through and right turning lane;
- **East (Reitz Street):** One shared through, left turning and right turning lane;
- **West (Reitz Street):** One shared through and right turning lane and one left turning slip-way;

Status Quo Peak Hour Volumes:



Legend

150 : Weekday AM Peak hr
(200) : Weekday PM Peak hr

Intersection Aerial View:



Analysis Results & Conclusion

Intersection: **Pierneef Blvd & Reitz Street**

Detailed Results: **Annexures H1 – H10**

Scenario	Geometry & Control	Peak	Stop Approach			Comment
			LOS	Delay(s)	v/c_{max}	
Scenario 1	Existing Geometry	AM	C	25	0.02	Acceptable overall level of operation
Scenario 2	Existing Geometry	AM	D	29	0.02	Acceptable overall level of operation
Scenario 3	Existing Geometry	AM	E	46	0.04	Acceptable level of operation in terms of capacity
Scenario 4	Existing Geometry	AM	F	62	0.07	Acceptable level of operation in terms of capacity
Scenario 4	Possible Geometry	AM	A	5	0.36	Very good overall level of operation
Scenario 1	Existing Geometry	PM	C	16	0.01	Acceptable overall level of operation
Scenario 2	Existing Geometry	PM	C	17	0.01	Acceptable overall level of operation
Scenario 3	Existing Geometry	PM	C	21	0.01	Acceptable overall level of operation
Scenario 4	Existing Geometry	PM	C	24	0.01	Acceptable overall level of operation
Scenario 4	Possible Geometry	PM	A	7	0.26	Very good overall level of operation
Improvements Required (Yes/No)				Yes		

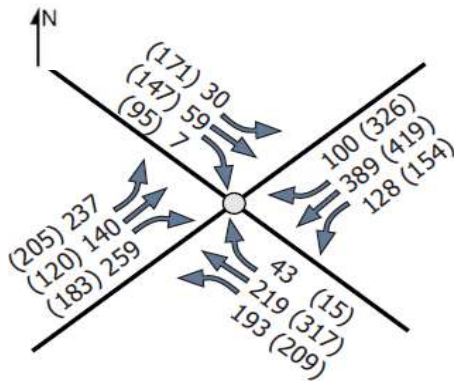


D.7.16 Pierneef Blvd & Jim Fouche Road Intersection

Existing Geometry & Control:

- 4-legged double circulating traffic circle;
- **North-West (Jim Fouche Road):** dual lane approach;
- **South-East (Jim Fouche Road):** dual lane approach;
- **North-East (Pierneef Blvd):** dual lane approach;
- **South-West (Pierneef Blvd):** dual lane approach;

Status Quo Peak Hour Volumes:



Legend

150 : Weekday AM Peak hr
(200) : Weekday PM Peak hr

Intersection Aerial View:



Analysis Results & Conclusion

Intersection: **Pierneef Blvd & Jim Fouche Road**

Detailed Results: **Annexures H1 – H10**

Scenario	Geometry & Control	Peak	Overall			Comment
			LOS	Delay(s)	v/C _{max}	
Scenario 1	Existing Geometry	AM	A	8	0.49	Very good overall level of operation
Scenario 2	Existing Geometry	AM	A	9	0.57	Very good overall level of operation
Scenario 3	Existing Geometry	AM	B	13	0.77	Good overall level of operation
Scenario 4	Existing Geometry	AM	C	18	0.91	Acceptable overall level of operation
Scenario 1	Existing Geometry	PM	B	11	0.69	Good overall level of operation
Scenario 2	Existing Geometry	PM	B	14	0.79	Good overall level of operation
Scenario 3	Existing Geometry	PM	C	22	0.89	Acceptable overall level of operation
Scenario 4	Existing Geometry	PM	C	32	0.93	Acceptable overall level of operation
Improvements Required (Yes/No)				No		

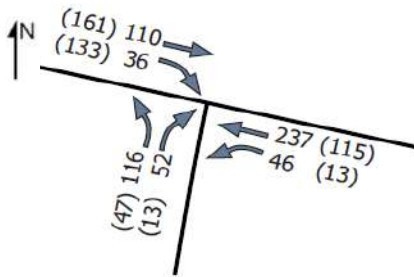


D.7.17 Henley Road & Cleeve Road Intersection

Existing Geometry & Control:

- All-way Stop Controlled T-intersection;
- **South (Cleeve Road):** One shared left turning and right turning lane;
- **East (Henley Road):** One shared through and left turning lane;
- **West (Henley Road):** One short through lane and a shared through and right turning lane;

Status Quo Peak Hour Volumes:



Legend

150 : Weekday AM Peak hr
(200) : Weekday PM Peak hr

Intersection Aerial View:



Analysis Results & Conclusion

Intersection: **Henley Road & Cleeve Road**

Detailed Results: **Annexures H1 – H4 & H6 – H9**

Scenario	Geometry & Control	Peak	Overall			Comment
			LOS	Delay(s)	v/c _{max}	
Scenario 1	Existing Geometry	AM	A	10	0.38	Very good overall level of operation
Scenario 2	Existing Geometry	AM	B	10	0.43	Good overall level of operation
Scenario 3	Existing Geometry	AM	B	12	0.54	Good overall level of operation
Scenario 4	Existing Geometry	AM	B	13	0.62	Good overall level of operation
Scenario 1	Existing Geometry	PM	A	9	0.22	Very good overall level of operation
Scenario 2	Existing Geometry	PM	A	9	0.25	Very good overall level of operation
Scenario 3	Existing Geometry	PM	A	10	0.31	Very good overall level of operation
Scenario 4	Existing Geometry	PM	A	10	0.35	Very good overall level of operation
Improvements Required (Yes/No)				No		

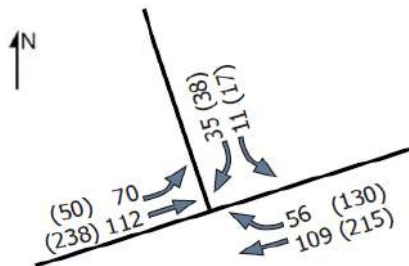


D.7.18 Road R551 & Ewelme Road Intersection

Existing Geometry & Control:

- Priority Stop Controlled T-intersection with free-flow along R551;
- **North (Ewelme Road):** One shared left turning and right turning lane;
- **East (R551):** One shared through and right turning lane and one short through lane;
- **West (R551):** One through lane and a short left turning lane;

Status Quo Peak Hour Volumes:



Intersection Aerial View:



Analysis Results & Conclusion

Intersection: **R551 & Ewelme Road**

Detailed Results: **Annexures H1 – H4 & H6 – H9**

Scenario	Geometry & Control	Peak	Stop Approach			Comment
			LOS	Delay(s)	v/C_{max}	
Scenario 1	Existing Geometry	AM	B	11	0.06	Good overall level of operation
Scenario 2	Existing Geometry	AM	B	11	0.07	Good overall level of operation
Scenario 3	Existing Geometry	AM	B	12	0.09	Good overall level of operation
Scenario 4	Existing Geometry	AM	B	13	0.11	Good overall level of operation
Scenario 1	Existing Geometry	PM	C	16	0.11	Acceptable overall level of operation
Scenario 2	Existing Geometry	PM	C	18	0.14	Acceptable overall level of operation
Scenario 3	Existing Geometry	PM	C	24	0.22	Acceptable overall level of operation
Scenario 4	Existing Geometry	PM	D	29	0.29	Acceptable overall level of operation
Improvements Required (Yes/No)				No		

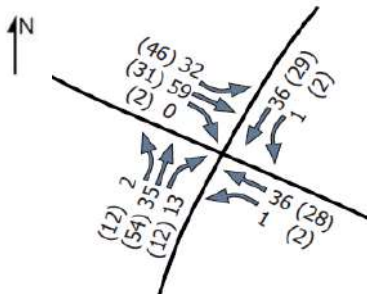


D.7.19 Jim Fouche Road & Uitvlugt Road Intersection

Existing Geometry & Control:

- Priority Stop Controlled T-intersection with free-flow along Uitvlugt Road;
- **North (Uitvlugt Road):** One shared through and right turning lane and one short shared through and left turning lane;
- **South (Uitvlugt Road):** One shared through and right turning lane and one short shared through and left turning lane;
- **East (Jim Fouche Road):** One shared through, left turning and right turning lane;
- **West (Jim Fouche Road):** One shared through, left turning and right turning lane;

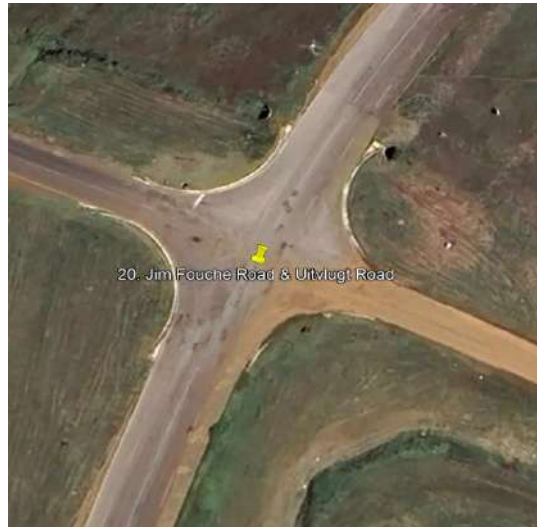
Status Quo Peak Hour Volumes:



Legend

150 : Weekday AM Peak hr
(200) : Weekday PM Peak hr

Intersection Aerial View:



Analysis Results & Conclusion

Intersection: **Jim Fouche Road & Uitvlugt Road**

Detailed Results: **Annexures H1 – H4 & H6 – H9**

Scenario	Geometry & Control	Peak	Stop Approach			Comment
			LOS	Delay(s)	v/c _{max}	
Scenario 1	Existing Geometry	AM	B	10	0.08	Good overall level of operation
Scenario 2	Existing Geometry	AM	B	10	0.09	Good overall level of operation
Scenario 3	Existing Geometry	AM	B	11	0.11	Good overall level of operation
Scenario 4	Existing Geometry	AM	B	11	0.13	Good overall level of operation
Scenario 1	Existing Geometry	PM	B	10	0.04	Good overall level of operation
Scenario 2	Existing Geometry	PM	B	10	0.05	Good overall level of operation
Scenario 3	Existing Geometry	PM	B	11	0.06	Good overall level of operation
Scenario 4	Existing Geometry	PM	B	11	0.07	Good overall level of operation
Improvements Required (Yes/No)				No		

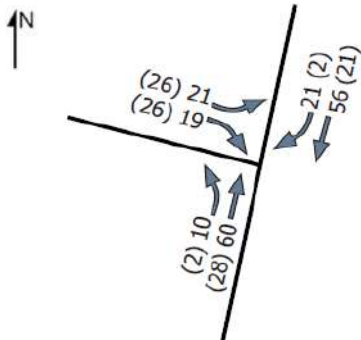


D.7.20 Anchovy Road & Garfish Road Intersection

Existing Geometry & Control:

- Priority Stop Controlled T-intersection with free-flow along Anchovy Road;
- **North (Anchovy Road):** One shared through and right turning lane;
- **South (Anchovy Road):** One shared through and left turning lane;
- **West (Garfish Road):** One shared left turning and right turning lane;

Status Quo Peak Hour Volumes:



Legend

150 : Weekday AM Peak hr
(200) : Weekday PM Peak hr

Intersection Aerial View:



Analysis Results & Conclusion

Intersection: **Anchovy Road & Garfish Road**

Detailed Results: **Annexures H1 – H4 & H6 – H9**

Scenario	Geometry & Control	Peak	Stop Approach			Comment
			LOS	Delay(s)	v/C _{max}	
Scenario 1	Existing Geometry	AM	A	10	0.03	Very good overall level of operation
Scenario 2	Existing Geometry	AM	A	10	0.03	Very good overall level of operation
Scenario 3	Existing Geometry	AM	B	10	0.04	Good overall level of operation
Scenario 4	Existing Geometry	AM	B	10	0.04	Good overall level of operation
Scenario 1	Existing Geometry	PM	A	9	0.03	Very good overall level of operation
Scenario 2	Existing Geometry	PM	A	9	0.03	Very good overall level of operation
Scenario 3	Existing Geometry	PM	A	9	0.04	Very good overall level of operation
Scenario 4	Existing Geometry	PM	A	9	0.05	Very good overall level of operation
Improvements Required (Yes/No)				No		



D.7.21 Possible Intersection Upgrades

Using the results from the intersection capacity analyses as a guideline, out of the 20 intersections that were analysed, the following 7 intersections have been flagged as key intersections that would require possible improvements due to the current and/or estimated peak hour future traffic demand:

- **INTERSECTION 8:** Johan Le Roux Road & Gourlay Street
- **INTERSECTION 9:** Springbok Road & Meyer Road
- **INTERSECTION 11:** Road R551 & Morris Road
- **INTERSECTION 12:** Pierneef Boulevard & Viljoen Avenue
- **INTERSECTION 13:** Johan Le Roux Road & Galloway Street
- **INTERSECTION 14:** Pierneef Boulevard & Mimosa Drive
- **INTERSECTION 15:** Pierneef Boulevard & Reitz Street

Refer to **Chapter H** for cost estimates for the above projects.

Table 9: Possible Capacity Upgrades at Analysed Intersections

Intersection No.	Possible Capacity Upgrades	Upgrade Priority
8	All four approaches of this all-way stop controlled intersection only consist of a single lane approach, which would not be sufficient to accommodate the peak hour traffic volumes in the long term. The most logical upgrade to implement would be a proper single circulating traffic circle with an outside diameter of at least 32m which also has the added benefit of lower maintenance costs as opposed to traffic signals that may become subject to theft/vandalism. As an alternative, traffic signals could also be considered which could further trigger the implementation of additional auxiliary turning lanes at the intersection.	Long Term
9	All four approaches of this all-way stop controlled intersection consist of a full shared through and right turning lane accompanied by a short left turning lane. This geometry, however, will not be sufficient to accommodate the peak hour traffic volumes in the short term. The most logical upgrade to implement would be a proper double circulating traffic circle with an outside diameter of at least 45m similar to what has been implemented at the intersection between Pierneef Blvd & Jim Fouche Road. As an alternative, traffic signals could also be considered which could further trigger the implementation of additional auxiliary turning lanes at the intersection.	Short Term



Intersection No.	Possible Capacity Upgrades	Upgrade Priority
11	Due to the high volume of vehicles travelling on Road R551, the signalization of this intersection as well as the implementation of auxiliary turning lanes would be required to meet the expected traffic demand through the intersection in the short term. Prior to the signalization of this intersection (including all the other intersections listed in this table), queue length surveys should be performed in order to determine whether signals are warranted in terms of the requirements of the <i>SARTSM (Vol. 3)</i>.	Short Term
12	If the current all-way stop geometry is kept as the intersection's control, queuing is expected to occur on the southern, eastern and western approaches. It can further be mentioned that the alignment of each approach isn't up to standards (i.e., skew). Therefore, to improve and rectify the overall operation of the intersection, it is proposed to implement a single circulating with an outside diameter in the order of 30m.	Short Term
13	Due to the high volume of vehicles travelling on Johan Le Roux Road, the signalization of this intersection is proposed. The signalization could further trigger the implementation of auxiliary turning lanes to meet the expected traffic demand through the intersection in the long term.	Long Term
14	Due to the high volume of vehicles travelling on Pierneef Boulevard, the signalization of this intersection is proposed. The signalization could further trigger the implementation of auxiliary turning lanes to meet the expected traffic demand through the intersection in the long term.	Long Term
15	Due to the high volume of vehicles travelling on Pierneef Boulevard, the signalization of this intersection is proposed. The signalization could further trigger the implementation of auxiliary turning lanes to meet the expected traffic demand through the intersection in the medium term.	Medium Term

D.8 PROJECT IDENTIFICATION & PRIORITIZATION

Based on site visits and taking into account the information presented in this document, road projects have been identified and categorized under four main categories based on its priority/urgency.

General projects which are not linked with a specific road or intersection have also been identified. These general projects will be continuous projects that will be relevant in the short, medium and long term to improve the overall quality of the road network.

- **Short Term Projects:** 0 – 5 years
- **Medium Term Projects:** 5 – 15 years
- **Long Term Projects:** 15 – 20 years
- **General Projects**



With regard to the various identified road projects, high level cost estimations have been provided for budgeting purposes. It is important to note that these cost estimations are provided based on the cost of constructing these upgrades based on the current average rates for construction.

Therefore, for any projects that will be implemented in the medium to long term, factors such as inflation that will influence the cost need to be accounted for.

These cost estimations also do not take into account factors such as unfavourable soil conditions that could increase the cost of construction.

D.9 CONCLUSION AND RECOMMENDATIONS

D.9.1 Future Traffic Volume Forecast

The analysis of the traffic data that was available suggests that the traffic within the Midvaal Local Municipality as a whole **is increasing at a rate of approximately 2% per annum**. Considering that the population is steadily increasing as shown by the census data, it is reasonable to assume that the traffic will continue to escalate annually as well.

For the traffic forecast model, the following year periods stretching over a period of 20 years, in five-year intervals, were considered as part of the traffic forecast model:

- Estimated 2024 Status Quo Traffic Volumes
- Estimated 2029 Future Base Traffic Volumes
- Estimated 2034 Future Base Traffic Volumes
- Estimated 2039 Future Base Traffic Volumes
- Estimated 2044 Future Base Traffic Volumes

It can be seen that with each 5-year interval, Category A marginally increases while Category D experiences a marginal downward trend which was expected. Given that if a road experience sustained traffic growth, it will eventually exceed the threshold of its current category and graduate to the next category.

Based on **Chart B** the following insights can be seen for the estimated data ranging for the periods of 2024 - 2044:

- The Category A link roads will increase the most with approximately 6% from 20% to 26%
- The Category B link roads will increase with approximately 2% from 24% to 26%
- The Category C link roads will decrease the most with approximately 5% from 31% to 26%
- The Category D link roads would decrease marginally by approximately 3% from 26% to 23%.



CHAPTER E : FUTURE DEMAND ASSESSMENT (STORMWATER)

E.1 STORMWATER

E.1.1 General

The building of roads, parking areas, the erection of buildings and the general improvement of land associated with development all have a direct impact on the hydraulic properties of the towns/townships in the Midvaal Local Municipality area of jurisdiction. By removing natural grass veld and replacing this with impermeable roofs or less permeable surfaces, the stormwater runoff properties are significantly altered.

The construction of piping systems and channelisation of natural watercourses routes the runoff of stormwater more effectively through a developed area, but at a greater velocity and in greater volumes than previously experienced in these catchment areas.

By altering the natural stormwater flow properties, a need arises for stormwater management while minimising the negative impacts of development.

In ***Clause 19 of the National Water Act (Act 36 of 1998)*** the prohibition of pollution is addressed. *“if pollution of a water resource occurs or might result from activities on land, the person who controls, occupies or uses the land in question is responsible for taking measures to prevent pollution of water resources”*.

E.1.2 Purpose of Stormwater Management

The principles on which stormwater management is based are as follows:

- The need to protect the health, welfare and safety of the public and to protect property from flood hazards by safely routing and discharging stormwater.
- The quest to improve the quality of life of affected communities.
- The opportunity to conserve water and make it available to the public for beneficial uses.
- The responsibility to preserve the natural environment.
- The need to strive for a sustainable environment while pursuing economic development.
- The desire to provide optimum methods of controlling runoff in such a way that the main beneficiaries pay in accordance with their potential benefits.
- The need to minimise the influence of faecal contamination in stormwater runoff.

While these goals may be reflected in other disciplines – and indeed may even be in apparent conflict with one another – specific objectives supporting these overall goals need to be identified by the planning team for each particular project.

E.1.3 Stormwater Infrastructure

E.1.3.1 Current Infrastructure Within Urban and Rural Area's

Midvaal Local Municipality does not currently have a Stormwater Bylaw or Stormwater Management Policy in place. It is recommended that such documents be compiled in accordance with the principles discussed in section E1.4 below.



Besides piped drainage, the various urban and rural areas rely to a large extent on surface drainage of stormwater, by means of roads and additional infrastructure such as unlined and lined channels.

The stormwater infrastructure can best be described as aged. In a number of cases, capacity problems are also experienced, due in large part to the accumulation of debris in the pipes and surface drains. This debris (gravel, silt, refuse, etc.) should be removed so that the stormwater systems can function efficiently.

It is recommended that a stormwater maintenance plan be implemented, and this report will provide guidelines for the successful implementation of a maintenance plan (See **Chapter K**).



LEGEND
----- GRAVEL ROADS
===== SURFACED ROADS

AMENDMENTS

REV	DATE	BY	DESCRIPTION
0	20/06/24	M.J.	ISSUED FOR INFORMATION

CLIENTS:

DEVELOPMENT BANK OF SOUTHERN AFRICA
Building Africa's Prosperity

PROJECT TITLE:
MIDVAAL STORMWATER MASTERPLAN

WARD 1: VAAL MARINA EXISTING LAYOUT

SCALE:
N.T.S.

INFRACONSULT ENGINEERING CC
P.O. BOX 4225 GERMISTON SOUTH 1411 TEL: 011-873-8126/7/8
EMAIL: info@infraconsult.co.za FAX: 011-873-0674

DRAWN:	A.S.
DESIGNED:	T.F.P.
CHECKED:	M.J.
APPROVED:	M.J.

APPROVED
EXECUTIVE OFFICER
SIGNATURE: _____
DATE: _____

DRAWING No:
MIDVAAL-SWMP-01A

SHEET No:
1 OF 2

PROUDLY SOUTH AFRICAN
© IN TERMS OF THE COPYRIGHT ACT NO. 98 OF 1978, NO PART OF THIS DRAWING DOCUMENT MAY BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT PERMISSION IN WRITING FROM INFRACONSULT ENGINEERING.

Drawing 4: Extraction from Vaal Marina Urban Stormwater Infrastructure (Very Minimal to No Stormwater Infrastructure)



LEGEND

- GRAVEL ROADS
- SURFACED ROADS

AMENDMENTS

REV	DATE	BY	DESCRIPTION
0	20/08/24	M.J.	ISSUED FOR INFORMATION

CLIENTS:

DBSA
DEVELOPMENT BANK OF SOUTHERN AFRICA
Building Africa's Prosperity

PROJECT TITLE:

MIDVAAL STORMWATER MASTERPLAN

WARD 8: SICELO EXISTING LAYOUT

SCALE:

N.T.S.

INFRACONSULT
INFRACONSULT ENGINEERING cc

55C 4225 GERMISTON SOUTH 1411 TEL: 021-873-8125/7/8
E-MAIL: info@infraconsult.co.za FAX: 021-873-0674

DRAWN:	A.S.
DESIGNED:	T.F.P.
CHECKED:	M.J.
APPROVED:	M.J.

APPROVED

EXECUTIVE OFFICER

SIGNATURE: _____

DATE: _____

DRAWING No:

MIDVAAL-SWMP-08A

SHEET No

1 OF 2

PROUDLY SOUTH AFRICAN

IN TERMS OF THE COPYRIGHT ACT NO. 98 OF 1978, NO PART OF THIS DRAWING OR DOCUMENT MAY BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT PERMISSION IN WRITING FROM INFRACONSULT ENGINEERING.

ISO 9001 CERTIFIED

Drawing 5: Extraction from Sicele Urban and Rural Stormwater Infrastructure (Very Minimal to No Stormwater Infrastructure)



LEGEND

- GRAVEL ROADS
- SURFACED ROADS
- MAJOR SW NETWORK
- MINOR SW NETWORK
- SW KERB INLETS
- OUTLET STRUCTURE
- ATTENUATION POND

AMENDMENTS

REV	DATE	BY	DESCRIPTION
9	23/08/24	M.J.	ISSUED FOR INFORMATION

CLIENTS:

DBSA
DEVELOPMENT BANK OF SOUTHERN AFRICA
Building Africa's Prosperity

PROJECT TITLE:
MIDVAAL STORMWATER MASTERPLAN

WARD 10: SICELO EXISTING LAYOUT

SCALE:
N.T.S.

INFRACONSULT
INFRACONSULT ENGINEERING CC

552-4225 GERMISTON SOUTH 1411 TEL: 073-8125/2/8
EVAL: infraconsult@infraconsult.co.za FAX: 073-0674

DRAWN: A.S.
DESIGNED: T.F.P.
CHECKED: M.J.
APPROVED: M.J.

APPROVED
EXECUTIVE OFFICER

SIGNATURE:
DATE:

DRAWING No:
MIDVAAL-SWMP-10A

SHEET No:
1 OF 2

PROUDLY SOUTH AFRICAN

© IN TERMS OF THE COPYRIGHT ACT NO. 94 OF 1978, NO PART OF THIS DRAWING OR DOCUMENT MAY BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT PERMISSION IN WRITING FROM INFRACONSULT ENGINEERING.

Drawing 6: Extraction from Sicele Urban Stormwater Infrastructure (Very Minimal to No Stormwater Infrastructure)



LEGEND

----- GRAVEL ROADS

===== SURFACED ROADS

REV	DATE	BY	DESCRIPTION
0	20/08/24	M.J.	ISSUED FOR INFORMATION

CLIENTS:

DBSA
DEVELOPMENT BANK OF SOUTHERN AFRICA
Building Africa's Prosperity

PROJECT TITLE:

MIDVAAL STORMWATER MASTERPLAN

WARD 14: MEYERTON EXISTING LAYOUT

SCALE:

N.T.S.

INFRACONSULT
INFRACONSULT ENGINEERING cc

0534225 GERMIEN SOUTH 1411 TEL: 073-812677/8
EMAIL: infraconsult@infraconsult.co.za FAX: 073-0674

DRAWN:	A.S.
DESIGNED:	T.F.P.
CHECKED:	M.J.
APPROVED:	M.J.

APPROVED:

EXECUTIVE OFFICER

SIGNATURE: _____

DATE: _____

DRAWING No:

MIDVAAL-SW-014A

SHEET No:

1 OF 2

PROUDLY SOUTH AFRICAN

© IN TERMS OF THE COPYRIGHT ACT NO. 98 OF 1978 NO PART OF THIS DRAWING/DOCUMENT MAY BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM WITHOUT PERMISSION IN WRITING FROM INFRACONSULT ENGINEERING.

Drawing 7: Extraction from Meyerton Urban Stormwater Infrastructure (Very Minimal to No Stormwater Infrastructure)



E.1.4 Proposed Stormwater Infrastructure

The proposed stormwater infrastructure will be discussed below, under the following headings respectively:

- Urban stormwater infrastructure
- Rural stormwater infrastructure
- Stormwater quality considerations

E.1.4.1 Proposed Urban Stormwater Infrastructure

It is recommended that in future urban stormwater runoff be accommodated by a **Dual Stormwater System**.

This implies that the runoff from **minor storms**, with a recurrence interval of typically 1:5 years, will be captured and conveyed by a stormwater reticulation system consisting of kerb inlets, field or grid inlets connected by a stormwater pipe system which conveys the runoff to convenient discharge points, such as natural water courses. This stormwater reticulation network is referred to as the **Minor System**.

The runoff from **major storm events**, which are far less frequent, will be conveyed to the discharge points by the urban road and road reserve networks when the stormwater pipes are running full. The residential roads must have a crossfall which is opposite to the fall of the terrain in order to:

- Increase the hydraulic capacity of the channel which is formed by the road and lower kerb.
- Prevent road surface runoff from flowing into the driveways and flooding the lower laying properties.

Special care must be taken at **local low points**, which can cause flooding of properties if not discharged properly. As the road channel here cannot act as a conduit to accommodate runoff of recurrence intervals larger than 1:5year, it is recommended that the discharge pipes and/or channels draining the local low points will be designed for a recurrence interval of 1:25year to prevent potential flooding of properties. **(See Annexure O)**

See below the Typical Stormwater Management Plan proposed for Urban Areas that includes Major, Minor and attenuation facilities.



LEGEND

- GRAVEL ROADS
- SURFACED ROADS
- SW EARTH CHANNEL
- SW OUTLET STRUCTURE

AMENDMENTS

REV	DATE	BY	DESCRIPTION
0	20/08/24	M.J.	ISSUED FOR INFORMATION

CLIENTS:

DBSA
DEVELOPMENT BANK OF SOUTHERN AFRICA
Building Africa's Prosperity

PROJECT TITLE:

MIDVAAL STORMWATER MASTERPLAN

WARD 1: VAAL MARINA PROPOSED STORMWATER MANAGEMENT PLAN

SCALE:

N.T.S.

INFRACONSULT
INFRACONSULT ENGINEERING cc

PO BOX 4025 GERMISTON, SOUTH 1411 TEL: 873-8126/7/8
EMAIL: infraconsult@infraconsult.co.za FAX: 873-0674

DRAWN:	A.S.
DESIGNED:	T.F.P.
CHECKED:	M.J.
APPROVED:	M.J.

APPROVED

EXECUTIVE OFFICER

SIGNATURE: _____

DATE: _____

DRAWING No

MIDVAAL-SWMP-01B

SHEET No

2 OF 2

PROUDLY SOUTH AFRICAN

© IN TERMS OF THE COPYRIGHT ACT NO 98 OF 1978, NO PART OF THIS DRAWING DOCUMENT MAY BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT PERMISSION IN WRITING FROM INFRACONSULT ENGINEERING.

Drawing 8: Extraction from Stormwater Provision Recommended in Urban Areas



LEGEND

- GRAVEL ROADS
- SURFACED ROADS
- MINOR SW NETWORK
- SW EARTH CHANNEL
- SW KERR IN ITS

REVISIONS			
NO.	DATE	BY	REASON
1	20/08/24	M.J.	ISSUE FOR INFORMATION

CLIENT

DBSA
DEVELOPMENT BANK OF SOUTHERN AFRICA
Building Africa's Prosperity

PROJECT TITLE

MIDVAAL STORMWATER MASTERPLAN

WARD 10: SICELO PROPOSED STORMWATER MANAGEMENT PLAN

SCALE

N.T.S.

INFRACONSULT
INFRACONSULT ENGINEERING CC

2024-2025: 01/08/24 TO 31/07/25
2025-2026: 01/08/25 TO 31/07/26

DRAWN	A.S.
DESIGNED	T.J.M.
CHECKED	M.J.
APPROVED	M.J.

APPROVED

EXECUTIVE OFFICER

SIGNATURE: _____
DATE: _____

ORGANIC NO

MIDVAAL-SWMP-10A

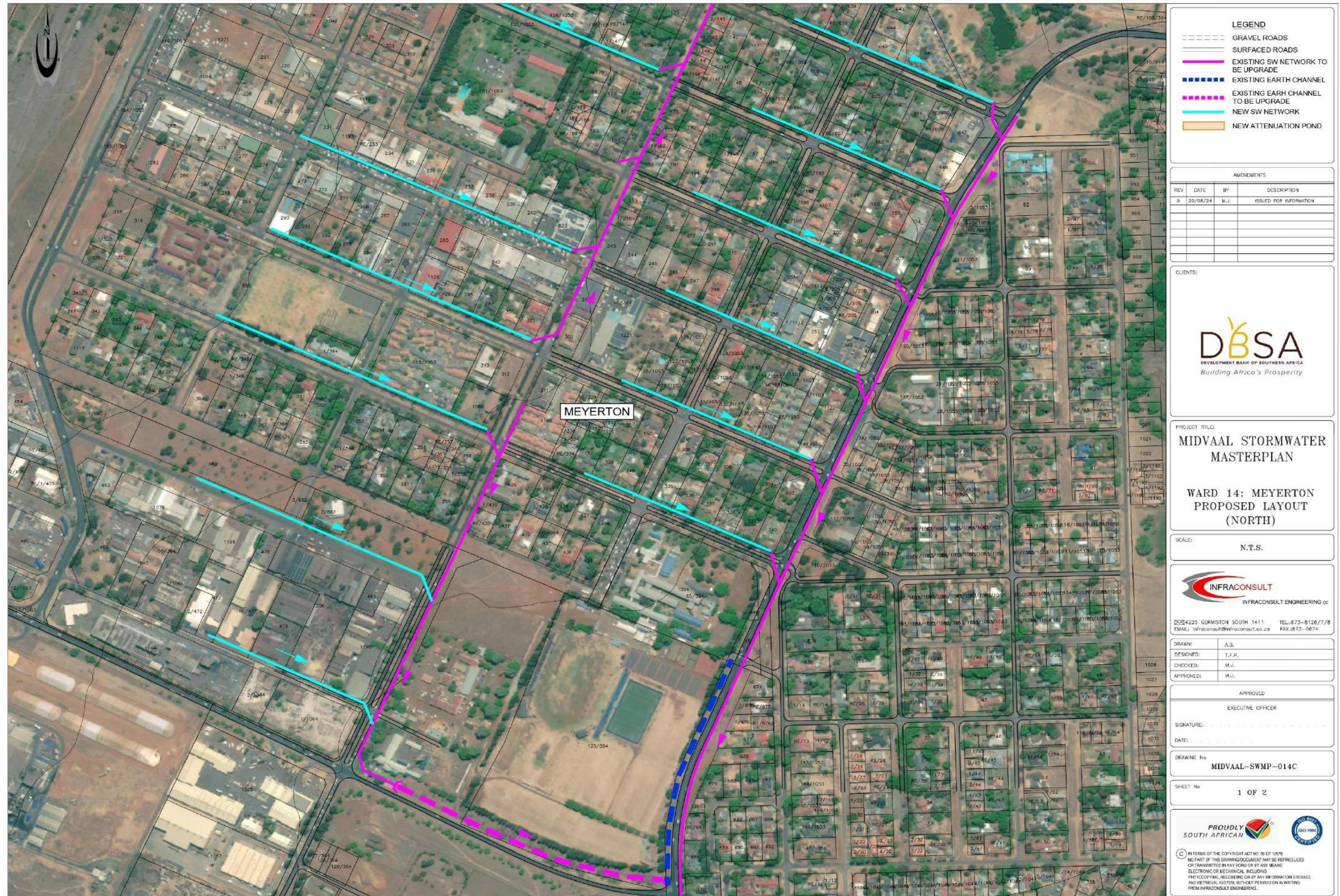
SHEET NO

1 OF 2

PROUDLY SOUTH AFRICAN

© 1999-2024 INFRACONSULT ENGINEERING CC. ALL RIGHTS RESERVED. NO PART OF THIS DOCUMENT MAY BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT PERMISSION IN WRITING FROM INFRACONSULT ENGINEERING CC.

Drawing 9: Extraction from Stormwater Provision Recommended in Urban Areas



- LEGEND**
- GRAVEL ROADS
 - SURFACED ROADS
 - EXISTING SW NETWORK TO BE UPGRADE
 - EXISTING EARTH CHANNEL
 - EXISTING EARTH CHANNEL TO BE UPGRADE
 - NEW SW NETWORK
 - NEW ATTENUATION POND

AMENDMENTS			
REV	DATE	BY	DESCRIPTION
0	20/08/24	M.J.	ISSUED FOR INFORMATION

CLIENTS:

DBSA
DEVELOPMENT BANK OF SOUTHERN AFRICA
Building Africa's Prosperity

PROJECT TITLE:
**MIDVAAL STORMWATER
MASTERPLAN**

**WARD 14: MEYERTON
PROPOSED LAYOUT
(NORTH)**

SCALE: N.T.S.

INFRACONSULT
INFRACONSULT ENGINEERING CC

0254225 GERMISTON SOUTH 1411 TEL: 873-8126/7/8
EMAIL: infraconsult@infraconsult.co.za FAX: 873-0674

DRAWN:	A.S.
DESIGNED:	T.F.P.
CHECKED:	M.J.
APPROVED:	M.J.

APPROVED

EXECUTIVE OFFICER

SIGNATURE: _____

DATE: _____

DRAWING No: **MIDVAAL-SWMP-014C**

SHEET No: **1 OF 2**

PROUDLY SOUTH AFRICAN

IN TERMS OF THE COPYRIGHT ACT NO. 98 OF 1978, NO PART OF THIS DRAWING DOCUMENT MAY BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT PERMISSION IN WRITING FROM INFRACONSULT ENGINEERING.

Drawing 10: Extraction from Stormwater Provision Recommended Major System in CBD Areas



The following considerations must be taken into consideration:

- **Capacity of kerb inlets:**

It is suggested to use lockable stormwater grids as kerb inlet cover. This will increase the capacity of the kerb inlets in case the kerb overtops at the lowest point of the road. An inlet length of 4.0m is desirable. On gradients, a wider and depressed roadside channel of at least 2.0m in length should be provided in order to increase the efficiency of the kerb inlet.

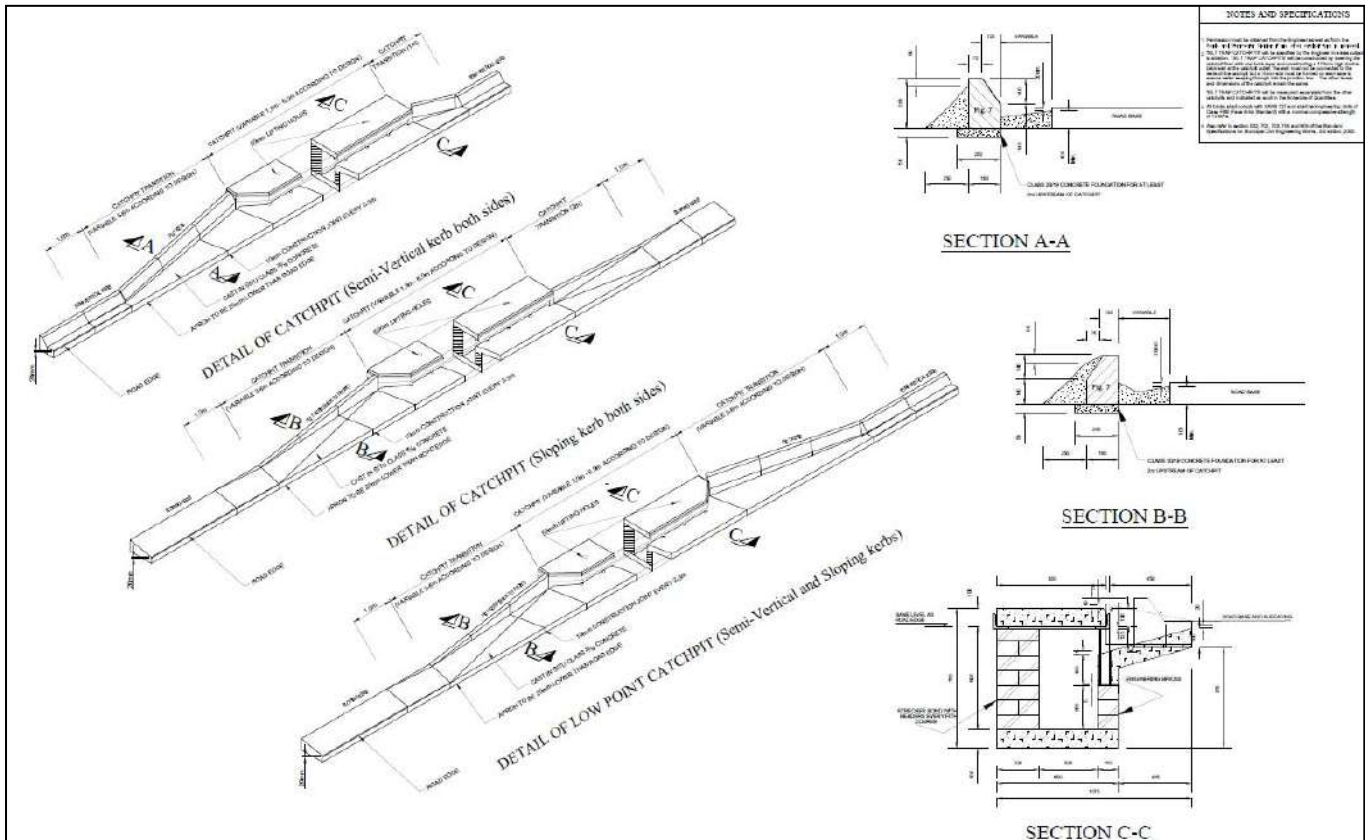


Figure 54: Typical Kerb Inlet Details

For implementing an efficient kerb inlet, the following improvements are proposed:

- Inlet length to be 4.0m minimum.
- 450mm wide lowered roadside channel before the start of the inlet. This will increase the height of the inlet weir.
- Lockable grid cover for kerb inlets at low points. The grids will increase the capacity once the cover slab starts topping over.
- **Design recurrence interval:**
As the road cannot provide extra capacity at low points it is proposed to use a recurrence interval of 1:10year to 1:20year, depending on the type of buildings which are threatened with flooding.
- **Registration of servitude for the outfall pipe:**
The servitude should be preferable be 3.0m wide. The absolute minimum width should be 2.0m. A dual drainage system should be used in the servitude and a stormwater pipe and including stone pitched stormwater channel should be constructed in the servitude.



- **Proper discharge point:**
An energy dissipation structure and erosion should be provided at discharge points in order to protect the natural watercourses.



- Proposed subsoil drains**
 In areas where wet conditions prevail, it is proposed to use subsoil drains to keep down the groundwater level below the road layer works. One subsoil drain on the higher side of the terrain is proposed for the local residential roads and two subsoil drains are proposed on either side of the road for the wider roads such as collector, arterial and industrial roads. The slotted pipes in the subsoil drains will discharge the groundwater at stormwater outlet points.

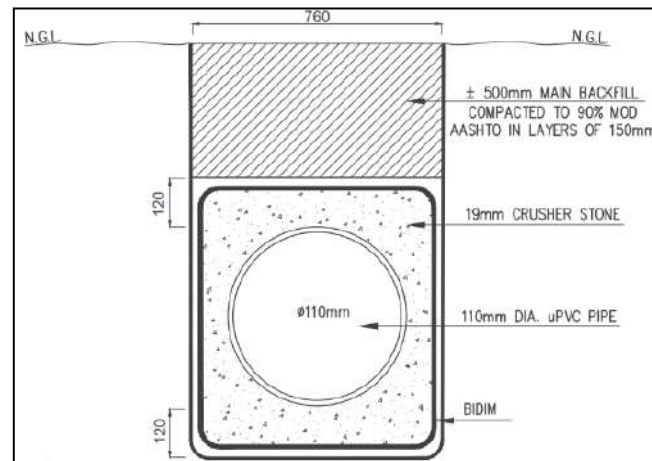


Figure 57: Typical Subsoil Drainage Detail

- Proposed drainage layer in wetlands**

As the soil is permanently soaked in the wetlands special care needs to be given, besides the subsoil drains, to keep the layer works dry. It is proposed to provide a drainage layer of a thickness of 300mm to 500mm under the layer works. The drainage consists of dump rock wrapped in a strong geofabric. The 160Ø slotted pipes will discharge into convenient points such as stormwater outlets and watercourses.

LAYER NUMBER	THICKNESS	MATERIAL DESCRIPTION	CLASSIFICATION	COMPACTION MOD AASHTO (min)	PI (max)	GM (min)	CBR % (min)
1	25mm	CONTINUOUSLY GRADED STANDARD TPA ASPHALT	-	-	-	-	-
2	150mm	BASE	G2	88% (APPARENT DENSITY)	-	-	-
3	150mm	SUBBASE	C4	95%	6	1.5	35
4	500mm	ROADBED (DUMP ROCK)	-	-	-	-	-

PROPOSED ROAD LAYERWORKS (WITH DUMP ROCK)

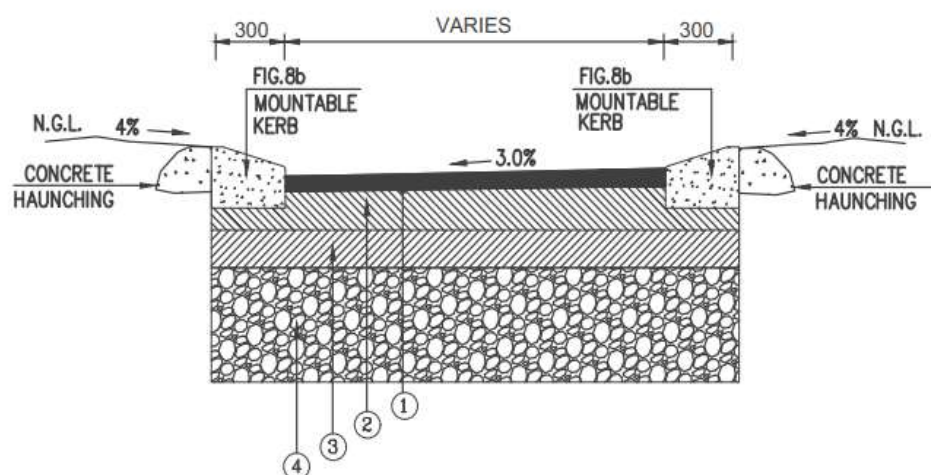


Figure 58: Typical Road with Dump Rock Layer

E.1.4.2 Pipe

Stormwater pipes must have a minimum diameter of 600mm to prevent blockages and make cleaning/maintenance easier.



E.1.4.3 Peak Flow Attenuation

It is recommended to implement a policy of stormwater peak flow attenuation for new developments to be constructed in the future. The new developments will increase the area of impervious surface, which will cause increased runoff and a lower time of concentration. This will put an additional load on the stormwater system.

As the stormwater system will be designed for the current land use only, the developers will be requested to provide facilities for on-site stormwater attenuation. This implies that an attenuation dam/reservoir has to be constructed at the lowest point of the site, from which the accumulated runoff will be released by means of an outlet control structure, at a rate similar to that of the previous, undeveloped condition.

E.1.4.4 Design of Attenuation Dam / Reservoir

Two types of attenuation reservoirs are commonly used, below the advantages and disadvantages of each will be discussed:

1. **Attenuation tank:**
 - Advantages:
 - Takes up less space as internal roads can be constructed over the tank and no side slopes are used.
 - Disadvantages:
 - Difficult and inconvenient to access and therefore difficult to maintain.
 - Sedimentation will take place and this will accumulate over time, reducing the capacity of the tank. As a result, the required peak flood attenuation will not take place.
 - Environmentally unfriendly.
2. **Open attenuation pond:**
 - Advantages:
 - Easy to clean out sediments if designed properly.
 - Easy to maintain.
 - Can be incorporated into the landscaping of the site.
 - Disadvantages:
 - Takes up site land which otherwise would have been developed.
 - Ponds can fail during major rainstorms if it is not properly designed.
 - Environmentally friendly if properly designed.

E.1.4.5 Design of Open Attenuation Pond

The Design of an open attenuation pond includes the following components:

- Energy dissipation zone at each inlet point to break the energy of the inflowing water and prevent erosion.
- Forebay at each inlet point for sediments such as sand & gravel to settle on the bottom and solid waste to be removed. Easy access to the sedimentation zone has to be provided for maintenance works. Once the sediment has settled and is removed from the sedimentation bay it should be disposed of at a landfill site and not to be thrown down the existing watercourse or river.
- Extended detention pond designed to allow for nutrient rich pollutants, such as nitrate and phosphorus, to settle, typically 24h.



- Emergency overflow with concrete lining. The crest of the Emergency Overflow should be 0.5m below the crest of the embankment. Adequate erosion protection has to be provided at the bottom of the emergency overflow.

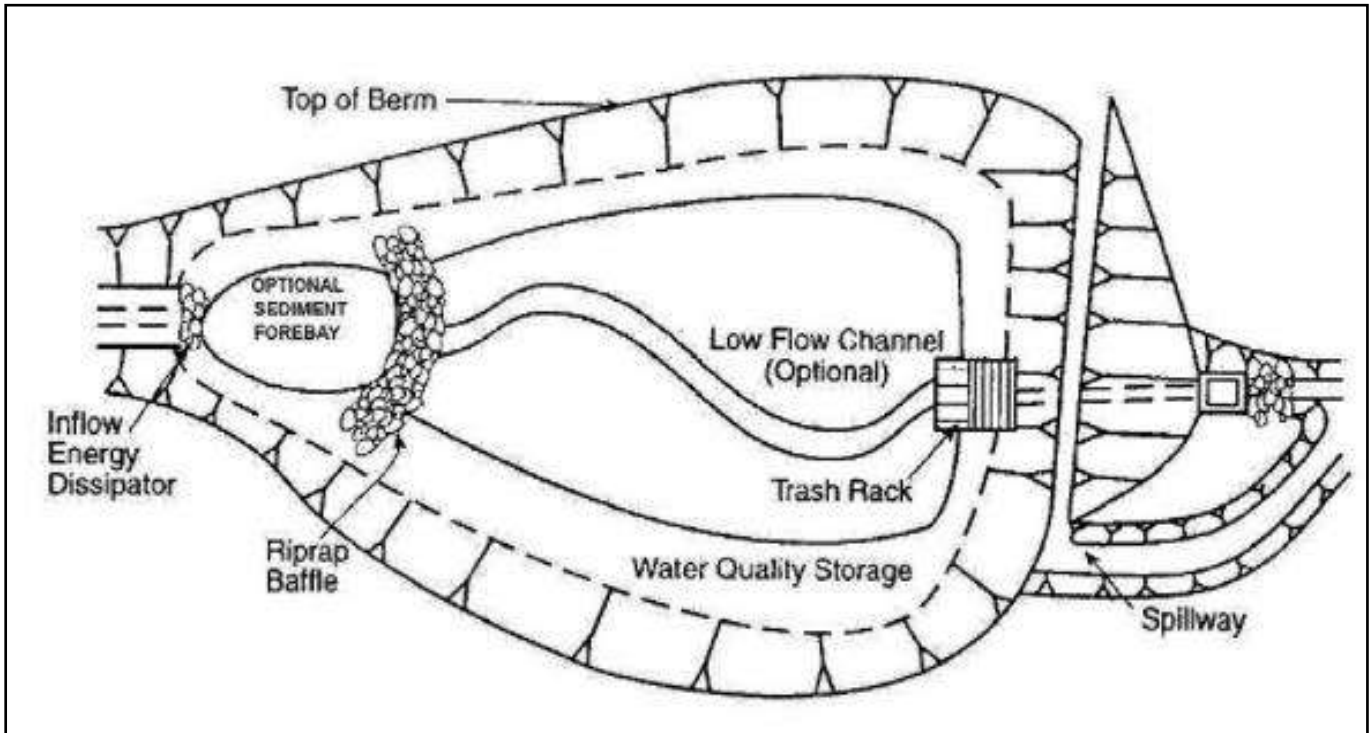


Figure 59: Example of an Attenuation Pond Design

It is recommended to use open attenuation ponds only. This will facilitate maintenance procedures and will provide a visual check of whether maintenance is being performed.

E.2 RURAL STORMWATER INFRASTRUCTURE DESIGN

In order to mitigate the stormwater, run-off in rural areas it is proposed that the following possible stormwater infrastructure be investigated. However note, that this should only be taken as interim measures while the formalisation of townships are in progress or should funds not be available for the implementation of urban stormwater infrastructure standards.



LEGEND

- GRAVEL ROADS
- SURFACED ROADS
- MAJOR SW NETWORK
- MINOR SW NETWORK
- SW KERB INLETS
- OUTLET STRUCTURE
- ATTENUATION POND

AMENDMENTS

REV	DATE	BY	DESCRIPTION
0	20/08/24	M.J.	ISSUED FOR INFORMATION

CLIENTS

DBSA
DEVELOPMENT BANK OF SOUTHERN AFRICA
Building Africa's Prosperity

PROJECT TITLE

MIDVAAL STORMWATER MASTERPLAN

WARD 8: SICELO PROPOSED STORMWATER MANAGEMENT PLAN

SCALE: N.T.S.

INFRACONSULT
INFRACONSULT ENGINEERING cc

5554225 GERURION SOUTH 1411 TEL: 873-8126/7/8
EMAIL: infraconsult@infraconsult.co.za FAX: 873-0874

DRAWN:	A.S.
DESIGNED:	T.F.P.
CHECKED:	M.J.
APPROVED:	M.J.

APPROVED

EXECUTIVE OFFICER

SIGNATURE: _____

DATE: _____

DRAWING NO

MIDVAAL-SWMP-08B

SHEET No

2 OF 2

PROUDLY SOUTH AFRICAN

ISO 9001

© IN TERMS OF THE COPYRIGHT ACT NO. 95 OF 1978, NO PART OF THIS DRAWING/DOCUMENT MAY BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPIING, RECORDING OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT PERMISSION IN WRITING FROM INFRACONSULT ENGINEERING.

Drawing 11: Extraction from Stormwater Provision Recommended in Urban and Rural Areas

E.2.1 Proposed Culverts

All river/stream crossings shall have culvert crossings implemented, either pedestrian only or pedestrian and vehicular crossings. Below are a few examples of culvert crossings within the Midvaal area.



Figure 60: Example of a Culvert bridge implemented at a low point



Figure 61: Two examples of Culvert bridges implemented on an internal road and provincial road respectively.

E.2.2 Proposed Road Drainage Channels

Where stormwater runoff deteriorates the road surface to a level that is unacceptable for ease of movement, it is recommended that concrete drainage channels be implemented, as this is a relatively quick and cost effective method to improve the levels of service of a town and its residents.



Figure 62: Example of a Concrete drainage channel implemented next to a surfaced road.

E.2.3 Proposed Discharge Point

An energy dissipation structure and erosion should be provided at discharge points in order to protect the natural watercourses.

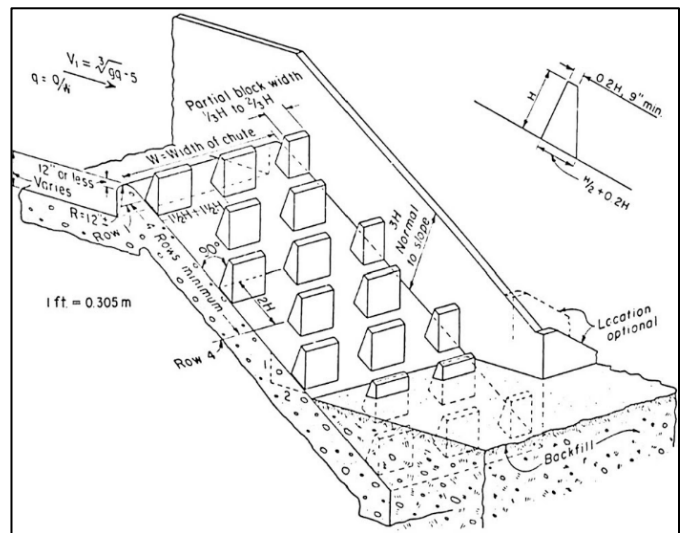


Figure 63: Typical Example of Energy Dissipation Structure



E.3 STORMWATER QUALITY CONSIDERATIONS

E.3.1 Protection of Rivers

It is recommended to manage the quality of the stormwater runoff as most of the runoff will be eventually conveyed to the estuaries situated at the river mouths.

Stormwater treatment close to the source of pollution is recommended. This will imply measures such as grease and oil traps at industrial sites and sedimentation bays at residential and commercial developments.

E.3.2 Water Quality Volume

The Water Quality Volume is referred to as the runoff volume which typically needs to be captured and treated in order to remove 80% of the pollutants out of the cumulative rainwater storms. The treatment is by sedimentation. Once the sediment has settled and is removed from the sedimentation bay it should be disposed of at a landfill site and not to be thrown down the existing watercourse or river.

The recurrence interval of a storm event used for the determination of the water quality is typically from 0.5year to 1year.

E.4 CONCLUSION

It is evident from the Existing Situation Analysis that Midvaal Local Municipality has minimal to low stormwater Infrastructure networks available within Urban and Rural Areas.

The main focus of this Stormwater Master Plan was to consolidate and coordinate all the planning actions of Midvaal Local Municipality. The purpose was to present an acceptable infrastructure development plan to the Municipality in order to assist with the implementation of projects that will ensure the improvement and sustainability of the current stormwater infrastructure.

The Midvaal Local Municipality Master Plan should be seen as the first step in a continuous process consisting of:

- Project identification, normally based on a recognised problem or need,
- Preliminary design of project solution,
- Inclusion of project in database and on maps,
- Prioritisation of projects,
- Allocation of funding and project execution,
- Updating of project status in database and on maps, and
- Development of an asset management programme for all the infrastructure.

The above process should be integrated into the normal operation of the Technical Department of Midvaal Local Municipality.



CHAPTER F : FUTURE DEMAND ASSESSMENT (FLOODLINES)

F.1 INTRODUCTION

The purpose of this report is to provide a desktop regional flood risk assessment using the Regional Maximum Flood method compiled by Kovacs 1988 using the dataset from TR 137 manual and data from the Department of Water and Sanitation.

Several existing developments are situated within floodplains and new developments are planned along various rivers in Midvaal Local Municipality in the Gauteng Province. Therefore, A need was identified to carry out a desktop study to obtain regional 1:50 year and 1:100-year reduced RMF (Regional Maximum Flood) floodline study to aid in quantifying current problem areas and ensure that future developments are not prone to unacceptable flooding. This section of the report deals with the floodline analysis carry out by the PSP in a detailed 1:50 year and 1:100-year floodline study for the entire Midvaal Local Municipality. Relevant details are given in this report.

The principal objective of this project is to determine the regional 1:50 and 1:100 Year floodlines along rivers within Midvaal Local Municipality. The floodlines were determined based on the current watercourse conditions. The catchment hydrology was determined by characterising the hydrological and hydraulic parameters of the catchment.

The catchment parameters were then used to generate the peak flow data (i.e.1:50 and 1:100-year flood peaks) using the Regional Maximum Flood method. The peak flow data and other relevant information were entered into the backwater model HECRAS to produce the results on the flooding extent along the riverbanks.

F.2 BACKGROUND

The study area is situated within the Midvaal Local Municipality in the Gauteng province. The watercourses, Vaal River, Langkuilspuit, Rietspruit, Blesbokspuit, Natalspruit and all their tributaries drain runoff from the peri-urban areas into Vaal Dam. The watercourse is fairly well defined with a variation of light, moderate and thick vegetation. Most of the watercourses run in rural areas but the main Langkuil River runs in parts of Meyerton and some tributaries and major rivers also run through developed areas.

Table 10: River Type and Location

River Type and Location	Model Representation
Perennial Rivers	RED 
Tributary Rivers	ORANGE 
Secondary Tributary Rivers	GREEN 

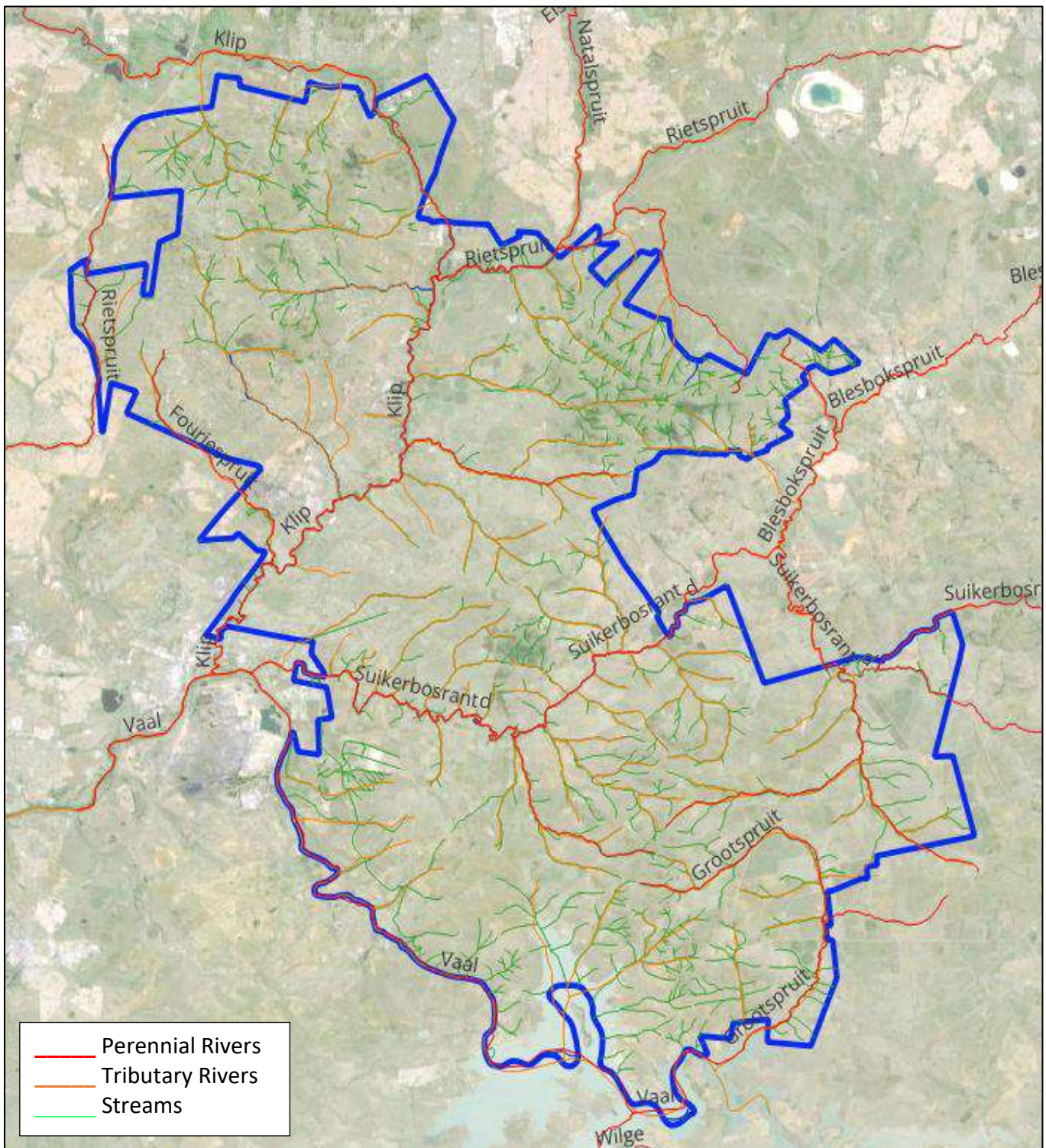


Figure 64: Indication of Perennial Rivers and Tributary Rivers

F.3 LEGAL REQUIREMENTS

The **1:100-year** floodline is required in terms of the National Water Act, Act 36 of 1998, Chapter 14 Part 3 as given below.

144. “For the purposes of ensuring that all persons who might be affected have access to information regarding potential flood hazards, no person may establish a township unless the layout plan shows, in a form acceptable to the local authority concerned, lines indicating the maximum level likely to be reached by flood waters on average once in every 100 years.”



F.4 REGIONAL FLOODLINE DETERMINATION

The floodlines were determined based on the current watercourse conditions. The catchment hydrology was determined by characterising the hydrological and hydraulic parameters of the catchment. The catchment parameters were then used to generate the peak flow data (i.e. 1:50 and 1:100-year flood peaks) using Regional Maximum Flood method.

The peak flow data and other relevant information were entered into the backwater model HECRAS to produce the results on the flooding extent along the riverbanks.

In Summary, the Regional Floodlines were determined, using the following steps:

- Delineating the Catchments and Sub-catchments.
- Estimation of the Peak Flow.
- Estimation of the flood peaks.
- Modelling the Floodlines using the HECRAS Software suite.

F.4.1 Catchment and Sub-Catchment Delineation

For the purpose of this study catchment delineation was conducted using the Archydro tool. Arc-Hydro is a model developed for building hydrologic information systems to synthesize geospatial and temporal water resource data that support hydrologic modelling and analysis. The model is developed as an extension or Add-on to ArcGIS software.

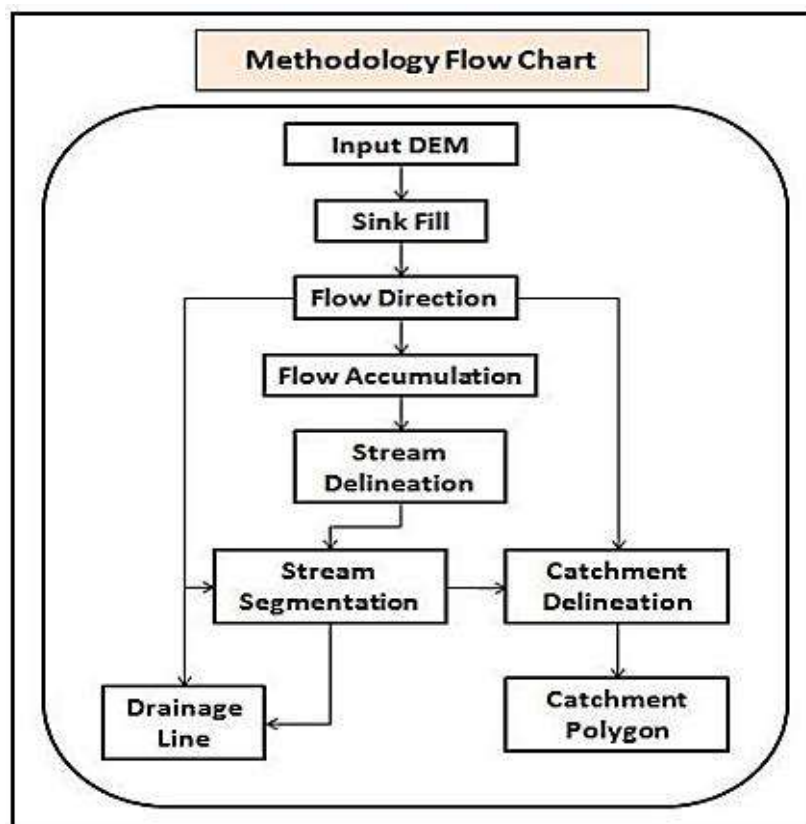


Figure 65: Methodology Flow Chart



Table 11 : Catchment Area of Midvaal LM

River Segment	Approximate Catchment Area (km ²)
Study Area (Midvaal LM)	1 723
Contributing Catchments	45 000

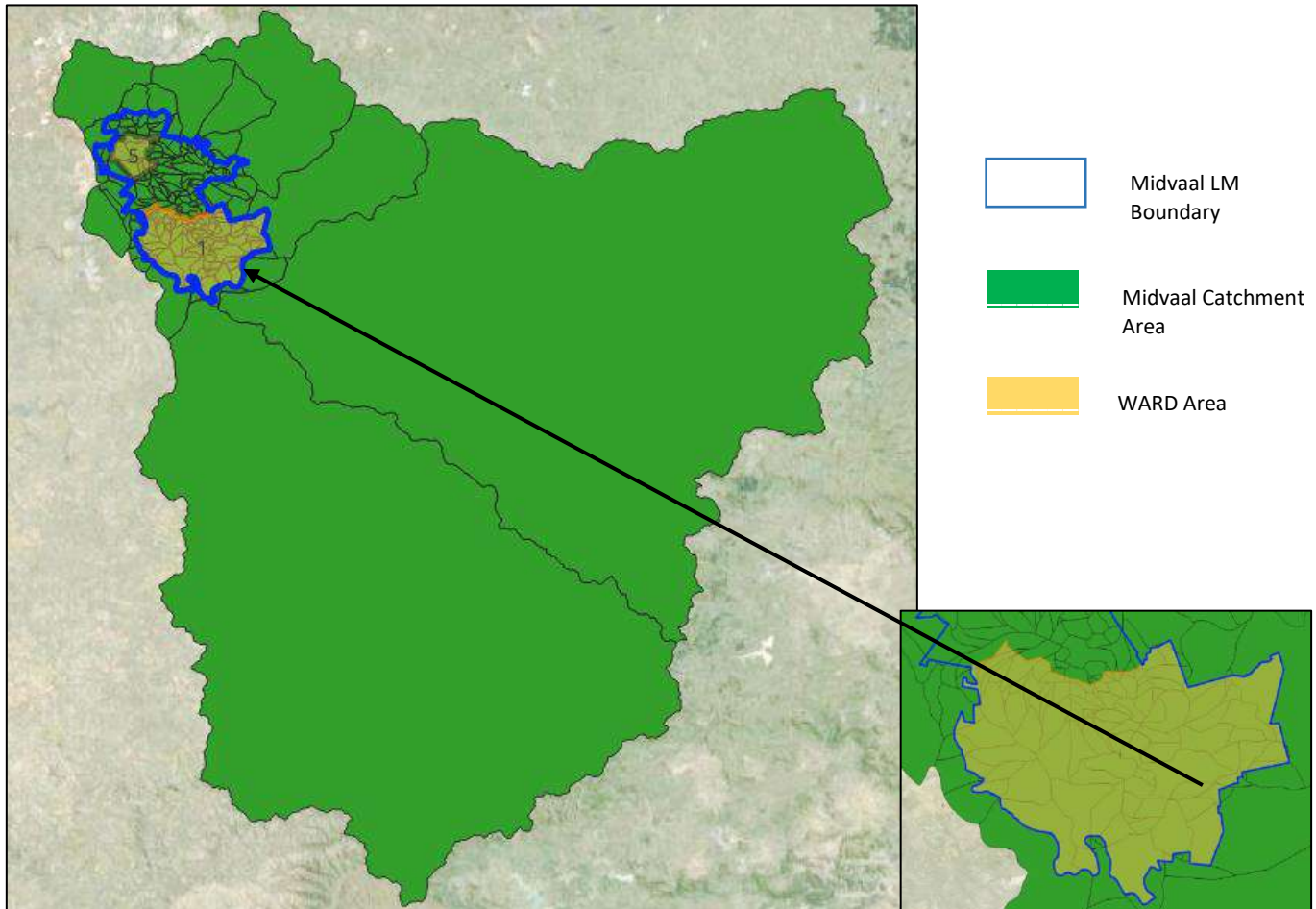


Figure 66: Sub-Catchment Areas of Midvaal LM

A summary of Catchment data is presented in **Annexure O**.

F.4.2 Peak Flow Estimation Using Regional Maximum Flood Study Method

To obtain an estimation of regional flood peaks along watercourses within the Midvaal area, a simple but yet robust method based on the Regional Maximum Flood manual (TR137) compiled by Z Kovacs in December 1988 for the Department of Water Affairs.

The regional maximum flood (RMF) is an empirically established upper limit of flood peaks that can be reasonably expected at a given site. The proposed method for the estimation of RMF is a revised and updated version of Departmental Technical Report TR 105 published in 1980.

The method is based on maximum flood peaks recorded since 1856 at more than 500 sites in Southern Africa. The relative flood peak magnitude is expressed by the Francou-Rodier regional coefficient K. Eight maximum flood peak regions were delimited by a joint consideration of K, maximum observed 3-day



rainfall and catchment characteristics. The respective K envelope lines (K_e) were established by taking into account the number and quality of data.

The RMF can be instantly calculated if the geographic position of the site and its effective catchment area are known. Owing to its consistency the RMF compares favourably with results obtained by other methods. It is also shown that flood peaks in the 50-to-200-year recurrence interval can be estimated from RMF.

In this approach, maximum flood peaks observed in a hydrologically homogeneous region are plotted against the catchment area and an envelope curve is drawn for the points which is then considered as the upper limit of expected flood peaks, Q_{max} .

The general algebraic expression of envelope curves is:

$$Q_{max} = CA^x$$

Where A is the catchment area and
 C, x are regional constants.

This equation is based on the RMF Equation Table from TR137 compiled by Kovacs in 1988.

It should be noted that the common shortcomings of the empirical approach are:

- Uncertainty regarding the boundaries of homogeneous regions. This is a common drawback of all regional approaches in hydrology.
- Very large and very small catchments often cannot be accounted for by the regional approach because of unusual hydrological features.
- The empirical equations of maximum flood peak envelope curves dating from the period before 1960 lacked physical meaning. Consequently, their justified application was restricted to well defined areas.
- The method is expected to render the best results for catchment sizes approximately between 300 km² and 20 000 km². In both the small and large catchments, one is confronted with the inherent weakness of all regionally based methods, namely that the characteristics of these catchments cannot be easily expressed by one common regional factor, in this case, K_e .

F.4.3 Estimation of 50 Year To 200 Year Flood Peaks from RMF

A simple, unorthodox analysis of the K value and the representative period (N) is entirely independent flood peaks has provided coefficients which represent the 50 year to 200 year peaks as fractions of RMF. For the purpose of this study only the 50 and 100-year peaks were computed for this study area.

Once all the peak flows were computed for the entire Midvaal Local Municipality area, then these peaks were used in the Hydraulic modelling of all watercourses bounded by Midvaal Local Municipality. The first step was to compute the flow levels for a reduced RMF100 flood and then merge the final polygon with a 32m buffer to create an open pace buffer along all the watercourses in the Midvaal area.

This helps to compute the estimated likely floodline that may occur along the rivers in Midvaal Local Municipality which excludes the impact of all crossings (Bridges, culverts, weirs, obstructions, pedestrian crossings, causeways, dam walls, etc).

It should also be noted that the peak flows are based on the RMF calculation thus the accuracy of these floodlines is meant for planning purposes only and should never be used for any detailed design planning.



F.4.4 Example of a RMF calculation

Step 1 – Determine the region where the catchment falls under (in this case Region 5)

Step 2 – Refer to the table which equation to use for a specific catchment area

($120 \text{ km}^2 Q = A 0.5 \times 100$ equating to $1200.5 \times 100 = 1095.45$ which is RMF peak flow this value is then reduced to 1:50 and 1:100 as per the table to give 201.4 for 1:50 and 265.5 for a 1:100 year flood event) for further clarification.

The TR137 manual is attached in **Annexure O**.

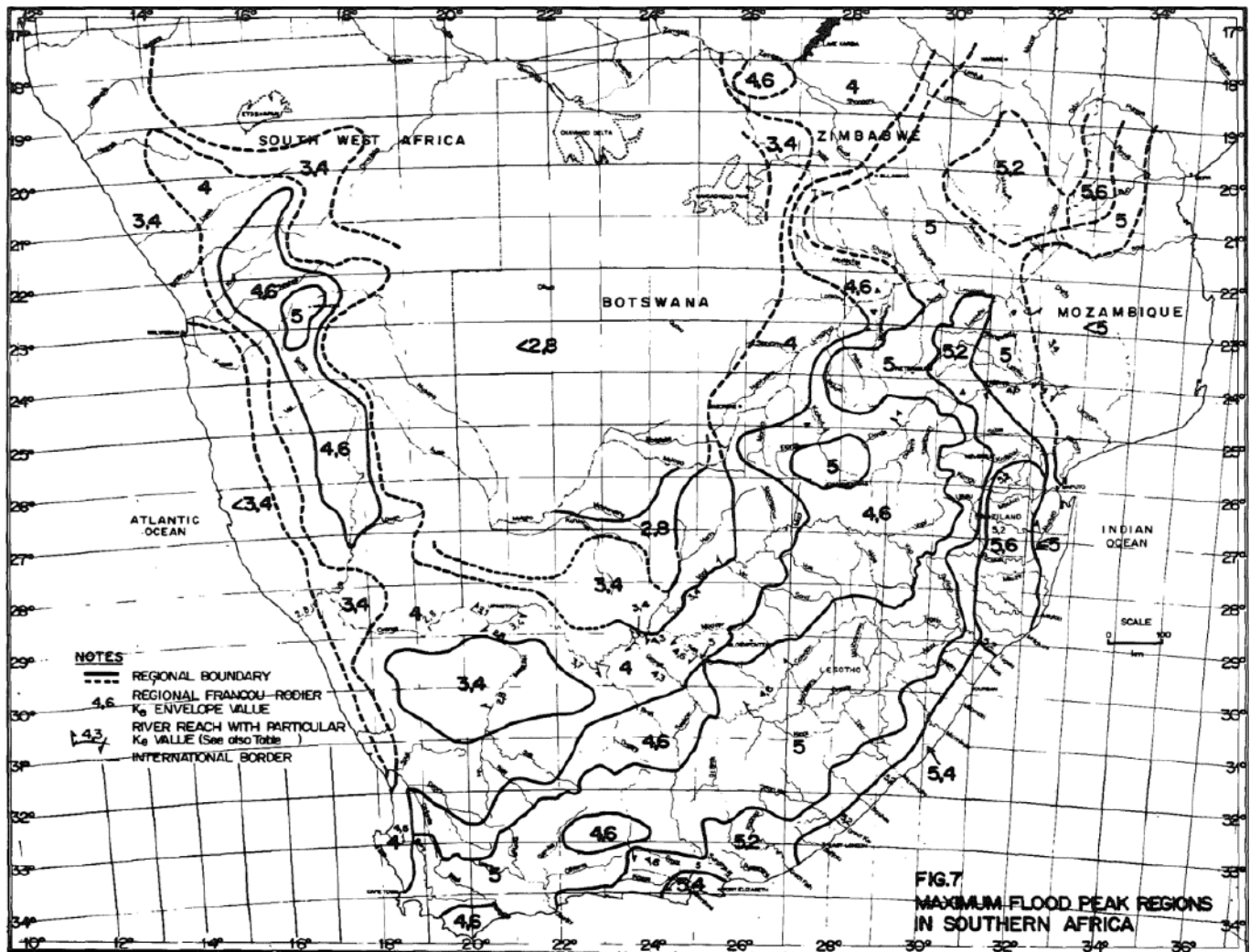


Figure 67: RMF Regions

APPENDIX 7: Q_T/IDF RATIOS FOR DIFFERENT CATCHMENT AREAS IN SOUTH WEST AFRICA AND ZIMBABWE

COUNTRY	REGION	RETURN PERIOD T (years)	K_T	EFFECTIVE CATCHMENT AREA, A_e (km ²)								
				$\leq 10^*$	30*	100	300	1000	3000	10000	30000	100000
SOUTH WEST AFRICA	5	50	4,50	0,562	0,534	0,501	0,529	0,562	0,594	0,631		
		100	4,70	0,708	0,686	0,661	0,683	0,708	0,732	0,759		
		200	4,85	0,841	0,828	0,813	0,826	0,841	0,855	0,871		
	4,6	50	4,14	0,589	0,561	0,530	0,558	0,589	0,620	0,654	0,690	0,727
		100	4,34	0,741	0,721	0,699	0,719	0,741	0,763	0,787	0,811	0,835
		200	4,48	0,871	0,860	0,848	0,860	0,871	0,883	0,895	0,909	0,920
	4	50	3,50	0,562	0,562	0,562*	0,529	0,562	0,585	0,631	0,666	0,710
		100	3,66	0,676	0,676	0,676*	0,648	0,676	0,703	0,731	0,759	0,793
		200	3,77	0,767	0,767	0,767*	0,746	0,767	0,788	0,809	0,829	0,856
	3,4	50	2,88	0,550	0,550	0,550*	0,517	0,550	0,585	0,619	0,656	0,696
		100	3,01	0,639	0,639	0,639*	0,610	0,639	0,669	0,698	0,729	0,762
		200	3,13	0,733	0,733	0,733*	0,711	0,733	0,758	0,779	0,803	0,828
ZIMBABWE**	5,2	50	4,65	0,531	0,502	0,468	0,497	0,531	0,564	0,603	0,640	
		100	4,86	0,676	0,652	0,625	0,649	0,676	0,702	0,731	0,759	
		200	5,03	0,822	0,807	0,791	0,806	0,822	0,838	0,855	0,871	

* GuesSED ratios

** In region 5 use the same ratios as in South Africa

Figure 68: Effective Catchment Area

F.4.5 HECRAS Software Modelling

The 1:50 and 1:100-year floodlines were determined along the river within the study area. The HECRAS model was used to estimate the expected high-water levels and determine the corresponding floodline.

The Model is a standard backwater model which has been widely used throughout the world. The basic computational procedure of HECRAS for steady and unsteady flow is based on the solution of the one-dimensional energy equation and wave equation respectively. Energy losses are evaluated by friction and contraction/expansion.

The momentum equation may be used in situations where the water surface profile is rapidly varied. These situations include hydraulic jumps, hydraulics of bridges, and evaluating profiles at river confluences.

The model has been developed by the USA Army Corps of Engineers – Hydrologic Control Centre and has successfully been used in South Africa.

The following main parameters were established:

- River cross sections.
- Sections at road, rail crossings and dimensions of the bridges and culverts.
- River roughness (depending on lining, and vegetation).
- River slope.
- Backwater levels from dams and any weirs within the river.
- Peak flow rates as determined in hydrology study.

The above input parameters were then entered into the HECRAS model which calculates the water levels at different sections along the river. The model was run in both supercritical and sub-critical modes thereby considering existing control structures which cause a damming-up effect and flow restriction.

The 5m survey data was entered into the HECRAS model. All “natural cross sections” were abstracted from the DEM (Digital Elevation Model).



Table 12: Calculated Floodline Results

Description	Total
River segments	212
Number of Catchments	212
Total Catchment area (km ²)	45 000
Number of cross sections	3 842

The main parameters of the model are summarized in **Table 13** below.

Table 13 : HECRAS Model Main Parameters

Parameter	Average Value/Selection	Reason
Manning 'n'	0.012 to 0.06 (main flow channel)	Defined channel with vegetation and artificial channels
	0.08 to 0.03 (floodplains)	Moderate vegetation (mainly grass) and thick vegetation
Boundary conditions	Normal flow depth	Control structures present
Flow regime	Mixed flow	Slope and cross section changes requiring super and sub-critical flow regimes

The HECRAS model cross-sections were named in accordance with the defined River Referencing System (RRS) that was developed for this study. The HECRAS model was then used in conjunction with the GIS program, Arc Map (With 3-D Analyst and Spatial Analyst extensions).

GEO-RAS was used to create cross sections and other geometrical data for use in HECRAS and was used to export water surface data from HECRAS into a GIS database. This was then used to create flood maps showing the expected 1:50-year and 1:100-year floodlines for the above river conditions and combinations thereof.

F.4.6 Floodlines

A steady flow HEC-RAS flood analysis model (one dimensional hydraulic model) was developed for the watercourse within the study area. Floodlines on river sections are analysed to evaluate risks associated with potential flooding of infrastructure and protection of natural resources. Legislation guides the minimum requirements for the placement of infrastructure in relation to a natural watercourse.

Section 144 of the NWA which deals with residential developments was considered in the study. The act states that *“no residential establishment may take place within the floodlines indicating the maximum level likely to be reached by floodwaters, on average, once in every 100 years.”*

Therefore the 1 in 100-year recurrence interval floodline was estimated for the proposed development. **Figure 69** depicts the methodology applied to complete the floodline analysis.

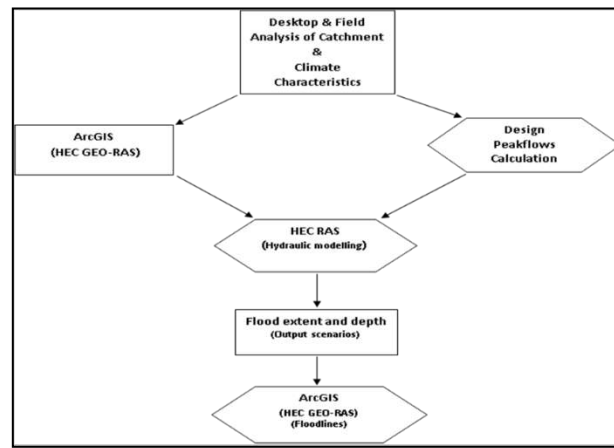


Figure 69: Floodline Methodology

The floodlines were simulated for the proposed conditions.

F.4.7 Cross Section Overlay

The HECRAS model was entered with the current conditions excluding existing culverts, typical river geometry is shown in **Figure 70**.

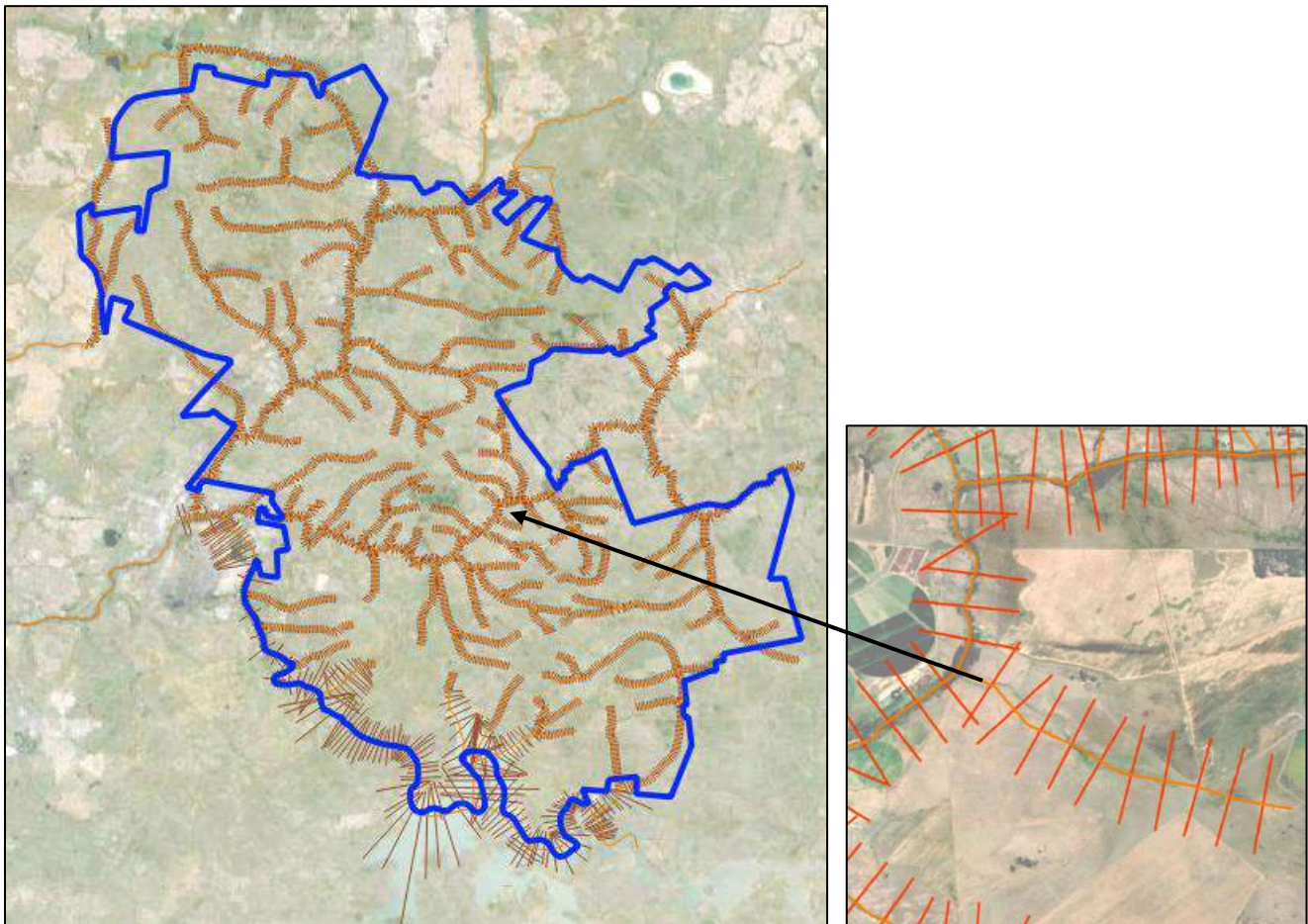


Figure 70: HECRAS Typical Cross Sections Geometry Layout



F.5 TOWNSHIP (VILLAGE) FLOODLINE DETERMINATION

Should the need arise for the development of more accurate floodlines, especially in Township Developments, the following factors should be taken into consideration.

F.5.1.1 Site Visits

The main purpose of a site visit is to determine the catchment characteristics from the on-site observations and to obtain details of the typical land cover. From the observations made during the site visit as well as using the available topographical information, the satellite images on Google Earth and the aerial imagery, the land use information can be assumed.

F.5.1.2 Catchment Characteristics

The catchment characteristics required for the study included the following:

- the longest drainage path and associated catchment area.
- the effective contributing area of the residential area.
- the time of concentration (T_c – time it takes for the drop of water that travels the longest route in the catchment).
- the mean slope of the river and catchment slopes; and
- soil permeability and land use cover.
- The general topography was determined using the 5m contours obtained from the national geo special instituted.

F.5.1.3 Impact of Development on Natural Drainage Systems

It is widely recognised that developments impact negatively on natural drainage systems in several ways, including:

- Reduced permeability of catchment areas by introduction of impervious surfaces such as streets and buildings. This results in increased catchment run-off volumes.
- The introduction of efficient stormwater drainage results in reduced catchment response times with contaminant's increased downstream flow.
- Alteration to the natural flow regimes in river systems resulting in both geomorphologic (e.g. channel/bank erosion) and aquatic ecosystem changes over time.
- Deteriorating water quality because of industrial fallout, fertilisers and other pollutants that are conveyed by stormwater systems directly to receiving water bodies, without any attempt to ameliorate in route; and
- Accumulation of litter, sediment and any non-degradable material that lands in the watercourse downstream.

These guidelines require greater cognisance to be taken of natural hydrological patterns and systems in the development of stormwater management systems and that the potential negative impacts highlighted above are reduced as far as is practically possible.

For this study, it was used to determine peak flow rates and volumes based on the various input parameters described below:

- **Rainfall data**
Rainfall is the primary driver related to flood events. It is the most important element and is considered the main component related to determining design floods in an area.

Design storm rainfall was determined based on a minute-by-minute grid developed by Smithers for the entire Southern African region. The analysis was based on the "Design Rainfall Estimation in South Africa" (DRE) program developed by JC Smithers and RE Schulze (2002).



The program implemented procedures from the Water Research Commission (WRC) project entitled “Rainfall Statistics for Design Flood Estimation in South Africa” (WRC Project K5/1060).

- **Soil Type Determination**

An important parameter of previous areas is the soil type which can consist of either clayey soils (high run-off potential) or sandy soils (low run-off potential).

The types of soils within the Sedibeng District were determined based on standard geological maps set up by the Agricultural Research Council, Institute for Soil, Climate and Water for South Africa. Type C soil was used for these models.

The hydrologic soil groups are shown in the **Table 14** below:

Table 14: Hydrological Soil Type

Hydrologic Soil Group	Description
A	Soils having a high infiltration rate consisting mainly of sand and gravel
B	Soils having moderate infiltration rates consisting of material having mainly fine to moderately coarse texture
A/B	Soils having a high to medium infiltration rate
C	Soils having a low infiltration rate consisting of material with a moderately fine to fine texture (This Study falls within this category)
B/C	Soils having a moderate to low infiltration rate
D	Soils having a very low infiltration rate consisting mainly of very fine to clayey material
C/D	Soils having a low to very low infiltration rate

- **Land-use categories**

Another important component for the model is the land-use, different kinds of development leads to varying infiltration rates for the ground due to the area that is being altered from a certain level of permeability to either a more permeable or less permeable depending on the type of development.

The roofs were manually digitised, and the streets were separated from normal servitudes and stands to get percentage previous against non-pervious. This was also used in calculating curve number in conjunction with Soil Type C for the area for permeability of soils.

F.6 CONCLUSIONS

The following is concluded:

- The floodlines are to be used only for regional planning purposes only.
- For the existing conditions very, few developments fall within a flooded area.
- Some existing infrastructures are affected by both 1:100-year and 1:50-year flood events.
- The flooded area inside the floodplain has shallow depths and thus low risk.



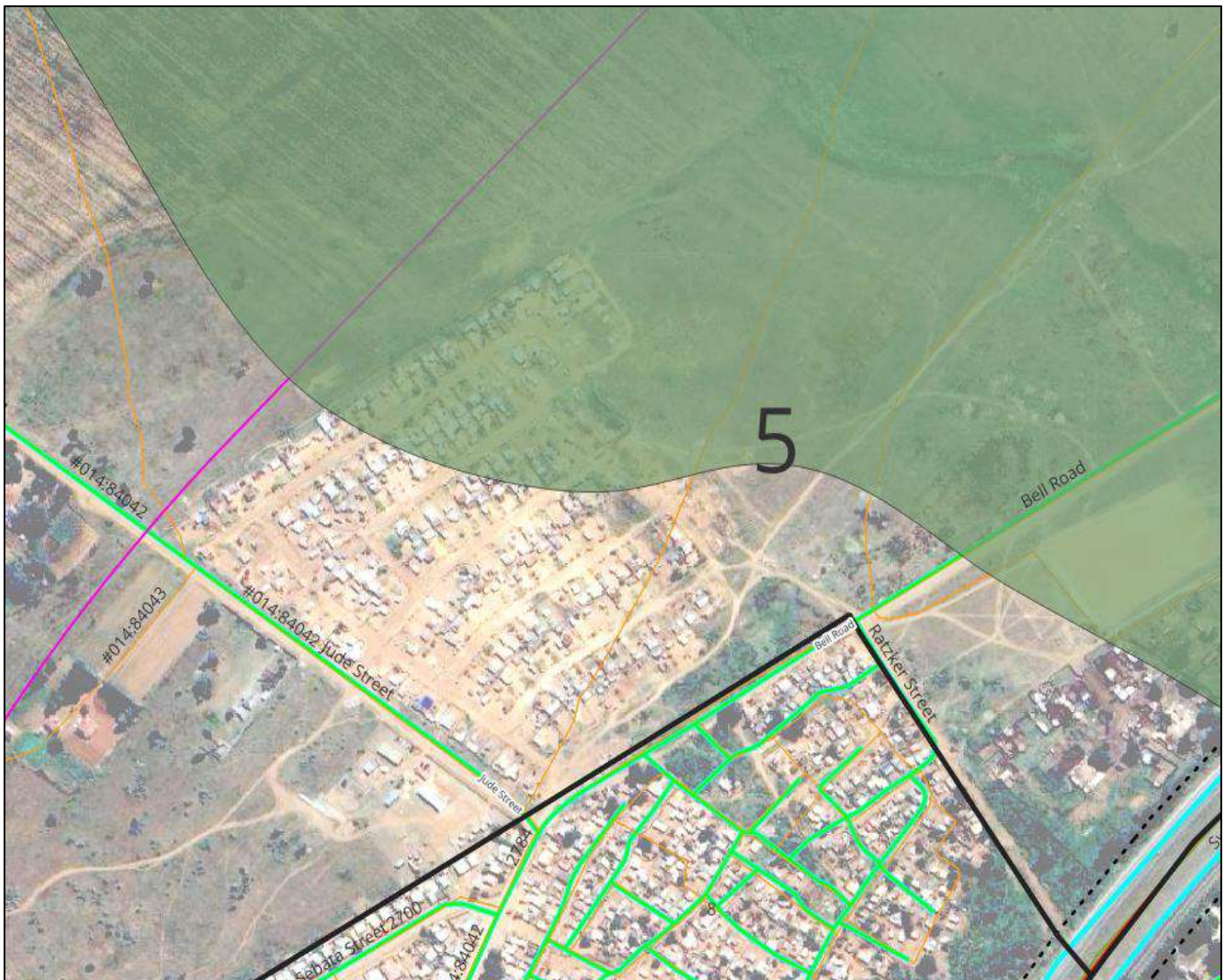
F.7 RECOMMENDATIONS

The following is recommended:

- Floodline data to be used for planning purposes only.
- No new developments are to be situated within the 1:50-year floodline area and floor levels to be above the 1:100-year flood level.
- Alternative positioning of the ervens that are found within a flood plain should be investigated.
- Any specialist studies including the environmental compliance studies that might be needed must be done in consultation with relevant authorities.
- The floodlines be revised should watercourse and/or control structures be modified in the future and detailed floodlines to be computed to include the effect of control structures such as bridges and culverts.

As per the **Floodline Layout 1** below (extracted from our Main Floodline Layout(s)) the rural area properties are being constructed within the floodline area and discussions should take place with the communities to prevent properties from being constructed within these areas.

Due to the size of the GIS system that was built by the PSP, the information containing all flood risk areas will be provided to Midvaal Local Municipality in a separate volume to this report to identify these areas.



Floodline Layout 1: Ward 5 Properties within Floodlines



CHAPTER G : INSTITUTIONAL ARRANGEMENTS AND REQUIRED AUTHORIZATIONS

G.1 INTRODUCTION

Institutional Arrangements and Required Authorizations refer to the framework of organizations, roles, and processes that are necessary for the effective implementation of a project, program, or regulatory framework. These arrangements ensure that all stakeholders are properly coordinated, and that all legal and procedural requirements are met.

By developing the Midvaal Local Municipality **Roads and Stormwater Masterplan**, several **institutional arrangements** and **required authorizations** had to be in place to ensure the project aligns with legal, environmental, technical, and administrative standards. These arrangements also ensure coordination between various government bodies, agencies, and stakeholders, and facilitate the implementation and management of the infrastructure.

G.1.1 Institutional Arrangements

In phase 1 and during the project different roles, responsibilities, and relationships between different entities involved in planning, approving, executing, and managing the Midvaal Local Municipality Roads and Stormwater Master Plan had to be considered to complete the project successfully. **(See Chapter C)**

G.1.1.1 Project Steering Committee

The Project Steering Committee (PSC) was established which consist of all relevant stakeholders from:

- Midvaal Local Municipality
- DBSA
- Project Service Provider (Infraconsult Engineering)
- Sedibeng District Municipality
- Provincial and National Department of Transport (i.e. Gauteng Department of Roads and Transport, SANRAL)
- Provincial Department of Human Settlement (if so required)
- CoGHSTA
- MISA

The above PSC structure was responsible for the following institutional arrangements, i.e:

- Review and Approval of Intermediate Progress Reports
- Statutory input and authorizations into Draft and Final Roads and Stormwater Master Plan.
- Overview of Codes and Standards used and referenced during compilation of Reports.

G.1.1.2 Supporting Agencies

In the process of developing the Midvaal Local Municipality Final Roads and Stormwater Master Plan, the following Stakeholders were engaged:

- Gauteng Department of Roads and Transport (Gautrans)
- Sedibeng District Municipality
- Midvaal LM Technical Department (Roads and Stormwater)
- Midvaal LM Operations and Maintenance Officials.



G.1.1.3 Stakeholder Engagements

Effective implementation of the model required collaboration and data-sharing among various stakeholders, including authorities, transport agencies, and other relevant bodies. Establishing such a collaboration faced challenges to conflict of interests.

Obtaining buy-in from the public for the model's implementation and potential outcomes was crucial as the complains registers that was provide by Midvaal Local Municipality had to be investigated by addressing concerns or perceptions about data privacy or potential disruptions due to transportation changes is essential. Given the need for surveys on the public's travel patterns that their cooperation was essential.

G.1.1.4 Coordination Bodies

Using the functional road classification model, the local municipality can identify some key roads which fall under the jurisdiction of Gautrans which they can take ownership of in the future. These roads might even be gravel roads that are not on the short-term agenda for Gautrans to upgrade to formalised asphalted roads or they could be asphalted roads in poor conditions that require rehabilitation and maintenance.

It is suggested that the jurisdiction of the roads be transferred to Midvaal Local Municipality. This would then enable the municipality to upgrade/rehabilitate and maintain these roads themselves. Such an occurrence will impact both Gautrans as well as Midvaal Local Municipality as Gautrans road network would be reduced while Midvaal Local Municipality's road network would be increased.

G.2 REQUIRED AUTHORIZATIONS

Various legal and regulatory authorizations will be needed for the implementation of the Midvaal Roads and Stormwater Master Plan and to ensure that it complies with national, regional, and local laws and policies. (See Chapter K)

G.2.1 Environmental Impact Assessment (EIA)

- **Environmental Clearance**

An EIA may be required for large-scale infrastructure projects, especially for stormwater and drainage works, which can affect natural water systems, ecosystems, and biodiversity. The EIA typically includes an assessment of potential environmental impacts and the measures needed to mitigate them.

- **Permits for Water Management**

Stormwater infrastructure must adhere to national water quality standards and water management policies. This may include permits for managing stormwater runoff, discharge into watercourses, or the diversion of natural streams.



G.2.2 Land Use and Zoning Approvals

The implementation of the master plan must comply with local land use zoning regulations and urban planning codes. Any proposed roadways or stormwater infrastructure may require rezoning, or a land use change approval from the local government.

G.2.3 Road Construction Permits

- **Road Design Approvals**
The road and transportation plans must meet design standards for road safety, traffic flow, and environmental considerations (e.g., noise, air quality).
- **Traffic Impact Assessments (TIA)**
In some cases, especially for large-scale developments or urban road systems, a Traffic Impact Assessment (TIA) may be required to ensure the new infrastructure can handle traffic volumes and improve transportation efficiency.

G.2.4 Stormwater and Drainage Permits

- **Stormwater Management Plan (SWMP) Approval**
This may be a standalone requirement or part of the EIA. It focuses on ensuring that the stormwater infrastructure meets best practices in managing flood risks, water quality, and environmental protection.
- **Floodplain Management and Flood Risk Assessment**
Any construction in flood-prone areas will require additional flood risk assessment and compliance with floodplain management regulations.

G.2.5 Utility and Infrastructure Permits

Approvals are needed for the relocation, alteration, or construction of utilities affected by the projects, including water, sewage, electricity, and telecommunications infrastructure.

G.2.6 Health and Safety Regulations

- **Construction and Safety Permits**
Compliance with construction safety standards, including worker safety and the prevention of accidents during construction.
- **Public Health Approval**
Ensuring the public health implications of the stormwater system, particularly in urban environments, are addressed, especially regarding waterborne diseases, pollution, and flooding.

G.2.7 Public Consultation and Transparency

- **Consultation Process**
Depending on local legislation, a public consultation process may be mandated, especially if the master plan impacts local communities, involves significant land acquisition, or requires substantial environmental mitigation measures.



- **Public Disclosure**

There may be a legal requirement for publishing notices, holding public meetings, or otherwise making plans available to the public.

G.2.8 Public Private Partnerships Approvals

If the project involves private sector participation or financing through a PPP model, approvals from relevant public entities or legislative bodies may be required to ensure that the terms of the agreement comply with public sector regulations.

G.2.9 Other Considerations

- **Social Impact Assessment (SIA)**

In cases where the project could displace communities, cause significant social disruption, or alter land use patterns, an SIA may be required.

- **Climate Resilience and Adaptation Plans**

Particularly in regions prone to extreme weather events, a plan addressing the resilience of roads and stormwater systems to climate change (e.g., increased rainfall, flooding) may be needed.

- **Funding and Budget Approvals**

Securing the necessary financial resources and authorizations from national, regional, or municipal budgeting authorities is often a prerequisite before proceeding with construction.

G.3 CONCLUSION

To successfully develop and implement a Roads and Stormwater Master Plan, it is crucial to navigate the complex of institutional arrangements and obtain all necessary authorizations. This includes the cooperation of multiple agencies and stakeholders, adherence to environmental, safety, and land use regulations, and securing public and political support. Coordination across these areas ensures that the project is well-designed, legally compliant, and socially and environmentally responsible.

See **Chapter C**, **Chapter K** and **Chapter L** for the implementation of the roads and stormwater master plan where we point out our current deficiencies and hierarchy of the Department and proposed certain amendments to build capacity in terms of manpower, planr, software,etc.

The PSP will also provide a training workshop to all relevant departments within Midvaal Local Municipality to implment the GIS system and how to clearly and effectively use the Final Roads and Stormwater Master Plan.



CHAPTER H : PROJECT PRIORITIZATION AND COST ESTIMATES

H.1 PROJECT IDENTIFICATION & PRIORITIZATION

Based on site visits and taking into account the information presented in this document, road projects have been identified and categorized under four main categories based on their priority/urgency.

General projects which are not linked with a specific road or intersection have also been identified. These general projects will be continuous projects that will be relevant in the short, medium and long term to improve the overall quality of the road network.

- **Short Term Projects:** 0 – 5 years
- **Medium Term Projects:** 5 – 15 years
- **Long Term Projects:** 15 – 20 years
- **General Projects**

With regard to the various identified road projects, high level cost estimates have been provided for budgeting purposes. It is important to note that these cost estimates are provided based on the cost of constructing these upgrades based on the current average rates for construction. Therefore, for any projects that will be implemented in the medium to long term, factors such as inflation that will influence the cost need to be accounted for. These cost estimates also do not take into account factors such as unfavourable soil conditions that could increase the cost of construction.

With all the priority projects investigated and selected, and then refined to a lower amount including the life-threatening/emergency projects as indicated by Midvaal Local Municipality. These projects are estimated in more detail in section H 1.8 Midvaal Local Municipality Refined Priority Projects.

H.1.1 Possible Projects From Site Visits (Road Links)

During site visits to the area, strategic road links of importance have been identified which require attention in the form of formalizing/ rehabilitating of the roads. The formalization of a road link refers to the upgrading of an informal gravel road to an asphalted/ paved road while the rehabilitation of a road refers to an asphalted road in a poor condition that requires resurfacing.

As per **Annexure I**, a typical road section of the layer works for asphalted Class 2-5 roads have been provided. It is recommended that these specifications be used for any road formalizations or new roads that will be constructed in the future for Class 5, 4, 3 and 2 roads or alternatively specified by the relevant authority. The estimated unit cost (per meter of road) associated with the formalization or rehabilitation of these classes of roads is provided as follows:

- | | |
|--|--------------------------|
| • Formalization of Class 5 roads (5m wide): | R 8 600 per meter |
| • Formalization of Class 4 roads (6m wide): | R14 500 per meter |
| • Formalization of Class 3 roads (7m wide): | R21 000 per meter |
| • Formalization of Class 2 roads (7.4m wide): | R28 000 per meter |
| • Rehabilitation of existing paved roads (single carriageway): | R 2 100 per meter |

Applying these unit rates to the length of the identified links which need to be upgraded, a high-level cost estimation (excluding VAT & professional fees) is provided in **Table 18** at the end of this section.

Eye of Africa: With reference to **Annexure J**, Carina Road / Hibiscus Road, travels between Bronk Drive to the west (which leads to the R82) and Cayman Road to the north-east (which leads to the R550 and



Eye of Africa). The indicated section of road, however, is currently a gravel road of ± 2.6 km in length that would benefit from being upgraded into an asphalted road. Since the surrounding area is fairly undeveloped, this link road can become a useful Class 4 collector road (see **Annexure A**) as more developments start to unfold in the area. This upgrade is considered as a **medium-term project**.

Waterval-Walkerville (Road K154) Link Upgrade: With reference to **Annexure K**, approximately 1.7km to the west of the R59 & R550 interchange, Road R550 transitions into a gravel road all the way up to Road R82 for a road length of about 11km. It is important to note, however, that this section of road will ultimately be replaced with the K154 Class 2 provincial road which follows a slightly different alignment to that of the current gravel road. Therefore, to implement an asphalted road for this link which connects the Waterval-area with the Walkerville-area would be a substantial upgrade since the asphalted road should be constructed according to the K154's alignment and not the current alignment of the R550.

It is expected that this road is key to further unlocking the development potential of the vacant land situated to the north and south of the K154, respectively. Consultation with Gautrans would also be required since the K154 future Class 2 road is under provincial jurisdiction. The length of the K154 to be constructed is ± 10.5 km in length.

With reference to the *Possible Projects from the Basic Road Model* section, a large section (6.7km) of the same road (R550) has been identified to be upgraded into an asphalted road based on its traffic volumes (Link MLM_64) as well. This confirms that the K154 upgrade would be appropriate for the area and is considered to be a **short-term project**.

Sicelo: With reference to **Annexure L**, Jude Street which is approximately 2.63km in length, is a gravel road that travels between Bell Road to the east and South Road to the north and it is proposed that this road be upgraded into an asphalted/paved road up to municipal standards due to its strategic importance. Currently, this road is accommodating low traffic volumes but is expected to become an important Class 4 collector (see **Annexure A**) in the near future as Sicelo expands further to the north since this road leads to Bell Road which in turn also leads to the higher order Road R551 (Johan Le Roux Road).

One known planned development which will greatly benefit from this upgrade is Sicelo Ext. 6 (situated on Langkuil Portion Ext 77). This is a large mixed-use development comprising Residential, Business, Educational and Institutional land-uses which will all make use of Jude Street since this road travels directly past the south-eastern boundary of this township. The formalization of Jude Street would therefore benefit this development as well as any other future development in the area given its strategic importance. The formalization of Jude Street is considered as a **short term upgrade**.

Furthermore, South Road in its current state (i.e. fairly narrow paved road, with a moderate pavement design, which is only intended to serve the local small holdings and undeveloped rural surrounds, is not a high order road, although its functionality is important at this stage, especially in light of the limited paved roads to the northwest of the R59. South Road is strategically located in the area, which allows it the potential to become an important Class 3 road (See **Annexure A**) in the **long term upgrade**.

It can also be noted that it will form an intersection with the planned future K210. Subsequently, the upgrading of South Road between Jude Street and Randvaal Road (R557) is proposed as a medium term project when more developments in the area (also to the north and west of South Road) trigger that traffic demand. Such an upgrade would then involve its full upgrade to a Class 3 status between Randvaal Road and at least Jude Street, which has a length of ± 5.85 km.



Henley-On-Klip: With reference to **Annexure M**, the residents of Henley-On-Klip situated on the eastern side of the Kliprivier currently only have two possible crossings to get to the main western side of Henley-on-Klip: via Iffley Road/ Winchester Road to the north or via Road 551 to the south (by using Gordon Road). It would also appear that a third crossing via Wargrave Road used to be in existence, but has since been closed off due to the Kliprivier which has completely flooded the road. Gordon Road leading towards the R551 exists in the form of an informal gravel road but from Etna Road to the north, the road is in fact asphalted.

As seen in **Annexure M**, the T-intersection between Gordon Road & R551 forms a staggered intersection with the Uitvlugt Road & R551 T-intersection. The Uitvlugt Road T-intersection, however, has been implemented at its approved position according to the future K174's planning.

Thus, as part of formalizing Gordon Road, it is proposed that the existing Gordon Road & R551 intersection be closed off and that Gordon Road be implemented at its correct position according to the K174's planning i.e., opposite Uitvlugt Road as indicated. Gordon Road is proposed to be formalized up to municipal standards between the R551 and Etna Road (± 1.1 km in length) since this is a strategic link that residents can use to either travel to Meyerton or the main western section of Henley-on-Klip. Furthermore, Eaton Road, which is the main north-south minor arterial road serving the eastern part of Henley-on-Klip, exists as an informal gravel road (± 1.4 km in length) between Windsor Avenue & Winchester Road. It is recommended that this section of road be upgraded into an asphalted road (Class 3 standards). These upgrades are considered as **medium term projects**.

Rusoord Secondary School: With reference to **Annexure N**, Road D478 (district road) in an eastbound direction from its T-intersection with Road D1884 transitions from an asphalted road into a gravel road. Along this gravel road, however, an existing school namely Rusoord Secondary School, takes access from this gravel road. Considering that pedestrians walk along this road (including scholars due to the school), it is proposed that the asphalted road of Road D1884 be extended past the school (for a length of ± 2.4 km) as indicated (Class 3 standards).

This would improve the safety of pedestrians as proper signage and road markings can be implemented at the school results in a safer overall environment around the school premises. The implementation of a bus stop at the school access should also be considered. This upgrade is considered as a **short term project**.

H.1.2 Possible Projects Based On Traffic Analyses

Based on the capacity analyses undertaken with PTV Vistro, 7 out of the 20 intersections that had been scrutinized would require upgrades based on either the status quo traffic or future background traffic growth applied to the status quo traffic. The following intersections have been identified for possible road & intersection upgrades:

- **Johan Le Roux Road & Gourlay Street Intersection:**
Implementation of a traffic circle or traffic signals (Intersection 8 from Analyses)
[Long Term Project];
- **Springbok Road & Meyer Road Intersection:**
Implementation of a traffic circle or traffic signals (Intersection 9)
[Short Term Project];
- **Road R551 & Morris Road Intersection:**
Implementation of traffic signals & geometric upgrades (Intersection 11)
[Short Term Project];
- **Pierneef Boulevard & Viljoen Avenue Intersection:**



- Implementation of a traffic circle (Intersection 12)
[Short Term Project];
- **Johan Le Roux Road & Galloway Street Intersection:**
Implementation of traffic signals (Intersection 13)
[Long Term Project];
- **Pierneef Boulevard & Mimosa Drive Intersection:**
Implementation of traffic signals (Intersection 14)
[Long Term Project]; and
- **Pierneef Boulevard & Reitz Street Intersection:**
Implementation of traffic signals (Intersection 15)
[Medium Term Project].

H.1.3 Possible Projects From Basic Road Model

Using the Basic Road Model, additional road links have been identified as possible projects which can be undertaken in the form of upgrading gravel road links to asphalted roads. The criteria used to identify these links are based on the road categorization as discussed under the Status Quo Traffic Demand Model section. If a road link is categorized as a Category C link or higher and the road is a gravel road, then this specific link has been identified as a possible project that could be implemented. Using the available data (refer to **Annexure F**), the following three links have been identified:

- **MLM_49:** ±2.5km section of gravel road situated on Road D1220 which currently is a Category D link that is estimated to become a Category C link by 2039 (Medium Term Project);
- **MLM_64:** ±6.7km section of gravel road situated on Road D1313 (Road R550) which currently is a Category B link (Short Term Project) [This project is superseded by the proposed K154 link upgrade mentioned under the *Possible Projects from Site Visits (Road Links)* section];
- **MLM_92:** ±2.0km section of gravel road situated on Road D2062 which currently is a Category D link that is estimated to become a Category C link by 2039 (Medium Term Project);

H.1.4 Future Projects From SDF & Precinct Plans

Apart from the newly identified upgrades as proposed in the previous sections, some road & intersection upgrades have also been identified in the SDF & precinct plans for Meyerton, Henley-On-Klip and Sicelo which are listed in **Table 15, 16 and 17** below. General comments with regards to these upgrades from a traffic engineering/ geometric design point of view are also provided.

Table 15: Meyerton CBD Upgrades from Precinct Plans

Proposed Upgrade	Comment
Signalization of Pierneef Boulevard & Loch Street	The signalization of these intersections is appropriate, but it should only be implemented if the critical queue lengths at the stop approaches of the intersections successfully meet the warrants for traffic signals as per the <i>SARTSM (Vol. 3)</i> .
Signalization of Pierneef Boulevard & Shippard Street	
Signalization of Pierneef Boulevard & Carvalho Street	
Geometric Upgrades at Meyer Road & Joubert Street	The implementation of geometric upgrades will benefit this intersection should the road reserve allow for it. Signals can also be considered at this intersection in the long-term.
Proposed Upgrade	Comment



Implementation of a Traffic Circle at Loch Street & Holliday Street	At all these intersections where traffic circles have been proposed, the intersecting roads consists of dual carriageway roads separated by median islands. Since the road reserve at these intersections are limited, the provision of a proper double circulating traffic circle with adequate deflections will not be possible and the only possible traffic circle would be a smaller single circulating traffic circle such as the one found at Galloway Street & Loch Street. With this geometry, the two lanes per direction will have to be choked down to a single lane per direction in the vicinity of the traffic circle which in essence would reduce the capacity of the intersection. The existing traffic volumes at these intersections should therefore be taken into consideration prior to the implementation of a traffic circle.
Implementation of a Traffic Circle at Galloway Street & Carvalho Street	
Implementation of a Traffic Circle at Shippard Street & Galloway Street	
Implementation of a Traffic Circle at Meyer Road & Shippard Street	
Implementation of a Traffic Circle at Meyer Road & Boet Kruger Street	

HENLEY ON KLIP

Table 16: Henley on Klip Upgrades from Precinct Plans

Proposed Upgrade	Comment
Proposed Placemaking Traffic Circle on Henley Drive & Springbok Road	The proposed placemaking circle's location is in fact situated on a bridge and not at an intersection and should therefore not be implemented as it would require the bridge to be widened without creating any additional capacity.
Proposed Extension of the Avenue up to the intersection of Henley Drive & Bokmakierie Road as well as the implementation of a traffic circle at this intersection	The proposed link is not recommended since there is already an intersection between The Avenue & Henley Drive which serves the same purpose as the proposed extension. The traffic circle can be implemented since it would provide some traffic calming on Henley Drive as well as creating more gaps for vehicles on Bokmakierie Road to merge onto Henley Drive.
Proposed Traffic Circle at St Davids Road & The Avenue	The implementation of a traffic circle at these intersections are supported provided that the traffic volumes through these intersections requires additional capacity to be created.
Proposed Traffic Circle at Windsor Road & Eaton Road	
Proposed Traffic Circle at Wargrave Road & Ewelme Road	
Proposed Traffic Circle at Ewelme Road & Henley Drive	



SICELO

Table 17: Sicelo Updates from Precinct Plans

Proposed Upgrade	Comment
Implementation of a Class 3 road through Sicelo linking with Alma Road	With reference to Annexure A & L, the proposed Class 3 road actually traverses the Sicelo Ext. 6 development and can therefore not be fully implemented as initially planned. As a good alternative, the upgrading of South Road into a Class 3 road as discussed under <i>Possible Projects from Site Visits (Road Links)</i> is proposed which in fact would serve a similar purpose.

H.1.5 General Projects

H.1.5.1 Transfer of Road Jurisdiction from Gautrans to Midvaal Local Municipality

Using the functional road classification model, the local municipality can identify some key roads which fall under the jurisdiction of Gautrans which they can take ownership of. These roads might even be gravel roads that are not on the short-term agenda for Gautrans to upgrade to formalized asphalted roads or they could be asphalted roads in poor condition that require rehabilitation and maintenance.

Therefore, it is suggested that the jurisdiction of the roads be transferred to Midvaal Local Municipality. This would then enable the municipality to upgrade/rehabilitate and maintain these roads themselves. Such an occurrence, by definition, will impact both Gautrans as well as Midvaal Local Municipality as Gautrans' road network would be reduced while Midvaal Local Municipality's road network would be increased.

H.1.5.2 Improving Road Safety

To minimize vehicle related accidents road safety can be improved continuously by the municipality.

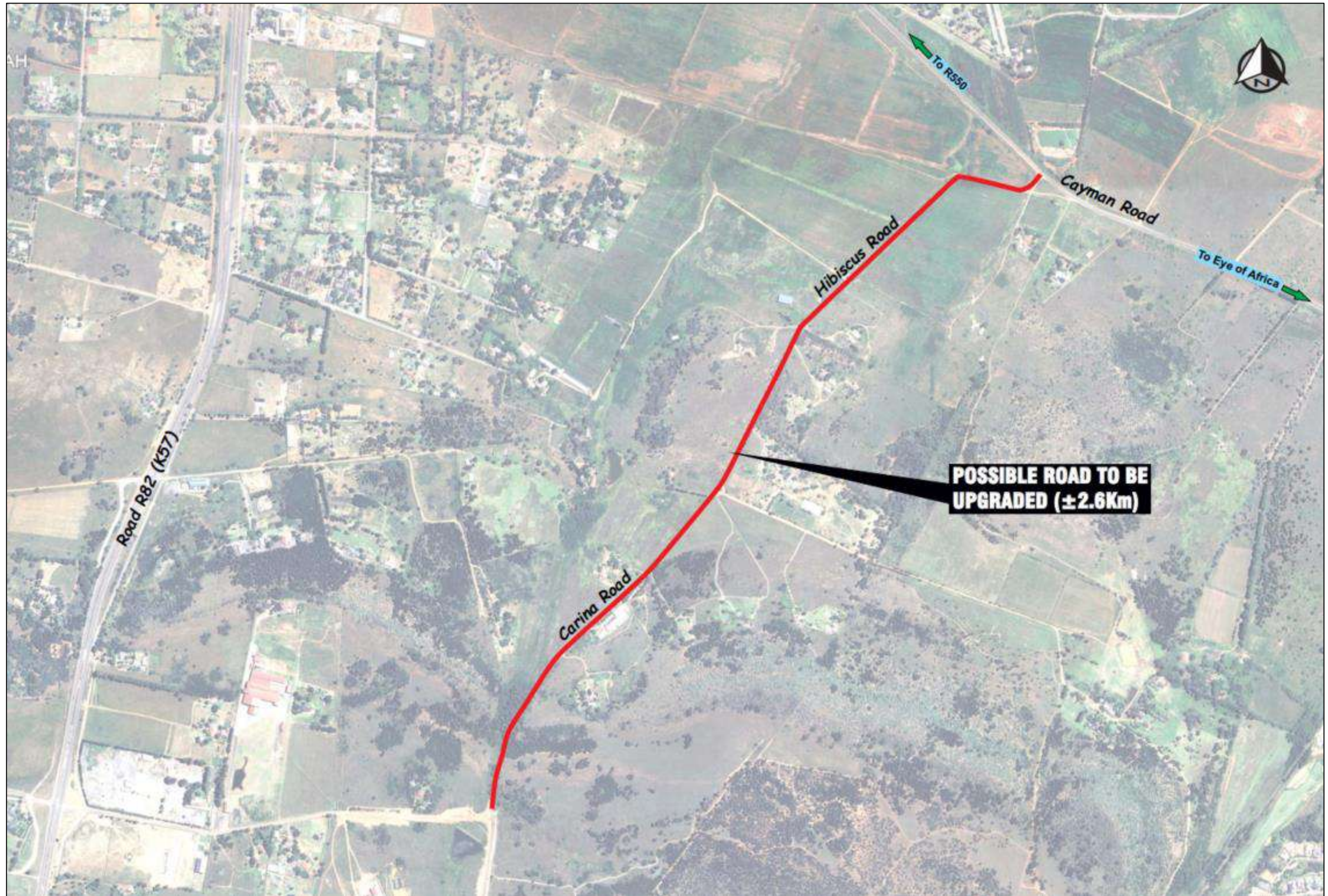
This includes, but is not only limited to, the following activities:

- Repairing potholes in existing asphalted roads;
- Providing adequate road markings and road signage along asphalted roads;
- Maintaining the vegetation growing adjacent to key roads to an adequate length. This assists with the visibility (sight distance) for road users.

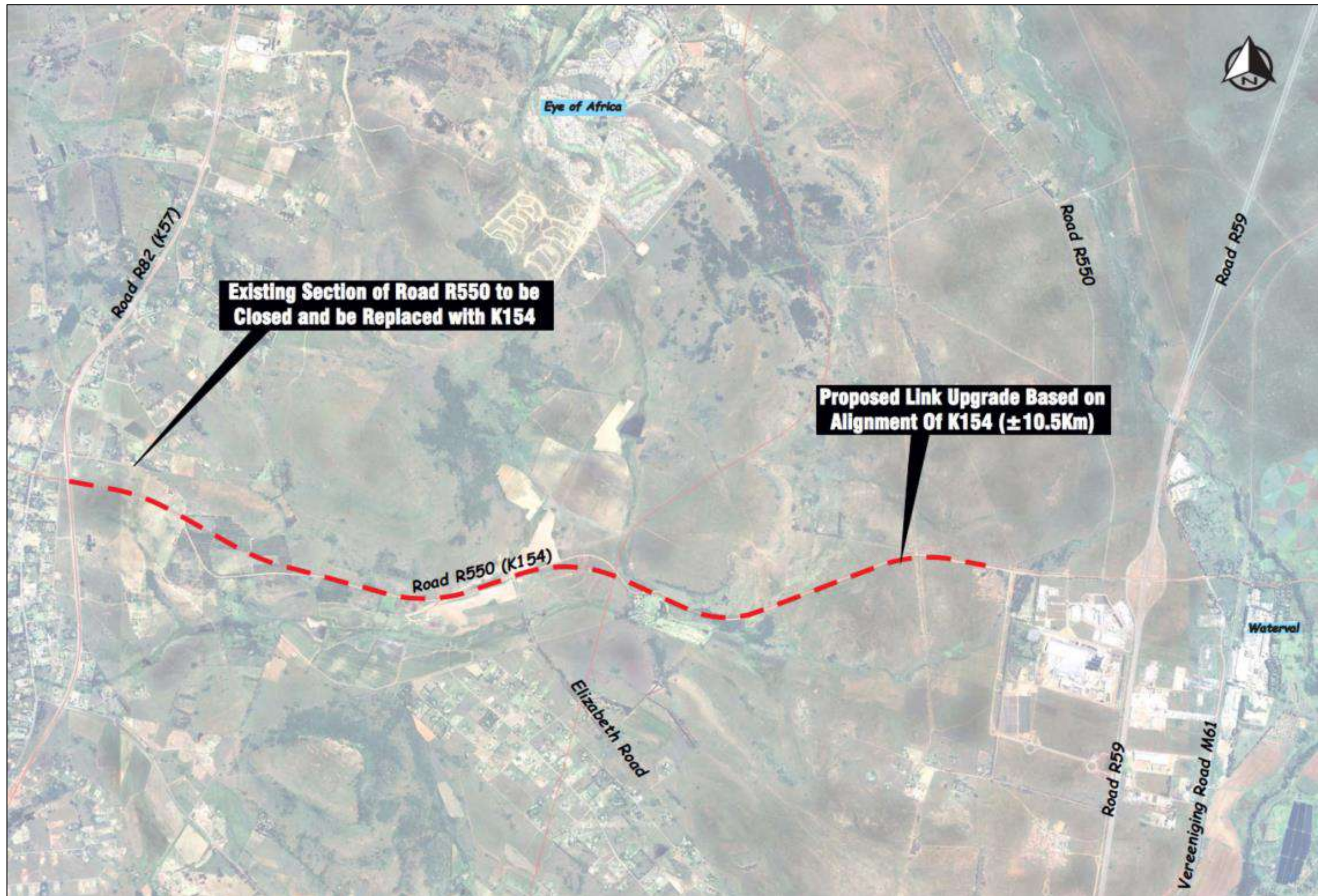
Furthermore, the municipality should also consider the undertaking of Road Safety Audits. A Road Safety Audit is a formal examination of a future or existing road/ traffic project/ any project where interaction with road users takes place, in which an independent, qualified examination team reports on the accident potential and safety performance of the project.

H.1.6 Summary and Priority of Projects

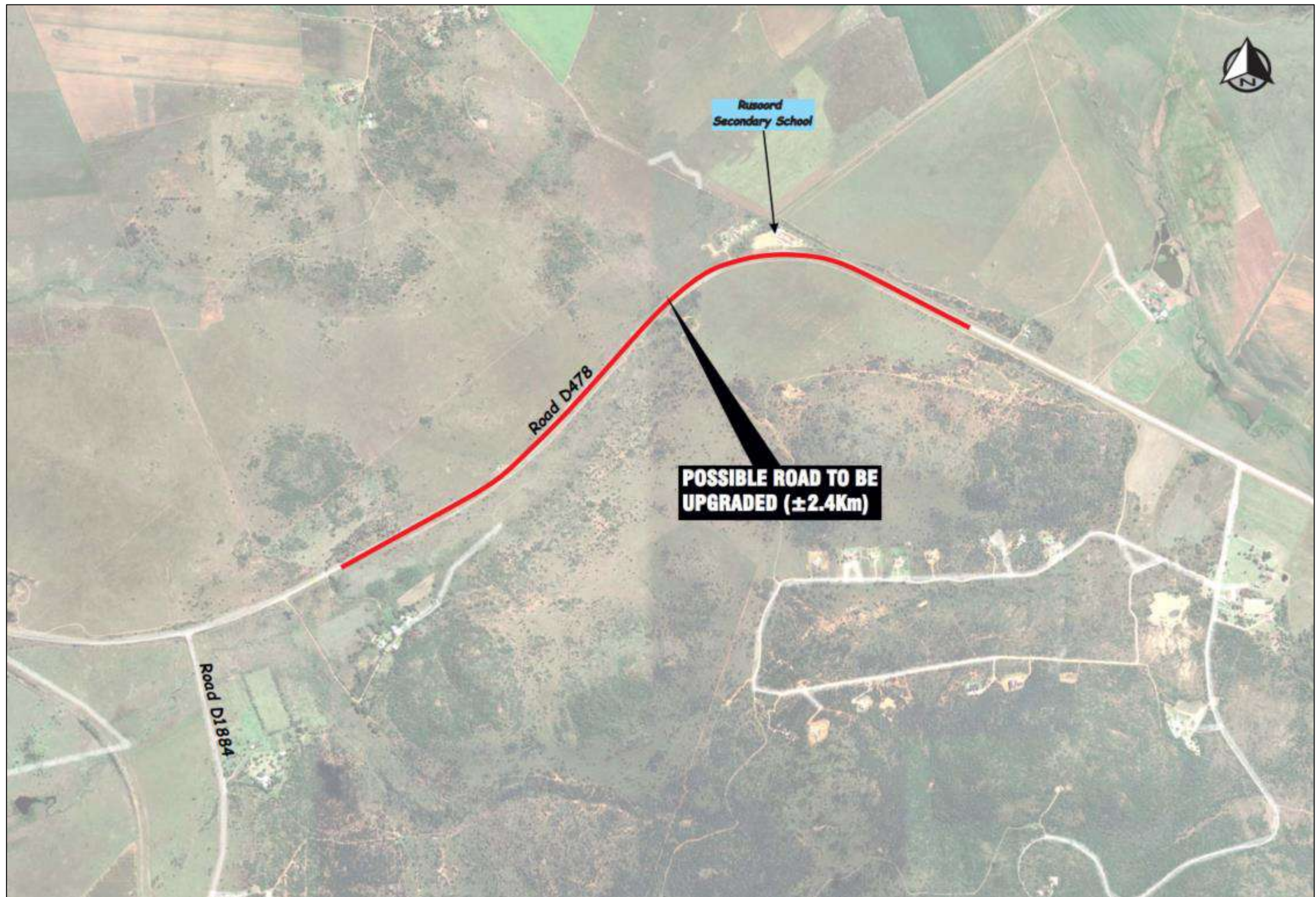
A summary of the projects identified in the previous sections is provided in **Table 18** below. Starting with the highest priority projects, the short, medium and long-term projects are listed in terms of priority. The estimated costs (excluding VAT & professional fees) for these projects have also been provided.



Drawing 12: Possible Road to be Upgraded Hibiscus Road



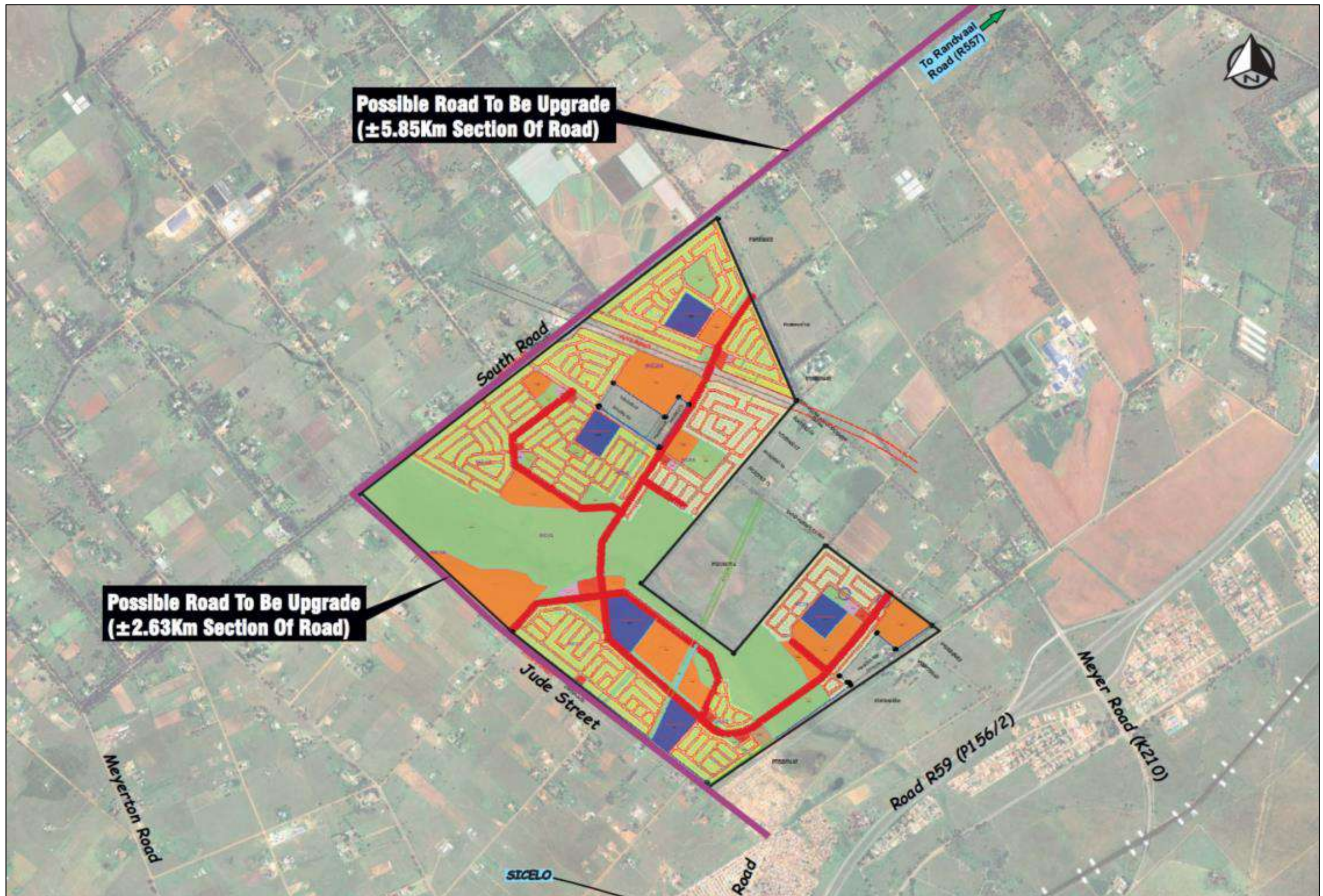
Drawing 13: Proposed Link Upgrade Alignment of K154



Drawing 14: Possible Road to be Upgraded Road D478



Drawing 15: Possible Road Upgrades (Eaton and Gordon Road)



Drawing 16: Possible Road Upgrades for New Developments



H.1.7 General Projects / Maintenance Projects (Gravel and Surfaced Roads)

In order to quantify the General / Maintenance Projects this report looks at the Midvaal Local Municipality from a WARD Perspective to identify the Gravel and Surfaced Roads. After the identification of the Gravel and Surfaced Roads the roads were prioritised as shown in **Figure 72** and **Figure 73** as follows:

- Priority 1 (0-5yrs),
- Priority 2 (5-10yrs)
- Priority 3 (10 -20yrs).

The basic criteria used for the Prioritisation of Gravel and Surfaced Roads, include the following but are not limited to:

H.1.7.1 Priority 1

- High population density
- Extremely Poor ride quality (for example rocky roads)
- Mountainous Topography
- High need for access to Schools, Clinics and Business
- Hindered by the presence of rivers.

H.1.7.2 Priority 2

- Poor ride quality
- Accessible Terrain
- Access to Residences
- Hindered by the presence of streams.

H.1.7.3 Priority 3

- Recent work done to improve usability.
- Access gained from Provincial or District Roads
- Flat Terrain
- Good Ground Conditions
- No possibility of flooding

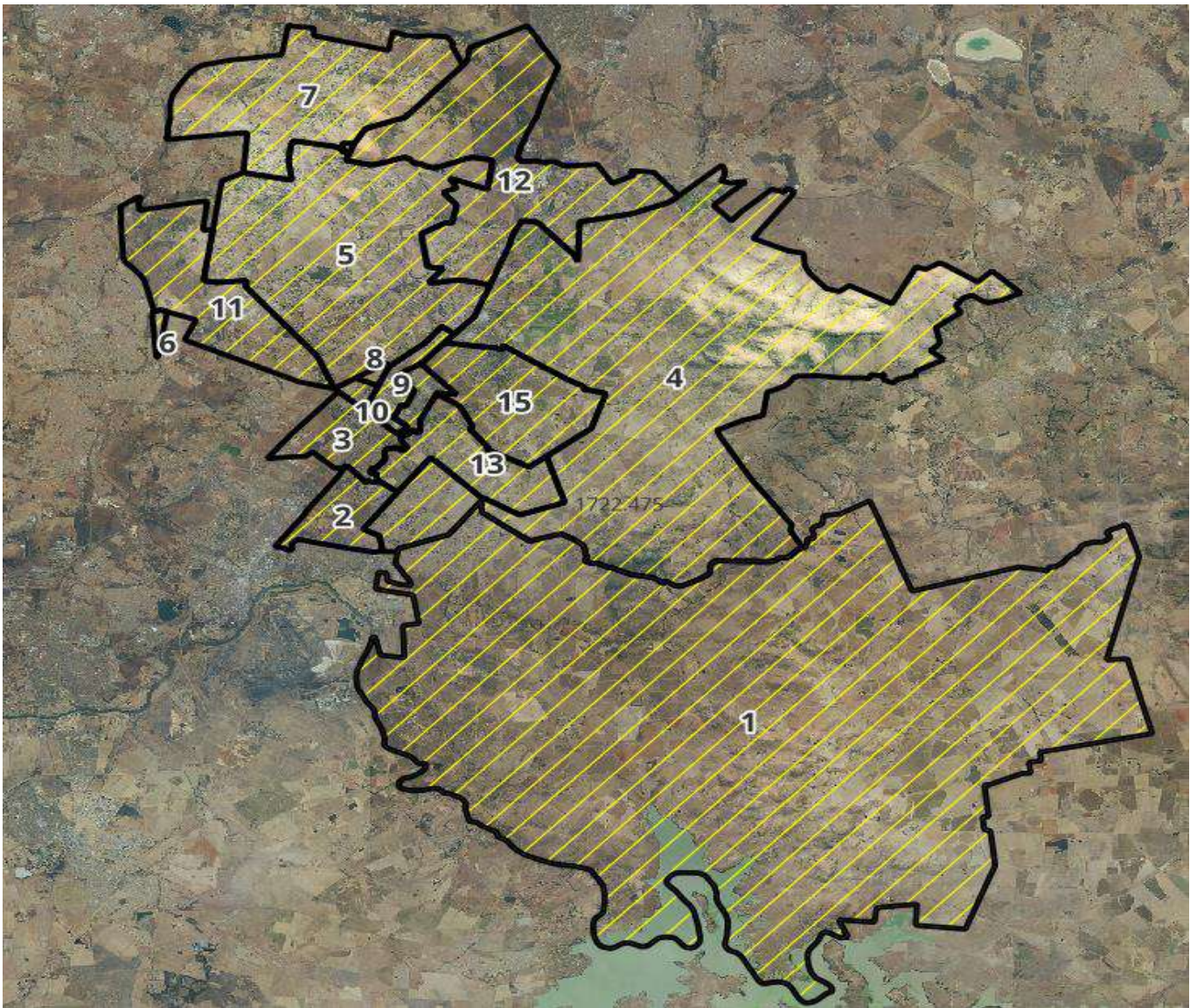


Figure 71: Midvaal Local Municipality 15 Wards

As previously established Midvaal Local Municipality consists of 15 Wards as follows:

Table 19: WARDS Landmarks and Street Names

Ward Number	Landmark	Street Name
Ward 1	Kudung Middle School (Nooitgedacht), Vaal Marina Community Hall, Mooilande AH	Maribou, R54, R549
Ward 2	Risiville Laerskool, Glen Donald AH	Brockett
Ward 3	Rothdene, Meyerton South	Sybrand van Niekerk R59
Ward 4	Daleside, Homelands AH, Koelfontein AH	Winchester R551
Ward 5	Drumblade AH, Highbury	Joan
Ward 6	Lakesides	St Patrick
Ward 7	Aloe Ridge Primary School	Loes R82
Ward 8	Sicelo White House	Bell
Ward 9	Meyerton Town Hall	Meyer
Ward 10	Sicelo Stadium	Johan le Roux R551



Ward Number	Landmark	Street Name
Ward 11	Walkerville Golf Club, De Deur Primary School	R82
Ward 12	Zwartkopjes, Klipview AH, Kliprivier	Sybrand van Niekerk R59
Ward 13	Voorwaarts Laerskool	Boundary
Ward 14	Dr Malan High School	Verwoerd R551
Ward 15	Randvaal, Henley on Klip	Ewelma, Kliprivier R551

The total length of Gravel Roads within Midvaal Local Municipality is calculated to be 4004km (Farm and Municipal Roads) and was prioritised from **Priority 1**, **Priority 2**, **Priority 3** and **Priority 4** and then determined per ward, as can be seen from **Figure 72**.

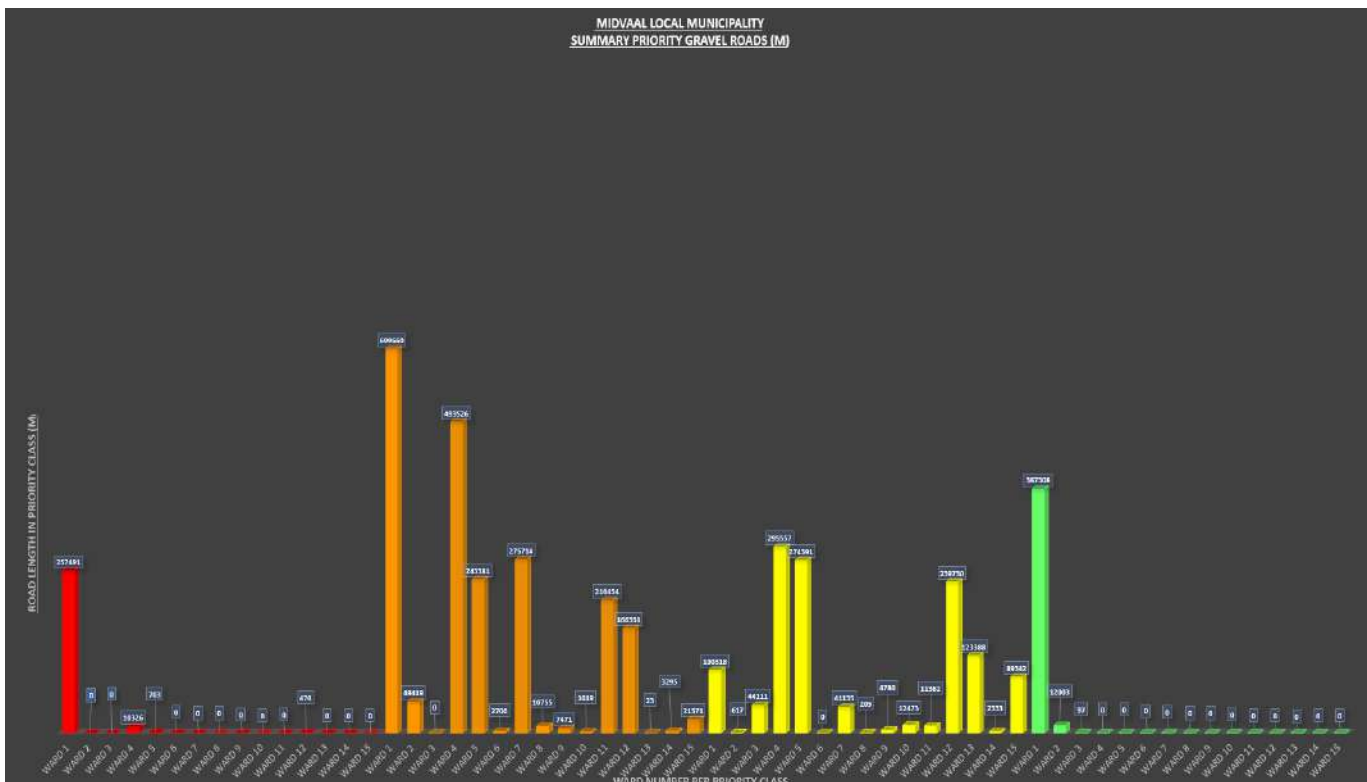


Figure 72: Midvaal Local Municipality - Ward Gravel Roads Prioritised

Analysing **Figure 72** Gravel Roads the following can be concluded:

- **Ward 1** – Consists of 1354km of gravel roads whereby:
257km of roads fall within Priority 1,
609km falls within the priority 2,
100km falls within the priority 3, and
387km falls within the priority 4 roads.
- **Ward 2** – Consists of 62km of gravel roads whereby:
49km of roads falls within Priority 2,
0.617km falls within Priority 3, and
12km falls within Priority 4 roads.
- **Ward 3** – Consists of 44.2km of gravel roads whereby:
44.1km falls within the Priority 3,
0.097km falls within the Priority 4 roads.



- **Ward 4** – Consists of 800km of gravel roads whereby:
10.3km falls within the Priority 1,
493km falls within the Priority 2, and
295km falls within the priority 3 roads.
- **Ward 5** – Consists of 520km of Gravel roads whereby:
0.703km falls within Priority 1,
243km falls within Priority 2, and
275km within Priority 3 roads.
- **Ward 6** – Consists of 2.7km of Gravel roads whereby:
2.7km of gravel roads fall within Priority 2 roads.
- **Ward 7** – Consists of 316km of Gravel roads whereby:
275km falls within Priority 2, and
41km falls within Priority 3 roads.
- **Ward 8** – consists of 10.9km of Gravel roads whereby:
10.7km falls within Priority 2, and
0.205km falls within Priority 3 roads.
- **Ward 9** – Consists of 12.9km of Gravel roads whereby:
7.4km falls within Priority 2, and
4.7km falls within Priority 3 roads.
- **Ward 10** – Consists of 14km of Gravel roads whereby:
1.6km falls within Priority 2, and
12.4km falls within Priority 3 roads.
- **Ward 11** – consists of 221km of Gravel roads whereby:
210km falls within Priority 2, and
11km falls with Priority 3 roads.
- **Ward 12** – Consists of 406km of Gravel roads whereby:
0.407km falls within Priority 1,
166km falls within Priority 2, and
239km falls within Priority 3 roads.
- **Ward 13** – Consists of 123km of Gravel roads whereby:
0.023km falls within Priority 2, and
123km falls within Priority 3 roads.
- **Ward 14** – Consists of 5.6km of Gravel roads whereby:
3.2km falls within Priority 2, and
2.3km falls within Priority 3 roads.
- **Ward 15** – Consists of 110km of Gravel roads whereby:
21km falls within Priority 2, and
89km falls within Priority 3 roads.



The total length of Asphalt Roads within Midvaal Local Municipality is calculated to be 1200km and was prioritised from **Priority 1**, **Priority 2**, **Priority 3** and **Priority 4** and then determined per ward, as can be seen from **Figure 73**.

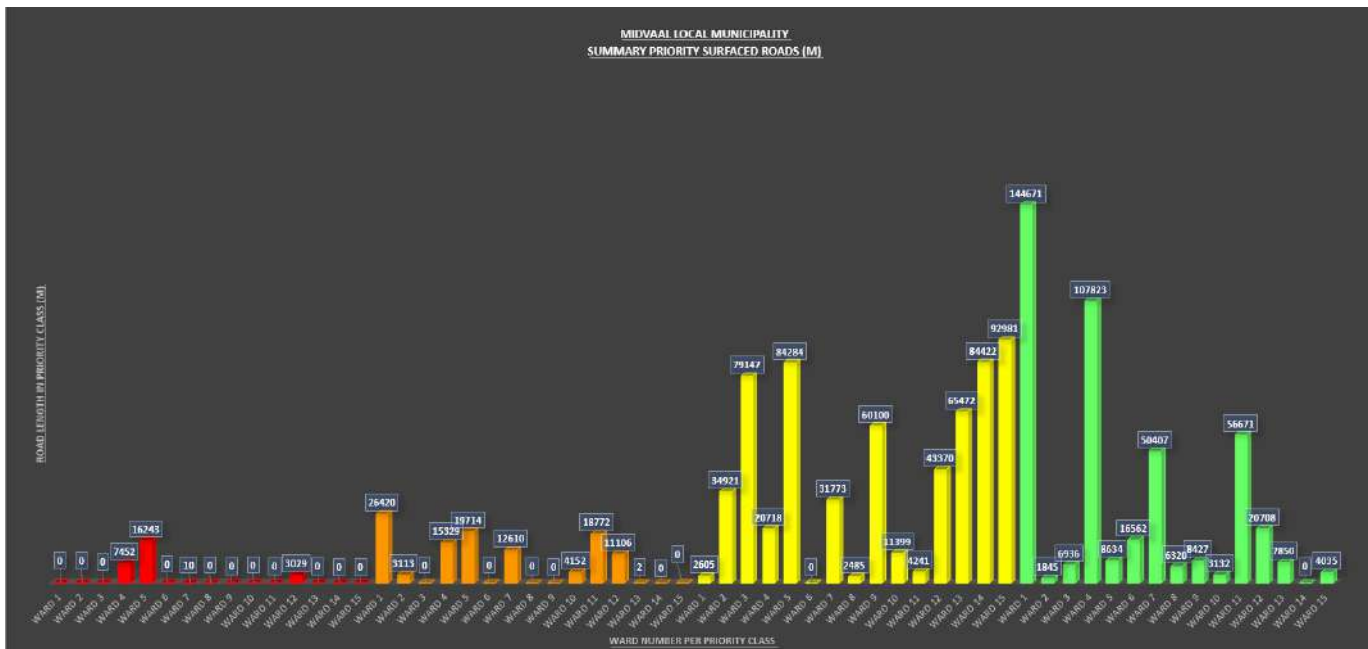


Figure 73: Midvaal Local Municipality - Ward Surfaced Roads Prioritised

Analysing **Figure 73** Surfaced Roads the following can be concluded:

- **Ward 1** – Consists of 174km of surfaced roads whereby:
26km of roads fall within Priority 2,
2.6km fall within priority 3, and
144km fall within priority 4.
- **Ward 2** – Consists of 39.8km of surfaced roads whereby:
3.1km of roads falls within Priority 2,
34km falls within Priority 3, and
1.8km falls within Priority 4 roads.
- **Ward 3** – Consists of 86km of surfaced roads whereby:
79km falls within the Priority 3, and
6.9km falls within the Priority 4 roads.
- **Ward 4** – Consists of 151km of surfaced roads whereby:
7.4km falls within the Priority 1,
15.3km falls within the Priority 2,
20.7km falls within the priority 3, and
107.8km falls within the Priority 4 roads.
- **Ward 5** – Consists of 129km of surfaced roads whereby:
16.2km falls within Priority 1,
19.7km falls within Priority 2,
84.2km within Priority 3, and
8.6km falls within the Priority 4 roads.



- **Ward 6** – Consists of 16.5km of surfaced roads whereby:
16.5km of falls within Priority 4 roads.
- **Ward 7** – Consists of 163km of surfaced roads whereby:
10km falls within Priority 1
12.6km falls within Priority 2 roads,
31.7km within Priority 3, and
50.4km falls within Priority 4 roads.
- **Ward 8** – consists of 8.7km of surfaced roads whereby:
2.4km falls within Priority 3 and
6.3km falls within Priority 4 roads.
- **Ward 9** – Consists of 70km of surfaced roads whereby:
60.1km falls within Priority 3, and
8.4km falls within Priority 4 roads.
- **Ward 10** – Consists of 18.5km of surfaced roads whereby:
4.1km falls within Priority 2,
11.3km falls within Priority 3 roads, and
3.1km falls within Priority 4 roads.
- **Ward 11** – consists of 80km of surfaced roads whereby:
18.7km falls within Priority 2,
4.2km falls with Priority 3, and
56.6km falls within Priority 4 roads.
- **Ward 12** – Consists of 78km of surfaced roads whereby:
3km falls within Priority 1,
11.1km falls within Priority 2,
43.3km falls within Priority 3, and
20.7km falls within Priority 4 roads.
- **Ward 13** – Consists of 73km of surfaced roads whereby:
0.002km falls within Priority 2,
65.4km falls within Priority 3, and
7.8km falls within Priority 4 roads.
- **Ward 14** – Consists of 84.4km of surfaced roads whereby:
84.4km falls within Priority 3 roads.
- **Ward 15** – Consists of 96km of surfaced roads whereby
92km falls within Priority 3, and
4km falls within Priority 4 roads.

H.1.7.4 Using GIS to Identify Priority Gravel and Surfaced Roads

In order to identify the Gravel and Surfaced Roads visually, snapshots of the GIS Graphic Modelling Software can be seen in **Figures 74 – 78**.

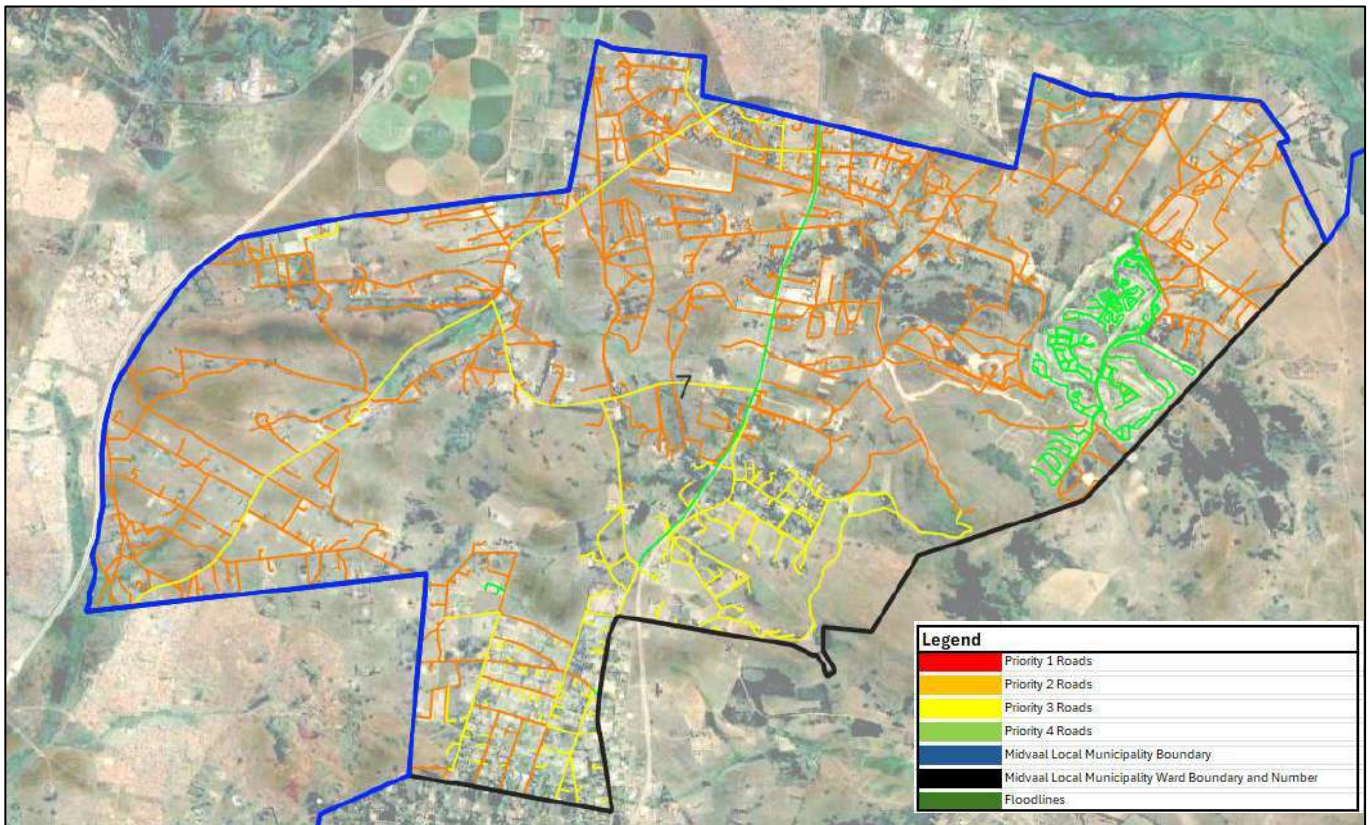


Figure 75: GIS Representation of Ward 7 and Prioritised Gravel Roads

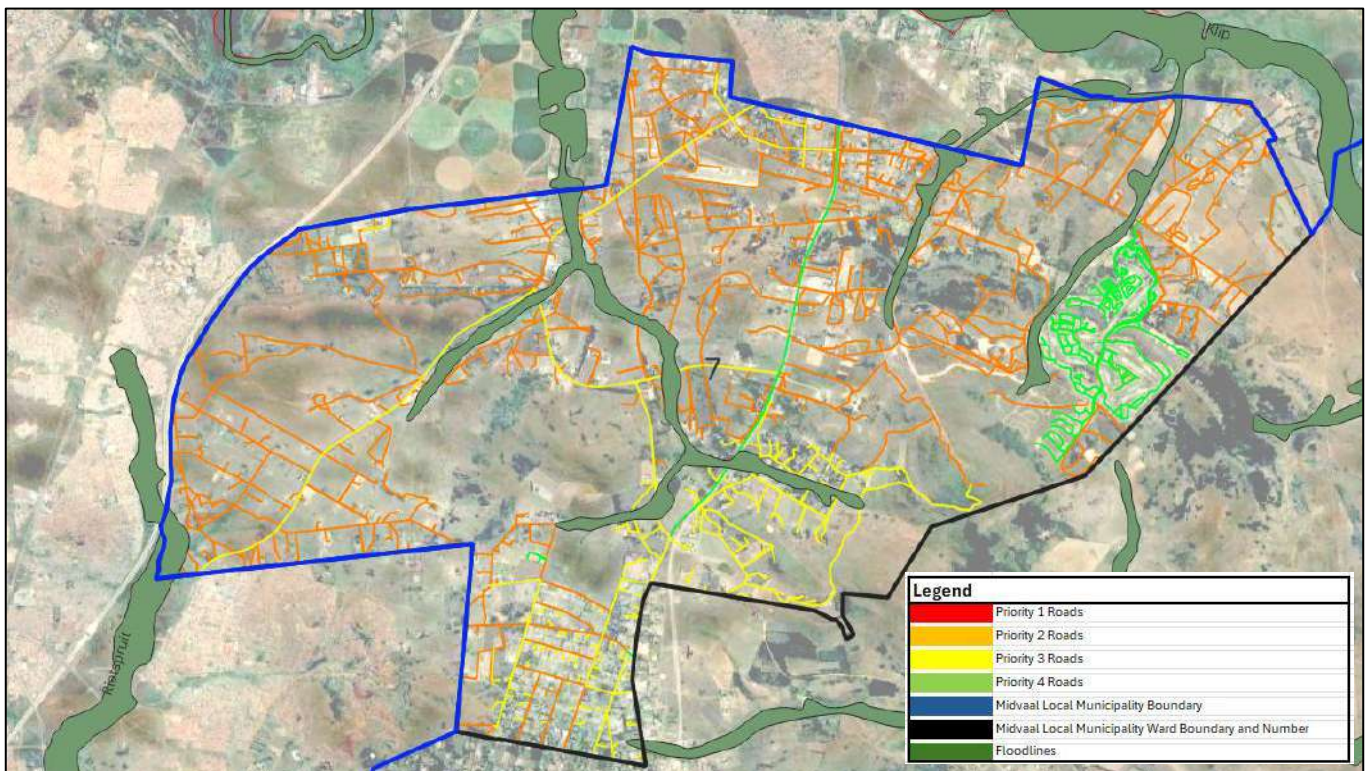


Figure 74: Wards 7 Gravel Roads Including 1 in 100 year Floodlines

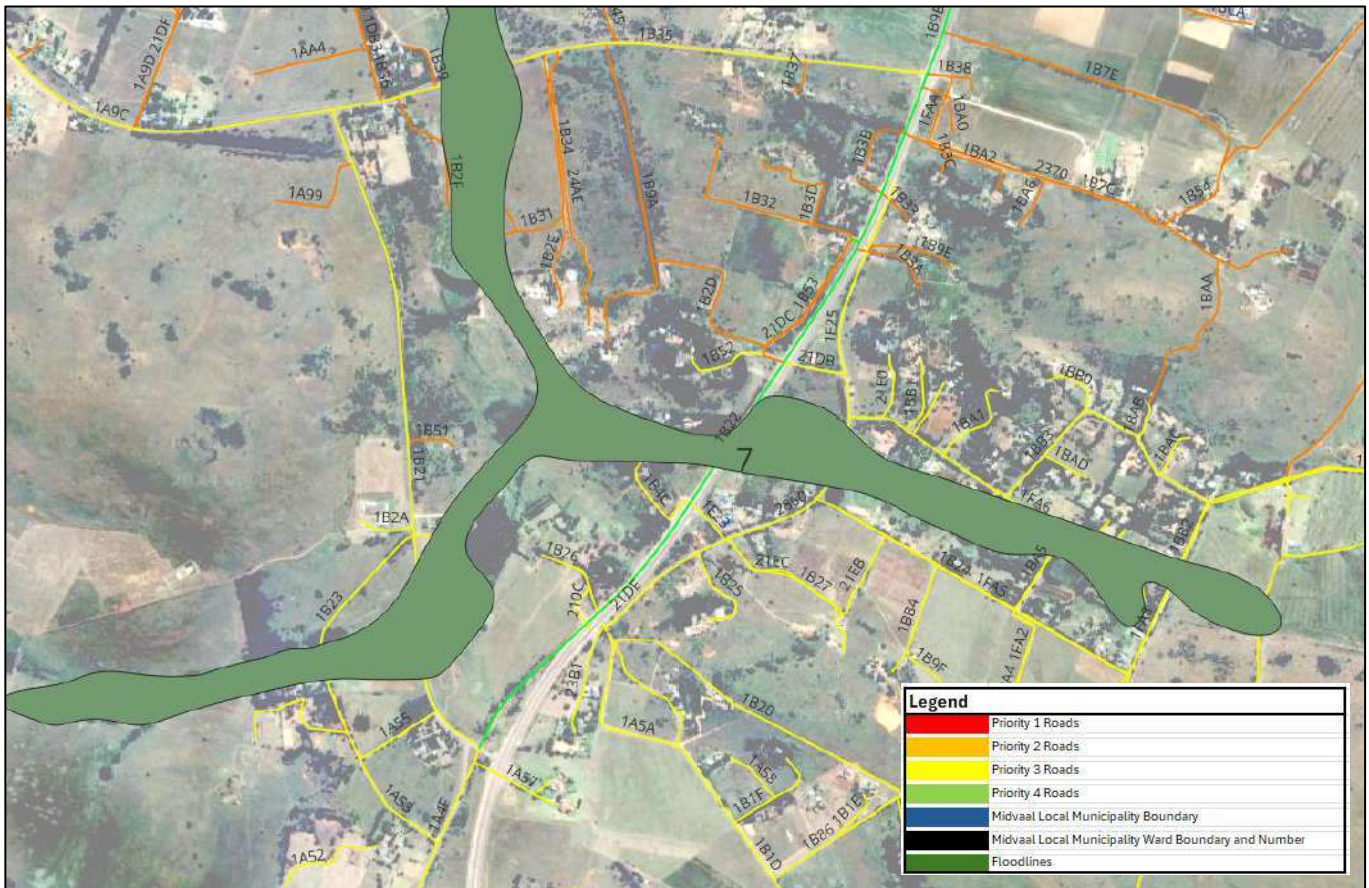


Figure 76: Ward 7 Prioritised Gravel Roads - Road Selection Named

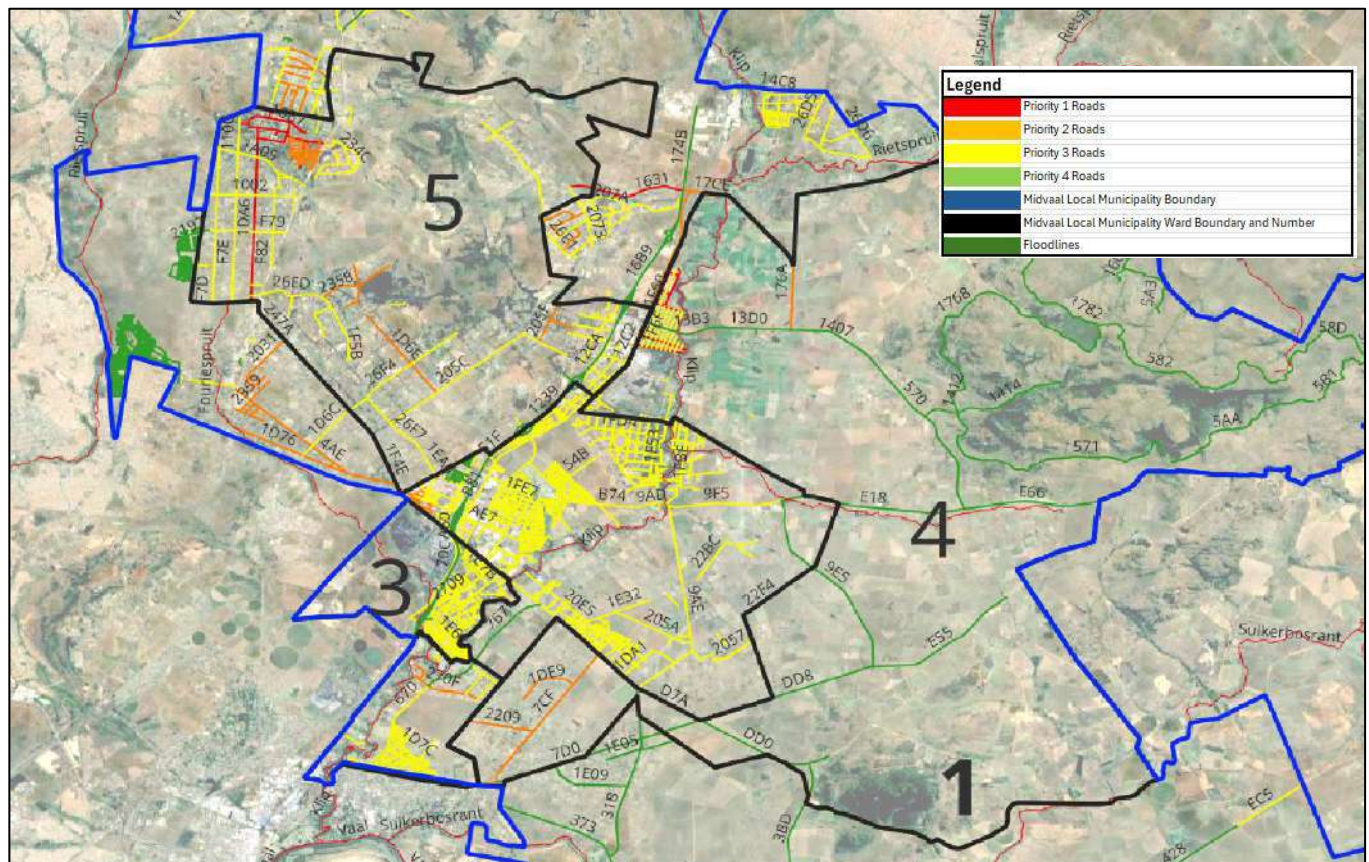


Figure 77: Ward 1, 3, 4 and 5 Prioritised Gravel Roads - Road Selection Named

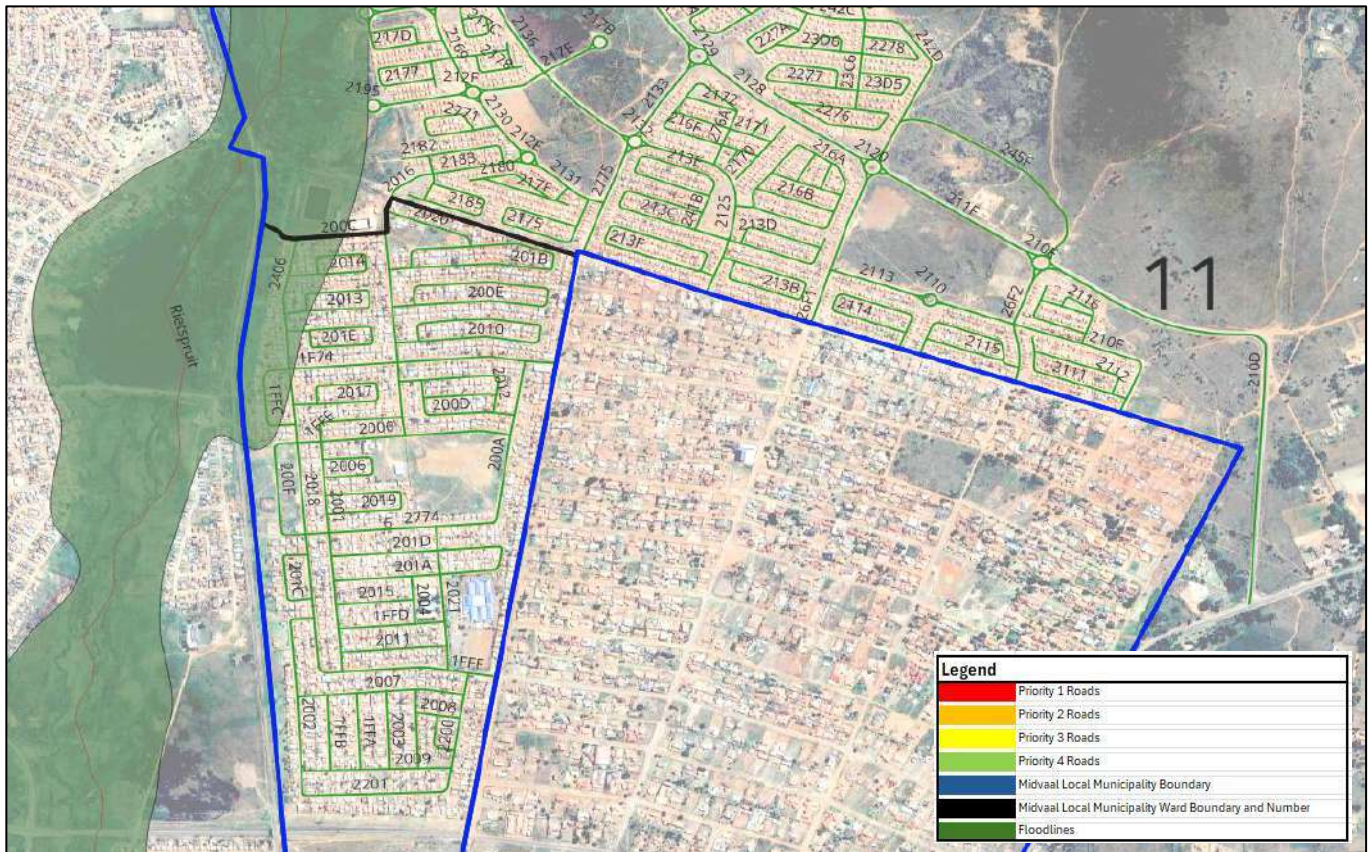


Figure 76: Ward 11, Lakeside Surfaced Roads - Road Selection Name and Floodline

H.1.7.5 Cost Estimate Assumptions and Rates (Gravel and Surface Roads)

In order to quantify a high-level cost estimate for the Gravel and Surface Roads the minimum Levels of Service requirements were computed for three main scenarios namely Gravel Road Refurbishment, Construction of an Asphalt Road Surface including Stormwater and Reseal of Existing Asphalt Roads.

In the below tables, a rate per meter length of roads were calculated for the three main scenarios, with the following assumptions:

- The base year for all rates is 2024 and no inflation nor escalation were incorporated.
- It is purely an estimated construction cost, and VAT and Preliminary and General items were excluded. It was assumed that construction would be done in house.
- All plant required to perform the activities are in place (Excl. Maintenance Costs of the Plant).
- Road widths were assumed to be uniform throughout the projects (In a real-world scenario, the road widths would be a mix of widths based on the function of the road).
- Ideal Ground Conditions are prevalent (Hard-rock, Wet Ground conditions were excluded)
- Operators are sufficiently in place and trained.
- Townplanning and the registration of Surveyor General Plans is a prerequisite for the Construction of Asphalt Roads Incl. Stormwater.
- Detail Design by a competent and registered Engineer were excluded for the Construction of Asphalt Roads.
- The position of Culvert was determined and cost per unit were indicated.
- Subsoil rates will be provided for more detailed estimates.
- Dump rock layer rates will be provided for more accurate estimation.

See **Annexure P** for complete Cost Estimate Calculation



H.1.8.1 Conclusion Urban Surfaced Roads and Stormwater Projects

Analysing **Table 28** above it can be concluded that Midvaal Local Municipality, for the near future 5 years must budget approximately 29 million Rand for the maintenance of Residential G1 (4.0m) Gravel Roads.

Should funding become available and town planning has been completed, Midvaal Local Municipality should budget approximately 1.5 Billion rand for the construction of Asphalt Roads with Stormwater Infrastructure from Gravel Roads.

An estimated amount (Priority 1) of 86 Million rand is to be budgeted for culverts in the rural areas.

Funding needs to be requested for upgrading of plant and operators to carry out regular maintenance.

All gravel roads to have earth drains to reroute surface flow within the rural areas.

H.1.8.2 Conclusion Urban Surfaced Roads and Stormwater Projects

Regular maintenance to be done on surface roads and existing stormwater infrastructure such as:

- Regular fixing of potholes.
- Cleaning of Channel and debris in roads.
- Cleaning of kerb inlets by removing debris and rubbish.
- Fixing of Kerb Inlets cover slabs and steel frames.
- Were low points occurring on surface roads to construct kerb openings for surface water to drain.
- To construct culverts at low points for runoff stormwater to runoff freely.
- Construct Attenuation ponds.
- Construct more discharge points with stormwater structures with siltation basins and energy breakers to prevent erosion.
- Lifting of kerb Inlets when roads are re-surfaced

Midvaal Local Municipality Draft Integrated Development Plan 2024/25 (IDP) were investigated to identify the background of the municipality and to formalise the estimated cash flow projections. It was noted in the IDP the different types of projects that are planned within the municipality and that there is a clear indication of which areas will be upgraded in the future. There was also inadequate information regarding operations and maintenance of roads and stormwater infrastructure. In **Annexure A** of the IDP 2024/25 the list of projects was investigated and will be refined in the cash flow projection summary sheet with the PSP's priority projects. In **Annexure B** of the IDP 2024/25 only concentrates on new developments with population demand within the municipal area.

These projects were then estimated and projected for the next 5 years to provide Midvaal Local Municipality and sponsor DBSA with a clear view of their future planning. These priority projects identified in Chapter H need to be incorporated into the updated IDP including and allowing participation in the IDP process, portfolio meetings, and mayoral committee to support the technical teams within the municipality.



CHAPTER I : FUNDING AND IMPLEMENTATION ARRANGEMENTS

I.1 MUNICIPAL REVENUE

The Midvaal Local Municipality's revenue comprises of operating revenue which includes property taxes, services charges, operating grants and capital revenues which consist of capital grants, borrowings and internally generated revenue. Therefore, stable sources of revenue are one of the key factors that support the sound financial position of the municipality. In addition to the need to grow the municipality's revenue by increasing its tax base, other means for securing funding for council projects must be explored in a variety of ways.

The municipality does not have the capacity of financing the ever-increased capital projects requirements. Sources of capital are already stretched with limited scope for further borrowing, consumer pressure to restrict tariff and tax increases and little likelihood of a structural upward adjustment in grant allocations. For the municipality to continue improving the quality of services provided to its citizens it needs to generate the required revenue. The Midvaal Local Municipality is faced with development backlogs and poverty. The expenditure required to address these challenges will inevitably always exceed available funding, hence difficult choices have to be made in relation to tariff increases and balancing expenditures against realistically anticipated revenues.

The capital and operating funding sources available to municipalities are (National Treasury, 2011):

- Rates on property
- Services charges / fees
- Other taxes, levies or duties
- Administrative fees
- Fines
- Borrowings
- Equitable Share allocation
- Conditional grants from national government
- Conditional grants from provincial government
- The municipality's Indigent Policy and rendering of free basic services
- Growth in the municipality and continued economic development

The funding framework applicable to local municipalities is indicated in the diagram below:

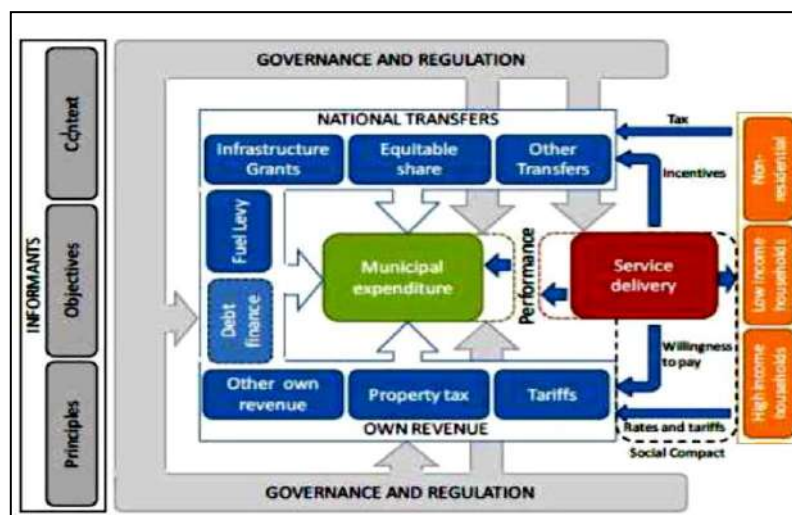


Figure 77: Funding Framework



Municipalities may borrow funds from the financial markets to finance part of the economic infrastructure portion of their capital budget (National Treasury, 2011). This suggests that whilst grant funding sources could be used to fund infrastructure that is provided for poor households, it may be possible to raise debt on the capital markets for the portion of the infrastructure that is provided to higher income households and commercial entities as these entities should be able to pay for the services provided. A municipality's capacity to borrow is a function of sound financial management and choice of infrastructure projects (National Treasury, 2011).

I.2 REVENUE RAISING STRATEGIES

The following are some of the more significant programmes that have been identified:

- a) The annual review and implementation of the credit control and debt collection policy. This policy and the relevant procedures detail all areas of customer care, credit control and debt collection of amounts billed to customers, including procedures for non-payment.
- b) The annual review and maintenance of a uniform tariff policy. This policy will ensure that fair tariffs are charged in a uniform manner throughout the municipal area.
- c) The annual review and maintenance of an indigent policy. This policy defines the qualification criteria for an indigent household and the level of free basic services enjoyed by indigent households.
- d) The annual review and maintenance of a property rates policy. This will ensure that a fair rates policy and an updated valuation roll are applied to the entire municipal area and will aim to ensure that all properties are included in the municipality's records. Furthermore, the policy will ensure that valuations are systematically carried out for all properties on a regular basis. The valuation roll should be implemented and if it is not happening the process of appointing a valuer for the compilation of the new valuation roll should start.
- e) Prescribed debt should be considered for write-off on an annual basis.

I.3 CAPITAL FINANCING STRATEGIES AND PROGRAMMES

The following are some of the more significant programmes that have been identified:

- a) The annual review and implementation of a borrowing policy. This policy will ensure that any borrowings taken by the municipality will be done in a responsible manner and that the repayment and servicing of such debt will be affordable.
- b) The annual review and implementation of a policy on donor funding.
- c) The development of a capital investment framework.



I.4 EXPLANATORY MEMORANDUM TO THE ALLOCATIONS SET OUT IN THE ATTACHED SCHEDULE

This Gazette is published in terms of the Division of Revenue Act, 2023, (Act No. 5 of 2023) (DoRA) as amended by the Division of Revenue Amendment Act, 2023 (Act No. 24 of 2023) (DoRAA) and provides information regarding the adjustment of allocations to municipalities in the 2023/24 financial year. This is necessitated by the need for the stopping and re-allocation of conditional grants to municipalities and is in terms of sections 18 and 19 of DoRA, as amended.

I.5 STOPPING AND RE-ALLOCATION: SCHEDULE 4B AND 5B (DIRECT)

The stopping and re-allocation of conditional grants is done in terms of sections 18 and 19 of the 2023, as amended, against municipalities that reported significant. Underperformance as of midyear i.e. 31 December 2023, and non-compliance against conditional grants frameworks and the provisions of the Act against their 2023/24 allocations.

The purpose of sections 18 and 19 of the 2023 DoRA is to avoid transferring more funds to municipalities that are sitting with unspent transferred funds, avoid fiscal dumping, address possible misuse of conditional grant funds, and to support fast-moving projects in- year with additional funding to accelerate the implementation of those projects and service delivery in those municipalities. The stopping however does not imply that projects should stop, rather municipalities should reprioritise to accelerate against their committed, and implementation-ready projects. Only projects that are not ready for implementation in the current year are affected by the stopping process as transferring more funds could lead to the misuse of conditional grants. It also of no use to transfer funds to municipalities which are not going to spend the funds by year end.

The stopping and re-allocation process provides that municipalities that are showing accelerated performance could be considered for additional funding, and the ones that are underperforming could have their funds stopped in the current year. These municipalities will be supported in future when their performance improves.

Ten capital grants are being affected by the stopping and re-allocation process namely; the Water Services Infrastructure Grant (WSIG 5B), Regional Bulk Infrastructure Grant (RBIG 5B), Public Transport Networks Grant (PTNG), Urban Settlements Development Grant (USDG), Informal Settlements Upgrading Partnership Grant (ISUPG), Neighbourhood Development Partnership Grant (NDPG 5B and 6B), Integrated National Electrification Programme (INEP 5B and 6B), Municipal Infrastructure Grant (MIG), Rural Road Assets Management Systems Grant (RRAMS) and the Integrated Urban Development Grant (IUDG).

From a capacity building perspective, the Energy Efficiency and Demand Side Management (EEDSM), the Expanded Public Works Programme (EPWP), and the Programme and Project Preparation Support Grant (PPPSG) are the three capacity building grants affected by sections 18 and 19 of DoRA.(Division of Revenue Amendment Act, 2023 (Act No.24 of 2023) (DoRAA)

I.6 MIDVAAL LOCAL MUNICIPALITY CAPITAL EXPENDITURE AND FUNDING

Midvaal Local Municipality is responsible for funding a variety of activities. This includes the development of infrastructure to ensure the provision of municipal services. This chapter of the report details the capital expenditure and revenue sources.



I.7 CAPITAL EXPENDITURE

Capital expenditure relates to the funding that is used to develop infrastructure for the provision of services in a municipality. This can be the building of new assets, renewal of existing assets or the upgrading of existing assets. This is usually a difficult task as municipalities have to ensure that existing assets are maintained, whilst also ensuring the eradication of any service delivery backlogs.

I.7.1.1 Analysis of capital expenditure

It looks like Midvaal will mainly use its capital expenditure below on infrastructure services and for the 2023/24 financial year more than 70% of the capital budget will be allocated to the Engineering Services department.

I.7.1.2 Capital Expenditure Funding

The capital budget for Midvaal Local Municipality will be funded as follows:

Table 59: Midvaal Local Municipality Capital Budget

Funding Source	Budget 2024/2025	Budget 2025/2026	Budget 2026/2027
Capital LGFMG	R 1 800 000.00	R 2 000 000.00	R 2 020 000.00
Capital EPWP	R 1 619 000.00	-	-
Capital INEP (MUN)	R 29 888 000.00	R 16 500 000.00	R 17 000 000.00
Capital MIG	R 172 049 000.00	R 185 364 000.00	R 130 414 000.00
Capital Monetary WSIG	R 32 599 000.00	R 21 519 000.00	R 22 509 000.00
Neighbourhood Technical Assistance	R 100 000.00	R 100 000.00	R 100 000.00
Neighbourhood Capital	R 10 000 000.00	R 10 000 000.00	R 1 000 000.00
Total			

(National Treasury/DoRA 2023)

The inability to renew/maintain existing assets presents a huge risk to the municipality, as without renewal/maintenance the lifespan of these assets is significantly reduced. The ultimate result of not renewing/maintaining existing assets includes constant breakdowns and failure, which in the long run will impact negatively on the Municipality's ability to deliver services.

I.8 Challenges faced by municipalities

Some of the problems that municipalities need to address in managing the roads and stormwater infrastructure include:

- Inappropriate prioritisation in allocating budgets: Prioritisation of new infrastructure happens at the expense of maintaining existing assets.



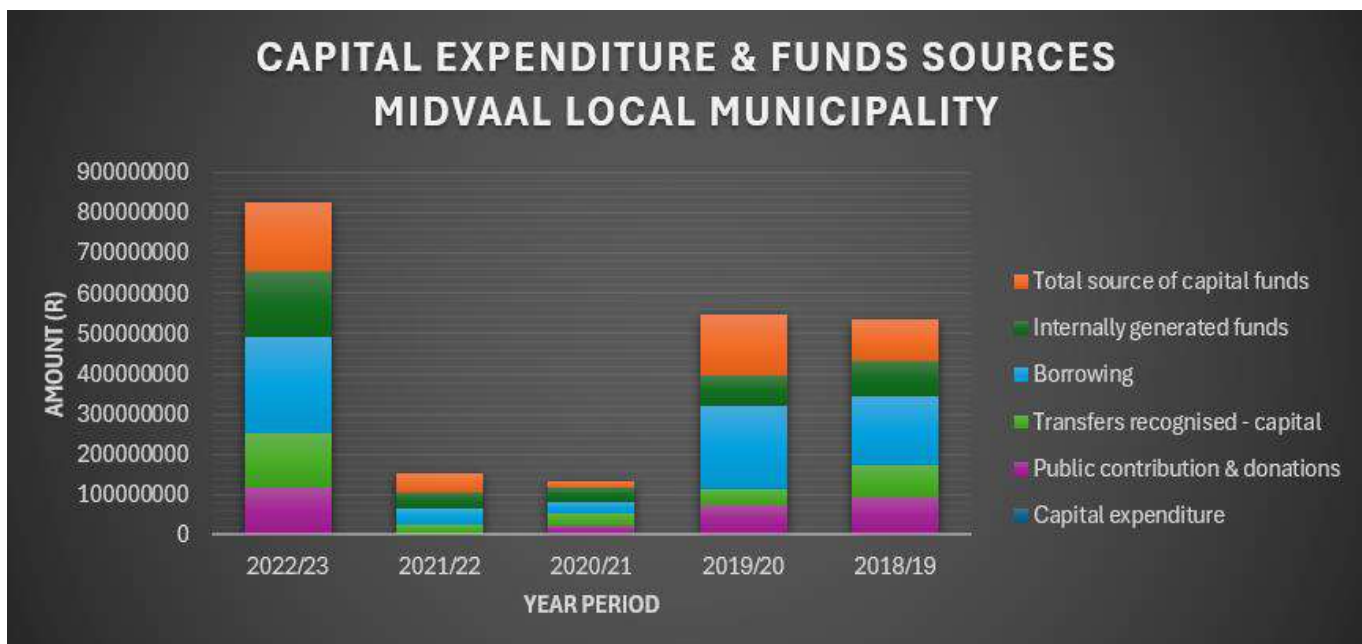
- Maintenance budgets: These are often treated as discretionary budget line items and are the first to be cut to realise savings. Municipalities need to be constantly investing in the refurbishment of their infrastructure and ensuring that ageing assets are upgraded timeously.
- Non-integrated housing developments: These occur because provinces are not working closely with municipalities to plan the location of new housing developments, as a result, houses get built where the support road infrastructure does not exist.
- Excavations by other service providers and illegal practices: These excavations damage the road infrastructure, as does overloading of heavy transport vehicles.
- Loss of key technical staff: Often key staff are not replaced or they are replaced by less qualified staff. A recent survey by the South African Institute of Civil Engineering revealed that 79 of the 231 local municipalities had no civil engineers, technologists or technicians on their permanent staff.
- Lack of asset lifecycle planning capability: Maintenance of roads and stormwater infrastructure is mainly done on an ad-hoc basis as there is no proper base for planning and budgeting for planned maintenance of infrastructure. Vehicle overloading and breaches of road safety regulations continue to be major problems.

I.9 CAPITAL FUNDING SOURCES

Capital expenditure within a municipal environment can be funded by different mechanisms. This includes grant funding, debt funding and internally generated funds.

Capital funding sources are expected to be largely by transfers from the national fiscus. In the current MTREF Midvaal Local Municipality will receive funding via MIG and INEP. Historically, the Municipality has funded a portion of the capital budget via internally generated funds however, there are no projections for internally generated funds from 2018/19 to 2020/21. This aspect should be investigated as the Municipality cannot sustainably be funded through grants only, without revenue generation.

Public-Private Partnerships (PPPs) are a funding option that is able to leverage private sector funders and skills. This would provide an opportunity for the Municipality to enter into long term concession agreements to Design, Build, Operate and Finance projects but will require alignment to National Treasury procurement processes. In addition, PPPs are mostly suited to large projects that generate revenue, such as water, electricity and toll roads projects. However, PPPs can still be structured on a non-revenue generating project if the Municipality has other sources of income to repay the private sector investment.



Graph 1: Midvaal Local Municipality Capital Expenditure and Funds Sources

I.10 POSSIBLE GRANT FUNDING AND BORROWING

- **Rural Roads Asset Management Systems Grant (RRAMS):**

The Rural Roads Asset Management Systems Grant was established to assist district municipalities in establishing Road Asset Management Systems and collect roads, bridges and traffic data on municipal road networks. The outcomes of the grant are improved data on municipal roads to guide municipal investment decisions, as well as, reduced operational expenditure.

The RRAMS allocation at the District Municipality is inadequate (R2 million) to make a meaningful contribution to the local municipalities.

- **Borrowing:**

The strong capital market in South Africa (commercial banks and other lending institutions like the Development Bank of Southern Africa provides an additional instrument to access financial resources. However, the municipality may not borrow to balance its operating budget and to finance any operating expenditure. Midvaal should have a policy in place that ensures borrowing in a responsible way. In order to access this market, the municipality will continue to maintain accurate and appropriate financial accounting and reporting systems and ensure that enough cash is generated to honour repayment commitments.

The manner in which the municipality manages debt or takes on new debt to finance investment activities will have a significant impact on the solvency and long-term viability of the municipality. Midvaal should aim at a maximum borrowing level of external loans that will not exceed 40% of the total operating revenue over the short and medium term. New borrowings are recommended for the 2022/2023 financial year as well as the outer years of the budget. The borrowings can also be used to finance new infrastructure as well as new operational vehicles.

- **Infrastructure Skills Development Grant:**

The Infrastructure Skills Development Grant is a capacity building grant that aims to create a sustainable pool of young professionals with technical skills related to municipal services,



such as water, electricity and town planning. The grant places interns in municipalities that can be hired by the municipality at the end of their internship period. (National Treasury, 2018).

Its strategic goal is to develop infrastructure delivery management capacity within municipalities by creating a long term and sustainable pool of registered professionals with built environment and related technical skills (engineering, town planning, architecture, quantity surveying, and geographic information system and project management skills).

The grant's purpose is to recruit unemployed graduates in municipalities to be trained as per the requirements of the relevant Statutory Councils within the built environment. The outcome statements should develop technical capacity within local government to enhance infrastructure related performance.

Trained graduates with built environment qualifications (national diplomas and degrees) in line with Statutory Council requirements will definitely increase the number of qualified and professionally registered technical experts appointed in municipalities to improve infrastructure planning and implementation within municipalities

I.10.1.1 How to apply

The Municipality should write a business plan that must demonstrate that the municipality has projects that can support graduates. Interested municipalities must submit a 3 year business plan for assessment by the National Treasury.

On the road -to- registration Candidates must have a national diploma or degree in the built environment from tertiary education institutions i.e. Universities or Universities of Technology and Municipalities must register graduates as candidates with the relevant Statutory Councils within 2 weeks of intake.

Municipalities must provide training as per the road-to-registration requirements of the relevant Statutory Councils and Municipalities must submit evidence of graduate registration to the National Treasury when graduates have qualified and are registered as professionals.

Mentoring must be provided by registered professionals in the same field as the graduates -in training and the full names and proof of registration of the mentor must be submitted to the National Treasury.

- **Expanded Public Works Programme Integrated Grant for Municipalities:**
Its strategic goal is to provide Expanded Public Works Programme (EPWP) incentive funding to expand job creation efforts in specific focus areas, where labour intensive delivery methods can be maximised.

The purpose is to incentivise municipalities to expand work creation efforts through the use of labour intensive delivery methods in the following identified focus areas, in compliance with the EPWP guidelines:

- **Road maintenance and the maintenance of buildings**
- **Low traffic volume roads and rural roads**
- **Basic services infrastructure, including water and sewer reticulation, sanitation, pipelines etc (excluding bulk infrastructure)**



The programme is implemented through municipalities using Incentive Agreements, project lists, creation of FTEs and work opportunities

I.10.1.2 How to apply

The Municipality should present a detailed business plans that comply with the project selection criteria determined in the EPWP grant manual, the EPWP guidelines set by the Department of Public Works (DPW) and the Ministerial Determination updated annually on 1 November each year.

Eligible municipalities must sign a funding agreement with the DPW before the first grant disbursement, with their final EPWP project list attached.

Municipalities must report quarterly on all EPWP projects via DPW's EPWP reporting system. Reports must be loaded on the EPWP reporting system within 15 days after the end of every quarter in order for progress to be assessed.

Municipalities must maintain beneficiary and payroll records as specified in the audit requirements in the EPWP grant manual.

- **Public Transport Network Grant:**

Its strategic goal is to support the National Land Transport Act (Act No. 5 of 2009) and Public Transport Strategy (PTS) and Action Plan in promoting the provision of accessible, reliable and affordable integrated municipal public transport network services.

Its purpose is to provide funding for **accelerated construction and improvement of public and non-motorised transport infrastructure that forms part of a municipal integrated public transport network and to support the planning, regulation, control, management and operations of financially sustainable municipal public transport network services.**

The priority is to implement an Improved public transport network infrastructure and services that are functioning optimally, safe, convenient, affordable, well managed and maintained and which are accessible to an increasing percentage of the population of urban municipalities and contribute to more spatially efficient urban areas.

I.11 Network Infrastructure Component

Public transport network infrastructure including dedicated lanes, routes and stops /shelters, stations, depots, signage and information displays, control centres and related information technology, fare systems and vehicles (if DoT approves use of grant funds to purchase vehicles), Non –Motorised Transport (NMT) infrastructure that supports network integration (e.g. sidewalks, cycleways, cycle storage at stations, etc.)

Plans and detailed design related to IPTN infrastructure and operations Projects must be based on a financially sustainable IPTN operational plan (including detailed financial modelling and universal design access plans) approved by the municipal council.

Projects must support an integrated network approach as defined in the National Land Transport Act(NLTA) and the PTS and municipalities must manage operations to progressively achieve the standard of service defined in the PTS within available resources.



Payments will be conditional on the attainment of milestones specified in the grant allocation letter to each municipality from the Department of Transport (DoT). Milestones are based on the approved IPTN operational plans of cities and are defined after consultation with municipalities.

All public transport infrastructure and services funded through this grant must ensure that there is provision for the needs of special categories of passengers (including disabled, elderly and pregnant passengers) in line with the requirements of section 11(c) (xiv) of the NLTA.

I.11.1.1 How to apply

Allocations for this grant are made for two components, with separate conditions applicable to each component as set out below. Funds gazetted for one component can be shifted to another component if approved by National Treasury, after consultation with the DoT. Municipalities must submit business plans based on sound IPTN operational plans and allocations will include formula -based and incentive elements. The revised allocation method will be consulted on as part of the second phase of the review of local government infrastructure grants.

I.11.1.2 Process for approval of business plans

- Municipalities must submit a technical report for each project to the regional office.
 - Regional offices must assess and approve technical reports.
 - Municipalities must prepare business plans based on the approved technical reports and lastly Municipalities must submit implementation plans.
- (Division of Revenue Amendment Act, 2023 (Act No.24 of 2023) (DoRAA)).

I.12 Budget Facility for Infrastructure (BFI)

Treasury on call for proposals for consideration by Budget Facility for Infrastructure (BFI) by 27 Mar 2024

A call for proposals for consideration by the budget facility for infrastructure National Treasury has published a Call for Proposals for consideration by the Budget Facility for Infrastructure (BFI). The BFI is a reform established in 2016 to support the execution of priority infrastructure projects and programmes through a more rigorous planning, appraisal, and selection process.

This Call for Proposals was announced by the Minister of Finance during the 2024 Budget Speech. The National Treasury intends to utilise this BFI Window to develop a pipeline of projects and programmes to test alternative financing and funding models. Public institutions are being invited to submit proposals in respect of projects and programmes that will form part of this pipeline. Public institutions that qualify to submit proposals include those in the National, Provincial and Municipal spheres of government as well as Public Entities.

The primary purpose of this BFI Special Window is to close funding gaps and provide viability gap funding for projects and programmes that will leverage private sector financing and technical assistance.

The Call for Proposals is open to projects and programmes that are undertaken under alternative financing and delivery mechanisms and private sector participation frameworks such as Public-Private Partnerships (PPPs) and concessions. To be eligible, proposals should closely follow the BFI Guideline for this Window which can be accessed here [2024 BFI Special Window Guideline \(National Treasury 2024\)](#).



For enquiries email: media@treasury.gov.za

- For the 2025 MTEF: Submissions from public institutions in support of large infrastructure projects and/or programmes that require budget allocations over the MTEF are invited. The proposal should consist of a primary submission and supporting documentation. The closing date for submissions is 14 July 2024.
- All proposals that required direct budget support in the 2024 MTEF are expected to be shovel ready (immediate procurement, contracting and construction).

I.12.1.1 What Is The Budget Facility For Infrastructure (BFI)?

The BFI is a reform to the budget process that seeks to support the execution of national priority projects and programmes by establishing specialised structures, procedures and criteria for committing fiscal resources to public infrastructure proposals.

The aim is to support quality public investments through effective development, robust appraisal, sustainable financing and appropriate contracting arrangements, and credible execution.

The BFI aims to:

- Ensure that full life-cycle costs are explicitly considered in planning, adequately budgeted for and anticipated in future budgets; and
- Capacitate government officials to understand the characteristics of large infrastructure proposals, engage with technical aspects of the proposals and use standard methods of appraisals.

The facility considers budget submissions in respect of new and existing national priority projects and programmes.

I.12.1.2 Budget Facility For Infrastructure Process Flow

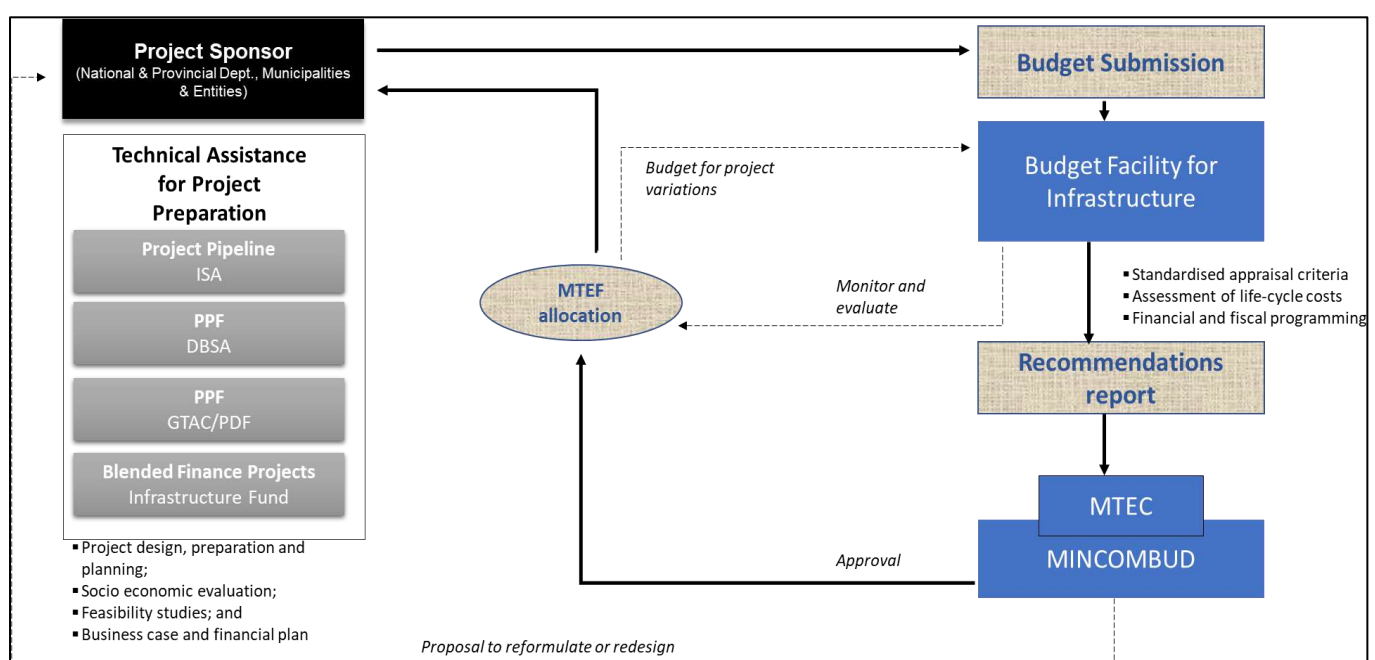


Figure 78: Budget Facility Process Flow Diagram



I.12.1.3 Budget Facility For Infrastructure Analytical Process

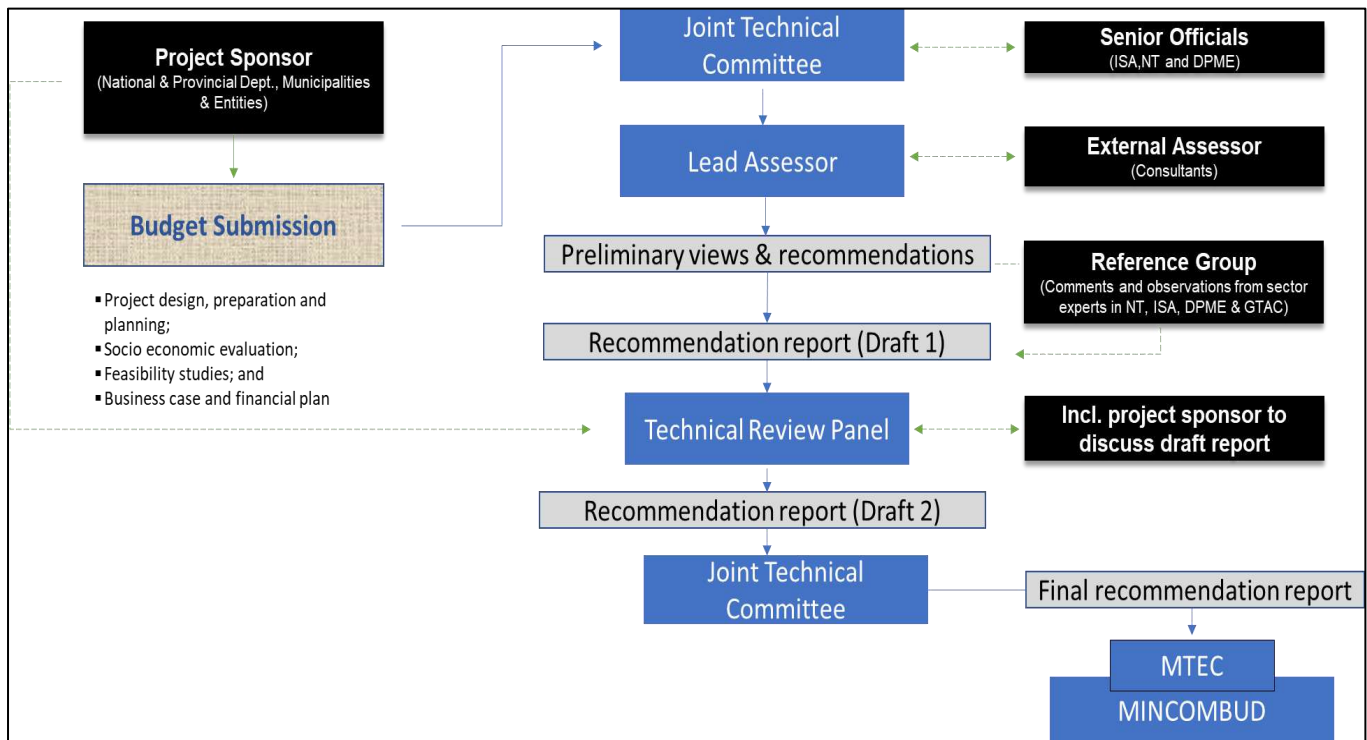


Figure 79: Budget Facility Analytical Process Flow Diagram

I.12.1.4 Requirements for Submission

The BFI will consider submissions from public institutions in respect of infrastructure proposals that meet the following minimum requirements:

1. Clearly identified as a national priority by the Presidential Infrastructure Coordinating Council and designated as Strategic Integrated Project or a priority as provided in the National Infrastructure Plan 2050 (NIP 2050).
2. The project/programme must receive endorsement and written support from the relevant national department(s), where applicable. The letter of support should be signed by the Director-General of the national department or any person to whom the function has been delegated (letter of delegation should be attached). The letter should include endorsement from the national department that the funds, if approved, will flow through the department, either as a conditional grant or on the departmental vote.
3. Very large (a minimum total project cost of R1 billion for projects and R3 billion for programmes) and strategic interventions. These are interventions that will have substantial long-term impacts on economic growth, social equity and employment creation.
4. Provide clear justification and rationale for allocating funding from the fiscus by providing a completed Cost Benefit Analysis or Cost Effectiveness Analysis.



5. A transparent Budget Statement that indicates that dedicated and appropriate funding sources have been considered. The BFI should be the last port of call and therefore, sponsors must demonstrate the extent to which alternative and conventional funding sources have been explored and deployed prior to approaching the BFI.
6. Projects and programmes to be submitted must be in the following sectors: Energy, Water and Sanitation, Transport, Digital Communications; Human Settlements, Agriculture and Agro- processing, Health, Education and Municipal infrastructure. With regards to Municipal Infrastructure, priority will be given to water and sanitation, energy and bulk infrastructure projects.

Smaller capital projects, programmes or asset acquisitions that are below the specified threshold (R1 billion for projects and R3 billion for programmes) will not be considered by the facility. These proposals should form part of the institution's main budget submission in terms of the main MTEF guidelines that will be published later this year.

I.12.1.5 Criteria To Be Considered In The Submission Of Proposals

The submission should be a summary of the following elements:

1. A description of the project or programme – brief summary of the key information.
2. A brief description of the prioritisation and approval process undertaken by the sponsoring institution resulting in the project or programme being a national priority and a clear justification or rationale for the proposal.
3. Justification of the project/programme: description of the status-quo, the challenges that the proposed intervention seeks to resolve and their extent. And demand analysis.
4. The objectives, outcomes and targets that the proposal seeks to achieve.
5. A summary of the technical options considered and the rationale for the preferred choice.
6. A socio-economic analysis comprising a summary of the CBA or CEA clearly showing the estimates of economic costs and benefits associated with the intervention and anticipated social and distributional impacts.
7. A budget statement that highlights the estimated capital, operations and maintenance costs over the intervention's full lifecycle; the proposed funding sources and funding requirements per source, cashflow projections; and contingent liability statement where applicable. The statement will include:
 - An expenditure statement
 - A funding statement
 - A cash-flow statement
 - Contingent liability statement



8. Risk Assessment – identify, describe, group key risks into major risk categories, use a risk matrix to assign the likelihood of occurrence and quantify the impacts on the project/programme, and provide risk mitigation strategies.
9. The procurement statement and plan associated with the proposal.
10. Institutional and operational readiness to implement the proposal with clear governance arrangements in place.

I.12.1.6 Format of submission

- The primary submission is a concise summary of the proposed project or programme, not longer than 20 pages. It should be a high-level analysis, explaining the problem, the alternatives that have been considered to solve the problem, and the assumptions, constraints, risks, costs, and timeframes involved in implementing a chosen solution.
- All the documentation and data that supports the primary submission should also be submitted in electronic format. The supporting documentation cannot substitute for the primary submission.
- For projects/programmes that are deemed to be shovel-ready, it is assumed that a recent feasibility study covering the financial, economic, social and institutional appraisal of the project has been completed and this should be attached to the primary submission.
- Projects that fail to complete the primary submission in terms of the guidelines provided will not be considered.
- The detailed guideline can be accessed on the National Treasury website.

[https://www.treasury.gov.za/publications/guidelines/2023%20LargeInfraBudgetGuideline%20-%20NTDS%20\(003\).pdf](https://www.treasury.gov.za/publications/guidelines/2023%20LargeInfraBudgetGuideline%20-%20NTDS%20(003).pdf)

I.12.1.7 Common Reasons Why Submissions Fail To Meet The BFI Appraisal Requirements

- Some proposals do not proceed beyond the pre-screening assessment: Not large enough, not aligned with national priorities; not in targeted sectors of priority; and not shovel ready.
- With respect to programmes, combination of components/projects that are not necessarily related to each other just to meet the cost threshold or are at different stages of development without phasing in implementation.
- Some proposals may meet the key requirements of the BFI, but inadequate information is submitted to enable the appraisal team to do a thorough assessment of the project/programme.
- There are proposals that may fully meet the key requirements of the BFI, submit adequate information but do not proceed beyond the pre-screening assessment stage because of broader sectoral, policy, institutional, etc. issues that cannot be resolved by the BFI.



- Proposals proceed to detailed technical analysis but are not recommended for fiscal support.

<https://www.gtac.gov.za/resource/common-reasons-why-submissions-fail-to-meet-bfi-appraisal-requirements/>

I.13 CONCLUSION:

Historically, Midvaal Local Municipality has funded the capital expenditure programme through a combination of grants, public contributions and internally generated funds. The municipality is projecting an increase in transfers to fund their capital expenditure programme but has not budgeted for internally generated funds over the MTREF. This could be a conservative budget provided by the municipality or highlight that the municipality would not be able to generate a surplus on the operating budget to fund the capital expenditure. It is also important to note that the municipality has not projected to incur any debt to enhance their capital expenditure programme.

Persistent underspending could be a result of under resourced municipalities. This institutional challenge will need to be resolved as this can lead to the under-delivery of services even if funding can be secured.

I.14 CONCLUSION: CAPITAL BUDGET

The RRAMS allocation at the District Municipality is inadequate (R2 million) to make a meaningful contribution to the local municipalities.

Capital funding sources are expected to be largely by transfers from the national fiscus.

In the current MTREF Midvaal Local Municipality will receive funding via MIG and INEP. Historically, the Municipality has funded a portion of the capital budget via internally generated funds however, there are minimal projections for internally generated funds from 2018/19 to 2020/21. This aspect should be investigated as the Municipality cannot sustainably be funded through grants only, without revenue generation.

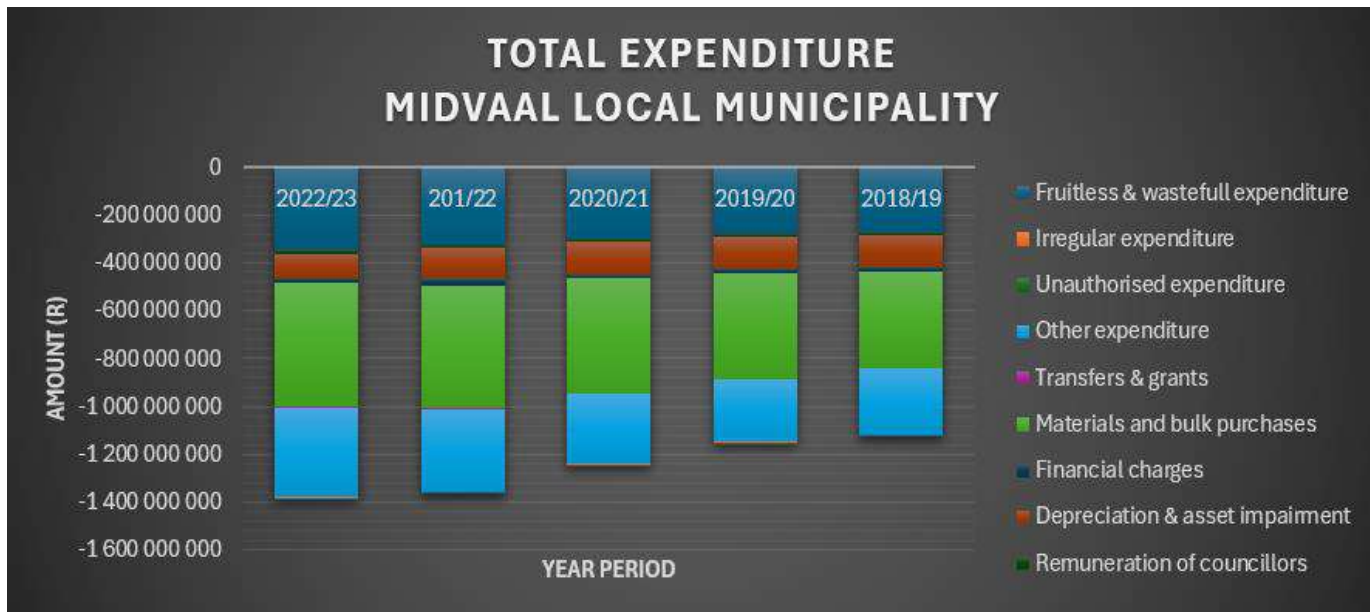
Public-Private Partnerships (PPPs) are a funding option that is able to leverage private sector funders and skills. This would provide an opportunity for the Municipality to enter into long term concession agreements to Design, Build, Operate and Finance projects but will require alignment to National Treasury procurement processes. In addition, PPPs are mostly suited to large projects that generate revenue, such as water, electricity and toll roads projects. However, PPPs can still be structured on a non-revenue generating project if the Municipality has other sources of income to repay the private sector investment.

I.15 MIDVAAL LOCAL MUNICIPALITY OPERATING BUDGET

Midvaal Local Municipality is required to ensure that services are provided in a sustainable manner. This section of the report details the operating expenditure and revenue for the municipality.

I.16 OPERATING EXPENDITURE

Operating expenditure occurs at two levels in the municipality. The first is at the global municipal level, and the second is within each unit of the municipality (Roads and Stormwater, Water Services, etc.). The operating expenditure at Midvaal Local Municipality indicated in the graph below.

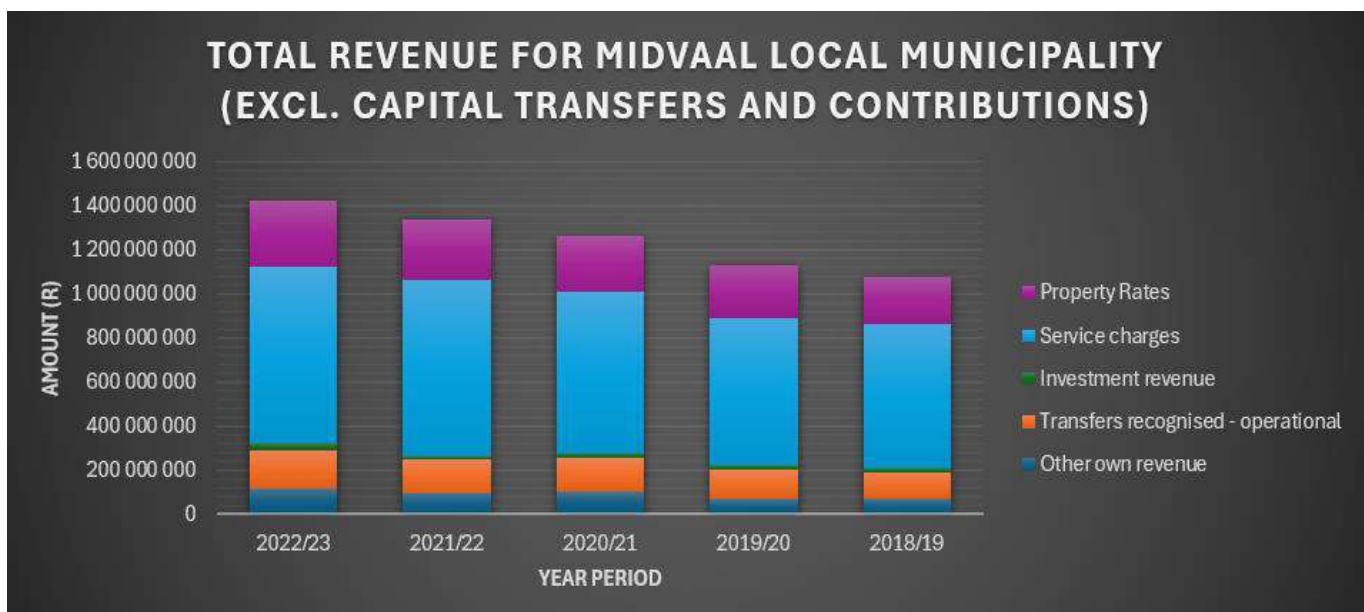


Graph 2: Midvaal Local Municipality Total Expenditure

National Treasury has indicated that repairs and maintenance should be 8% of the carrying value of the asset. This is significantly below the targeted norm provided by Treasury and suggests that repairs and maintenance will need to be reprioritised as this could increase the impairment of useful assets.

I.17 OPERATING REVENUE

Municipalities have several potential sources of operating revenues. This includes property rates, service charges and operating transfers. The operating revenue streams of Midvaal Local Municipality are presented below.



Graph 3: Midvaal Local Municipality Total Revenue

Equitable Share:

The Local Government equitable share is an unconditional transfer that supplements the revenue that local municipalities can raise themselves. The equitable share provides funding for municipalities to deliver free basic services to poor households and subsidises the cost of administration and other core services for those municipalities that have the least potential to cover the costs from their own revenues (National Treasury, 2018). The equitable share allocation to a municipality is based on a formula that utilises demographic and other data.



However, this would need to be considered with the affordability and cash flow position of the Municipality.

- The Municipality has attracted public contributions from large institutions to fund the capital expenditure programme. It may be possible to attract similar institutions for Roads and Stormwater projects that could provide enhanced access to their facilities. The potential benefits to the institutions are enhanced access, as well as lower operating costs on vehicles.
- The allocation towards repairs and maintenance for infrastructure does need to be increased. The Municipality runs the risk of existing infrastructure failing prior to the end of their expected useful life as insufficient maintenance is undertaken. This could negatively impact service delivery. Institutionally, the Municipality has to consider enhancing revenue collection mechanisms as this will enhance its ability to service debt and increase allocations towards operations and maintenance.

Institutionally, the Municipality should consider alternative revenue enhancing mechanisms such as VAT apportionment issues, and improved collections methods for both rates and taxes as well as electricity. Because when done properly, these are normally good sources of revenue needed by municipalities. The municipality should, as part of enhanced revenue collection initiatives, make sure that proper property valuations are undertaken periodically to make sure that they are charging the right rates and taxes all the time as this will enhance their cash flow position. The Municipality should also consider institutional challenges that could result in the underspending of capital budgets, as underspending is detrimental to service delivery and funders alike. Municipality should engage a service provider to assist with these alternative revenue enhancing mechanisms.

- The Municipality should start looking at various private sector funding programs both locally and abroad. Programs such as **Public-Private Partnerships (PPPs)** are funding options which are available to leverage private sector funders and skills. This would provide an opportunity for the Municipality to enter into long term concession agreements to Design, Build, Operate and Finance projects but will require alignment to National Treasury procurement processes. In addition, PPPs are mostly suited to large projects. The Treasury Act allows municipalities to issue debt instruments such as Municipal Bonds to finance their capital expenditure. However this goes with good corporate governance, good risk management as well as a healthy balance sheet and cash flows. In line with debt funding through the issuance of Municipal Bonds, we recommend that the Municipality should check with National Treasury if they could enter into private placement programs (PPP). These are other sources of funding with first-tier international banks which could be utilized to secure funding for infrastructure and the introduction and development of mega industries within the municipality. Industrial development of the municipality will, in addition, assist municipality with more revenues as more people will be residing in the area and paying for rendered services. We recommend that Midvaal Local Municipality should consider this other funding routes. Since these are specialized funding methods, the services of the professional service provider will be necessary.
- The President of the Republic has established a program called the **Sustainable Infrastructure Development Program for South Africa (SIDSA)**, previously headed by Dr Ramokgopa, the former Mayor of Tshwane Metro now appointed as the Minister of Electricity.



The aim of the Sustainable Infrastructure Development Program for South Africa (SIDSA) is to assist the South African Government in addressing its Medium Term Strategic Framework and the Strategic Development Plan which seeks to improve the conditions of life of South Africans by addressing poverty and unemployment, as well as contributing to enhancing regional economic integration in the South African Development Community (SADC) Region.

In his opening statement when launching the program, the President of the Republic said

“Government will consider adopting policies that have a short-term impact on job creation and trade to facilitate economic recovery from the COVID-19 pandemic. We are deliberating stimulus packages that boost the government’s infrastructure spending in projects that reactivate the economy; creating financing instruments that provide liquidity, bridge financing, or debt restructuring instruments as well as guarantee products and funds. The SIDSA process has prioritized the network industries, namely: energy, water, transport and ICT infrastructure for investment. These sectors have proven to have a superior multiplier effect, introduce greater efficiencies in the economy, lead to spatial justice, and have the capacity to adsorb supply-side skills....”

Given the above statement by the President, we advise that perhaps Midvaal Local Municipality should, through the provincial office, apply for such funding from SIDSA. We are aware that provinces are submitting their respective proposals for infrastructure funding through to SIDSA and some provinces are lacking behind in submitting theirs.

I.20 SUMMARY AND FURTHER RECOMMENDATIONS

In summary the following is a list of possible funding avenues to be explored by Midvaal LM, Roads and Stormwater related projects:

- DBSA (Development Bank of South Africa), the municipality can approach DBSA to assist with some of the required funding.
- With the help of professional service providers Municipality should consider projects which could be financed through Public Private Partnerships (PPPs),
- We recommend the Municipality apply for an Infrastructure Skills Development Grant (ISDG), as this will help both by employing interns and reducing unemployment.
- Because Midvaal Local Municipality’s jurisdiction encompasses a large rural footprint, it will qualify for Rural Roads Assets Management Systems Grant (RRAMS), we therefore recommend that the municipality apply for such funds.
- We recommend the municipality approach local commercial and Private Banks (First National Bank, ABSA, Standard Bank, etc.) to establish possible long-term funding, even though our banks are very strict and no-flexible.
- We recommend the Municipality to check with National Treasury if they would be allowed to get funding through private placement programs with international first-tier banks etc.
- Municipality collects and pays a lot of VAT (input and output tax), perhaps it is time to start engaging the services of a tax expert to assist in claiming such funds from SARS. The focus should be on finding innovative ways of assisting municipalities in identifying risk, optimizing VAT recoveries and minimizing unnecessary VAT leakage. Maybe permission should be obtained from Treasury as there was a moratorium on this exercise in some other municipalities due to abuse.
- Start engaging the services of the service provider to put together an enterprise-wide revenue enhancement framework which will help to improve municipal revenue (these will include: collection, property valuations, etc.).
- Municipality should consider issuing a debt instrument after improving and/or implementing good corporate governance and risk management.



- It is highly recommended for the Municipality to see if SIDA can fund some of the infrastructure in this report.
- Cooperative Governance and Traditional Affairs (Vote 4), Schedule 5, Part B, offers Infrastructure Urban Development Grant (IUDG) to municipalities the purpose of which is:
 - a) To support spatially aligned public infrastructure investment that will lead to functional and efficient urban spaces and ultimately unlock growth;
 - b) To provide funding for public investment in infrastructure for the poor and to promote increased access to municipal own sources of capital finance in order to increase funding for public investment in economic infrastructure;
 - c) To ensure that public investments are spatially aligned and to promote the sound management of the assets delivered. We therefore recommend that Midvaal Local Municipality should consider applying for such grants as they will assist a lot in the infrastructure development program.

The funding to be sourced will address all capital expenditure including plant and machinery where necessary. The funding will come in different forms depending on the funding institution, e.g. It could be loans, grants, investments or hybrid and each will come with its own terms and conditions which may not be the same. If it happens to be loans, bank/funders charge different rates to different customers depending on the banks' policy and risk classification of the customer, e.g. it could be from prime+, or from LIBOR or EUBOR. Overseas institutions usually don't go beyond 5% on their rates.

I.21 FUNDING POSSIBILITIES FOR PROCUREMENT OF PLANT

In summary, the following is a list of possible funding avenues to be explored by Midvaal LM, procurement instead of plant rental:

- DBSA (Development Bank of South Africa),
- Sedibeng District Municipality,
- Private Banks (First National Bank, ABSA, Standard Bank, etc.).
- Plant manufacturers (Sales agreement)

I.22 LOAN REPAYMENT ANALYSIS

The report makes the following projected loan repayment of Projects, based on a preliminary analysis.

Annual interest rate: 7.0%

Loan period of: 5years

Number of Payments per annum: 12

Start date of loan: 03 February 2025

See below figures which indicate the Loan Repayment value for an example **Rural** project:

Rural Development			
EntreValue		Loan Summary	
Loan Amount	R 5312 400.00	Scheduled Payment	R 105 191.89
Annual Interest Rate	7.00%	Scheduled Number of Payments	60
Loan Period in Years	5	Actual Number of Payments	5
Number of Payments Per Year	12	Total Early Payments	R -
Start Date of Loan	03/02/2025	Total Interest	R 8 582.38
Optional Extra Payments	R -		
		Lender Name: Midvaal Local Municipality	
		Project Name: Midvaal Road Upgrade	
		Town: Sicelo	
		Ward No.: WARD 10	



See the below figures which indicate the Loan Repayment value for an example **Urban** project:

Urban Development		
Entre Value	Loan Summary	
Loan Amount R 8592 731.48	Scheduled Payment R 170 146.38	Lender Name: Midvaal Local Municipality
Annual Interest Rate 7.00%	Scheduled Number of Payments 60	Project Name: Midvaal Road Upgrade
Loan Period in Years 5	Actual Number of Payments 3	Town: Meyerton
Number of Payments Per Year 12	Total Early Payments R -	Ward No.: WARD 3
Start Date of Loan 03/02/2025	Total Interest R 5 817.79	
Optional Extra Payments R -		

I.23 LOCAL GOVERNMENT BUDGETS AND EXPENDITURE REVIEW

Funding and expenditure on road infrastructure and maintenance. Funding the municipal roads network. Municipalities receive intergovernmental transfers in line with the Division of Revenue Act and this includes the local government equitable share, which is an unconditional grant. Municipalities might therefore decide to use a portion of the local government equity share to finance road infrastructure projects, guided by their own needs and priorities. Municipal internally generated funding should also be used to finance road infrastructure.

For many municipalities, the most significant source of road infrastructure funding is the municipal infrastructure grant (MIG). The grant is aimed at assisting municipalities to deliver basic infrastructure to poor communities. Another major source of funding for road infrastructure at the municipal level is the public Transport Infrastructure and systems grant (PTIS), which is a conditional grant administered by the Department of Transport. The grant provides for the planning, establishment, construction and improvement of new and existing public transport infrastructure and non-motorised transport infrastructure systems.

For many of the poor and rural municipalities, the public works programmes implemented by both national and provincial departments of public works serve as an important means of developing roads within their jurisdictions.

I.24 Municipal expenditure on road infrastructure and maintenance

Maintaining the municipal road infrastructure includes routine maintenance, upgrading and rehabilitation activities, all of which require planning and adequate budgets. It is difficult to get a clear picture of consolidated municipal expenditure on road infrastructure (including stormwater infrastructure) and maintenance, due to the previous budgeting reporting formats.

I.25 Policy and funding developments in the roads sector

In the execution of its mandate, the Department of Transport has identified the following strategic priority outcomes and key policy developments for the medium term in relation to roads:

- *Development of an effective and integrated infrastructure network that serves as a catalyst for social and economic development:*
This will be achieved by ensuring maintenance and the strategic expansion of the road network.



- *Development of road asset management and preservation policy:*

This will begin to effectively support the implementation of the road infrastructure strategic framework of South Africa. Furthermore, it will ensure that road authorities conduct road condition surveys regularly and use road asset management systems in planning for investments. This will allow optimum decisions to be taken on increasing the asset lifespan of roads, reducing transport costs, and improving accountability and expenditure outcomes.



CHAPTER J : REGISTRATION OF MIG PROJECTS

J.1 INTRODUCTION

As part of Contract 352/2022 for the compilation of the Roads and Stormwater Master Plan for the Midvaal Local Municipality (MLM), the PSP (Infraconsult Engineering) were tasked to identify three (3) projects and achieve Notice of Registration with the Municipal Infrastructure Grant (MIG).

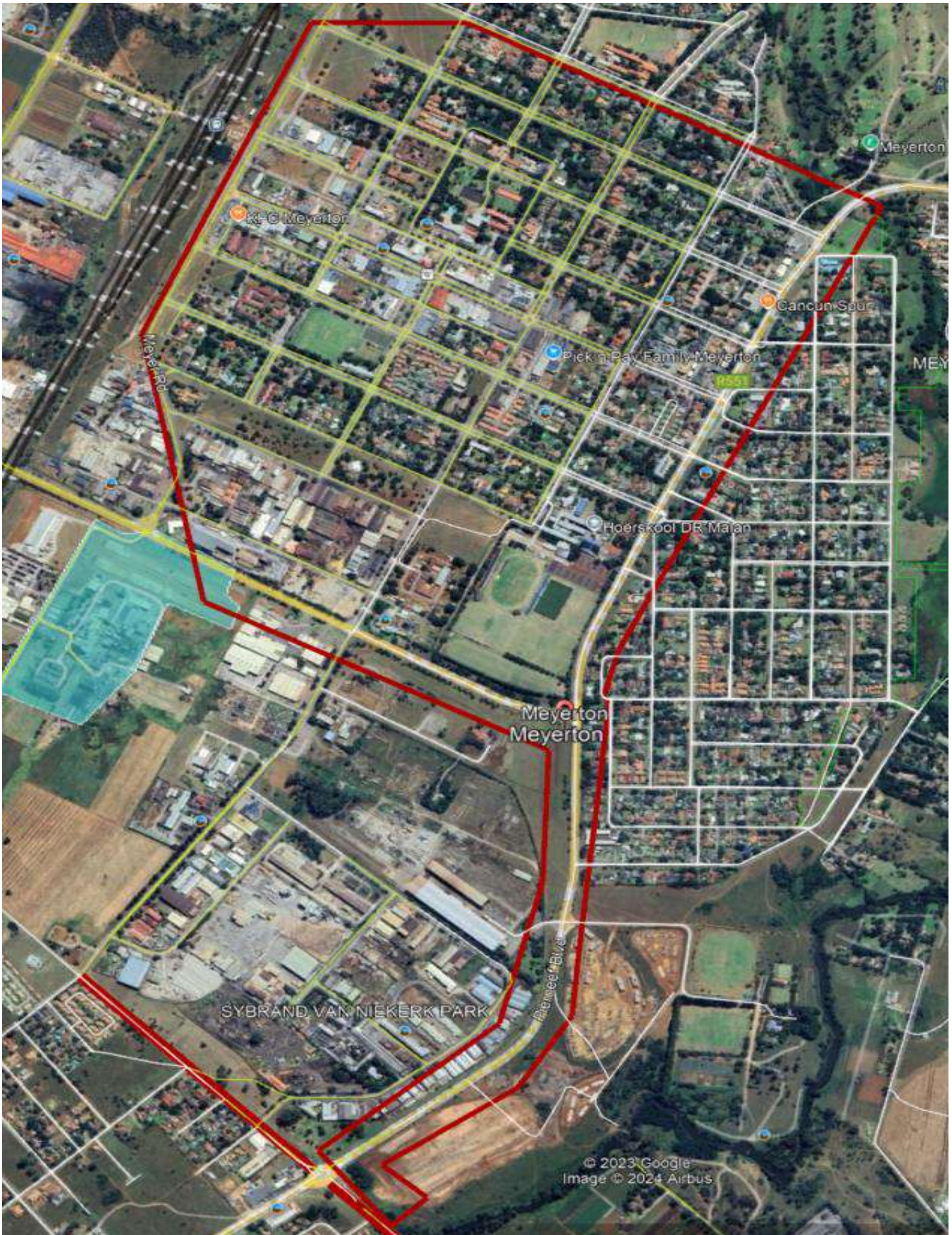
Therefore, the PSP indicated around 25 priority projects within the future demand assessment report that was discussed in PSC meeting no. 06.

Midvaal Local Municipality then indicated 3 priority projects as follows:

- WARD 6 Lakeside Stormwater Open channel/Culvert System
- WARD 14 Meyerton Intersection at DR Malan High School Stormwater System
- WARD 1 VAAL MARINA Entrance Road Upgrade



Priority 1: WARD 6 Lakeside Stormwater Open Channel/Culvert System



Priority 2: WARD 14 Meyerton Intersection at DR Malan High School



It is herewith recommended that Midvaal Local Municipality consider the above proposal by the PSP and advise on the way forward for possible implementation upon consultation with both the sponsor (DBSA) and PSP.



CHAPTER K OPERATIONS AND MAINTENANCE PLAN

K.1 INTRODUCTION

An Asset Maintenance Plan is a strategic document which contains a systematic approach towards the maintenance of Midvaal Local Municipality Roads and Stormwater assets in-order to increase and enhance the effective use of the municipality's physical assets.

Through effective maintenance, the risk of future financial burdens and operational malfunctioning of municipal assets will be minimised. Poor maintenance of assets results in unavoidable damages and deterioration of the asset condition and, as a result major repairs or to some extent capital replacement of the asset is required. Neglect of maintenance obligations can also give rise to safety hazards and the municipality may be found legally liable for any injuries and damages to citizen's properties.

Thus it is believed that through regular expenditure of small amounts of repairs and maintenance funds will optimise the expected useful life of Infrastructure Assets and thus become cost-effective than large injections of capital every 3 years or more towards capital replacement of assets due to unplanned and or lack of maintenance.

K.2 SCOPE OF THE MAINTENANCE PLAN

The Asset Maintenance Plan applies to municipal building assets with associated fixed plant and equipment. It includes building fabric and structure, fixed plant and equipment that are part of a building's services, civil works (roads & paved areas) and site services (electricity and storm-water drainage systems).

The Asset Maintenance Plan only applies to immovable assets for which Midvaal Local Municipality have been assigned responsibility and ownership. It does not apply to site services owned by the District Municipality (Water Services Authority) and movable assets.

Immovable assets are commonly described as "infrastructure assets". While there is no universally accepted definition of infrastructure assets, these assets usually display some or all of the following characteristics:

- (a) they are part of a system or network;
- (b) they are specialised in nature and do not have alternative uses;
- (c) they are immovable; and
- (d) they may be subject to constraints on disposal.

K.3 ROADS MAINTENANCE PLAN IMPLEMENTATION STRATEGY

K.3.1 Introduction

Road maintenance is essential in order to preserve the road in its originally constructed condition, protect adjacent resources and user safety against road hazards that may arise due to poor maintenance and provide efficient, convenient & smooth travel along the road. Improper maintenance may result in rapid deterioration of the road structure and ultimately collapse to a point requiring a total reconstruction.

K.3.2 Road Maintenance Types

Effective maintenance is achieved through efficient scheduling of resources, proper planning and application of road maintenance types. These road maintenance types are classified as follows:



- **Routine Road maintenance** – refers to the day-to-day operational activities to keep the asset in a smooth and trafficable operational manner (repair of potholes, surface crack repairs, cleaning of drains, repairing leaks, etc.) and forms part of the annual operating budget.
- **Preventative Road maintenance** - Its purpose is to extend the life of the road and to keep it looking and riding, as much as possible, in like-new condition. The work performed under the preventive maintenance program is called chip sealing, slurry sealing and resurfacing. The purpose is to stop water from entering the roadway, which causes early breakup of the road surface. The useful life of roads can be extended from 20 up to as much as 100 years if, on a regularly scheduled basis, small breaks are fixed and a seal coat or resurfacing is done before more severe damage occurs.
- **Special maintenance** – is mostly applicable when a portion of the road structure or surface requires total reconstruction even though it may still be within or not even close to 50% of its remaining useful life. This usually occurs due to the failure of underlying layers and underground water rising which results in surface layer pumping.
- **Reconstruction/rehabilitation maintenance** - reconstruction involves removing the entire portion of the roadway and replacing it with new layers. This maintenance activity usually occurs when the condition of the roadway or street reaches a point where preventive maintenance is no longer cost-effective. – Access roads that are totally dilapidated.

The applicable road maintenance type should be performed prior the road begins to break up even when the road surface is still in good condition.

K.3.3 Community Awareness and Road Maintenance

Road users and respective communities have a vital role towards preserving the road network infrastructure from being damaged through unattended oil & diesel spillages, fire burning and illegal diversion of surface stormwater runoff. Therefore, providing general awareness to the public on the value and importance of preserving the roads network infrastructure is essential towards ensuring that the design lifespan (expected useful life) is not disturbed or reduced.

K.3.4 Road Maintenance Legislative Requirements

The Road Management Act 2004 requires the Council in this case Midvaal Local Municipality (the Road Authority as per section 37 (1), ii - iv) to inspect, repair and maintain Public Roads (section 40) for which it is the Road Authority.

This applies to any part of a public road which is:

- a roadway,
- a pathway,
- a road shoulder, or
- road infrastructure, for which the Council is the Road Authority.

The municipality as the Road Authority may in terms of:

- Section 41 (1) determine the standard to which it will construct, inspect, maintain and repair its road infrastructure. In relation to inspections, it may also determine the inspection intervals.



- Section 41 (2) (c) in relation to maintenance determine the maintenance programs, the maintenance work to be performed in the course of regular maintenance and the standard to which the maintenance is to be performed.
- Section 41 (2) (d) determine in relation to the repair of defects reported or found on inspection.
- Section 41 (3) may during the undertaking of the above actions conduct repairs, erect warning signs or reduce or remove risk.

K.3.5 Successful Implementation of a Routine Road Maintenance Plan

The Routine Road Maintenance Plan establishes key routine road maintenance practices for Council managed roads including:

- Current Maintenance Situation
- Complaints
- Inspections
- Emergency Works
- Responsive Maintenance (Gravel Roads)

K.3.5.1 Current Maintenance Situation

The municipality is currently experiencing a huge backlog on road maintenance to the extent that some of the roads have reached their lifespan. The backlog is gradually being addressed through capital funds and MIG.

The municipality should develop a Roads Maintenance Programme which is mostly affected by emergency response due to the current maintenance backlog and recent floods that have greatly damaged most of the municipal gravel roads. This is due to the Municipal Area being prone to flooding and lack of a proper storm-water drainage system. Therefore, the current response is mainly to address emergency and corrective maintenance including response to community complaints.

The latter plant & equipment are in fairly good condition but inadequate to meet the current road maintenance demand and backlog.

The municipality is currently having under its plant and machinery ownership as shown below:

**Table 60: Midvaal Local Municipality Current Plant List****Midvaal Local Municipality Current Surfaced Plant and Operators List**

NO.	DESCRIPTION	REGISTRATION / ASSET NUMBER	ODOMETER / HOUR METER READING	WORKING? YES OR NO	STATUS / REMARK
1	UD - 6m ³ Tipper Truck	VCG483GP	-	NO	WORKSHOP
2	UD Single Cab 4 Ton truck	PYG439GP	-	NO	WORKSHOP
3	UD Single Cab 4 Ton truck	TKT539GP	-	NO	WORKSHOP
4	Nissan Single Cab LDV	RXL266GP	-	NO	WORKSHOP
5	Hino Single Cab 4 Ton truck	BY51GPGGP	132406	YES	SKEW BACK BUMPER. EXHAUST BRAKE NOT WORKING
6	CAT TLB	DC26RKGP	-	NO	WORKSHOP
7	Isuzu Double Cab Tipper 4 Ton truck	DK76BPGP	-	NO	WORKSHOP
8	Isuzu Water Bowser truck 12 000 litres	FC74YVGP	108780	YES	REAR TYRE WORN. CRACKS ON WINDSCREEN
9	Isuzu Single Cab LDV	FT60JFGP	154435	YES	BROKEN BRAKE LIGHT COVER. CRACKS ON WINDSCREEN
10	Bell motor grader	HG18ZSGP	5231,2	YES	ONE LIGHT NOT WORKING
11	Isuzu Single Cab bakkie	HK38WSGP	109047	YES	BROKEN BRAKE LIGHT COVER.
12	Isuzu Double Cab 4 Ton truck	HL33VVGp	71410	YES	SEAT COVER DAMAGE. CRACKS ON WINDSCREEN.
13	Isuzu Double Cab 4 Ton truck	HX60LMGP	63495	YES	DAMAGE ON BACK BUMPER. 2 X INNER TYRES WORN.
14	MAN Water Bowser Truck 12 000 litres	HH59VHGP	-	NO	REAR TYRE WORN. WHEEL ALIGNMENT AND BROKEN STEPS ON LEFT
15	CAT TLB	JR21RKGP	237912	YES	BROKEN WINDOW ON RIGHT SIDE. BROKEN BRAKE LIGHT AND OLD BUCKET BUSHES
16	Nissan NP200 LDV	KD77DNGP	41365	YES	LOOSE BUMPER ON RIGHT SIDE. BROKEN BRAKE LIGHT COVER ON RIGHT.
17	Ford Ranger Double Cab	KC18VSGP	058475	YES	PLUG CUP BROKEN. CRACKS ON WINDSCREEN
18	Isuzu Double Cab LDV	KR10RJGP	28150	YES	
19	Trailer	HL69LDGP	-	NO	BROKEN TOWBAR. NO JACKWHEEL. PUNCHER ON RIGHT. NO DISC.
20	Trailer	SJC459GP	-	NO	NO JACKWHEEL AND DISC
21	Trailer	PKX197GP	-	NO	NO LICENSE DISC. NO JACKWHEEL AND CHEVRON
22	Trailer	HL69KTGP	-	NO	NO JACKWHEEL AND LICENSE
23	Trailer	HL69KMGP	-	YES	NO JACKWHEEL
24	Trailer	FV24ZVGP	-	NO	NO JACKWHEEL AND LICENSE DISC
25	Trailer	WZS654GP	-	NO	FADED NUMBER PLATE. PUNCHER ON LEFT SIDE. NO JACKWHEEL AND DISC.
26	Trailer	DD72RDGP	-	NO	NO DISC
27	Old Road Marking Machine	88370	-	NO	WORKSHOP
28	New Road Marking Machine	92531	-	YES	

Midvaal Local Municipality Current Surfaced Plant and Operators List**K.3.5.2 Inspections**

The Municipality should develop a systematic inspection process, including unscheduled inspections in response to the community's advice these are conducted routinely after heavy or consistent rains; on call from public; emergency inspections.

The inspections will identify defects and key maintenance items such as storm defects or lack of stormwater infrastructure.

The maintenance items identified will be assessed, prioritised and added to maintenance works programs, to ensure that the high-risk maintenance items are attended to in order of priority, taking into account road hierarchy and traffic volumes.



Table 61 : Priorities vs Response Times

Priorities	Incidents	Response time	Completion
Priority 1 (Emergencies)	• endanger life or represent a serious health & safety risk • cause serious disruption to the operation of a building • cause extensive damage to property	12 Hrs	48 Hrs
Priorities	• Incidents	Response time	Completion
Priority 2 (Urgent)	• represent a lesser health & safety risk • cause disruption to the operation of the building/business • cause minor damage to property	48 Hrs	4 Days
Priority 3 (Routine)	Incidents that are routine or non-essential in nature and can normally be undertaken at any time.	7 Days from Issue	14 Days from Issue

The Municipal Road section staff will report any risk or maintenance issues they may observe as they move around the Municipality in the course of their duties. Municipality's inspectors will respond to urgent works generally within the most appropriate time upon receipt of a report.



Assessor		Date		Ward	
Village		Street name		Coordinates	
Type of area		Road type		Length of road (Km)	
COMMENTS ON THE GENERAL DESCRIPTION OF THE ROAD					
Road Profile	Is it very good (<2%) or good (>2%) or flat or uneven or very uneven.			Provide description	
Drainage from the road	Is the road above or level or below ground level				
Description of the problem/ sketch plan/ attach photo					
Recommended remedial actions					
PROPOSED MAINTENANCE CATEGORY: Specify _____ Backlog Maintenance: maintenance that is necessary to prevent the deterioration of the asset. Corrective Maintenance: the actions performed, as a result of failure, to restore an item or asset to its original condition, as far as practicable. Planned maintenance: maintenance work to prevent failure of the asset during or within its life cycle. Preventive Maintenance: the actions performed to retain an item or asset in its original condition as far as practicable by providing systematic inspection, detection and prevention of incipient failure. Emergency corrective maintenance: is outside routine maintenance and works programs that must be initiated immediately for health, safety, security, hazard reasons or that may result in the rapid deterioration of the property plant or equipment if not undertaken. Deferred Maintenance: maintenance planned to be carried out in the current financial year but due to shortage of funds or unforeseen circumstances is not carried out and added to the Backlog Maintenance awaiting attention.					
Projected timelines of response:					
..... Signature by Assessor			 Signature by Manager		
..... Date			 Date		

Figure 80: Inspection Sheet Example

K.3.5.3 Complaints

Complaints and reports from the community should be recorded on a Complaints Register. A qualified or competent road official should be assigned to conduct a visual inspection to determine the extent of damage or defect within 3 working days. See the example of a Complaints Register Template below.



Table 62 : Complaints Register Template

No	DATE RECEIVED	INITIALS & SURNAME	CONTACT	COMPLAINT	ASSIGNED OFFICIAL'S NAME	START DATE	DURATION (DAYS)	DATE COMPLETED

K.3.5.4 Emergency Works

Emergency works will among other things include traffic incidents management, floods, storms and potential spillages (oil & diesel) that may undermine and damage the surface layers.

The response to emergency work shall take precedence over some of the activities planned on the Roads Maintenance Programme including inspections and may to some extent affect the timeframes set on the approved Roads Maintenance Programme.

K.3.5.5 Responsive Maintenance (Gravel Roads)

Responsive maintenance is performed in response to received community complaints, municipal staff reports and others. This method of maintenance takes precedence in the Rural areas consisting of large extents of gravel roads.

K.3.6 Successful Implementation of a Routine Stormwater Maintenance Plan

K.3.6.1 Introduction

Technical Services Division or Directorate of Midvaal LM undertakes the function of inspecting and maintaining all the municipal owned stormwater systems within the municipal area. The droughts and floods have increased in frequency with greater volatility in weather patterns which leads to stormwater facilities requiring more frequent unblocking.

Technical Services of Midvaal Local Municipality has the:

- Right of entry on any property within its jurisdictional area to perform safety inspections of potential flooding.
- Right to question and take steps to prevent illegal activities by citizens that may lead to stormwater control and management being jeopardised and as a result causing flooding to municipal and privately owned properties.

K.3.6.2 Understanding the Status Quo of Midvaal LM

The Roads Technician & Team Supervisor of the Technical Services Division or Directorate takes full responsibility towards the management of inspections and maintenance of the components that make up the drainage system of Midvaal Local Municipality. This process also includes the removal of manmade obstructions that prohibit smooth flow of stormwater runoff.

K.3.6.3 Stormwater Infrastructure inspections

Subsurface System Inspections

- Inspection of the subsurface system will determine what repair or maintenance is needed.
- Inspection and cleaning will typically be performed at the same time.
- The condition of associated structures will be evaluated, and the information will be reported to the Technical Manager.



- Repairs or replacement will be scheduled and performed as per the departmental Stormwater Maintenance Programme
- Removal of miscellaneous debris and sediment will be performed at the time of the inspection or will be scheduled for completion in a timely manner.

Surface System Inspections

- Inspection of the surface system will include functional and aesthetic needs.
- Functional maintenance is important for performance and safety reasons.
- Aesthetic is important primarily for public acceptance of stormwater facilities.
- The removal of debris, sediment, overgrown or weedy vegetation and erosion conditions will be evaluated and rectified accordingly.
- Conditions of structures such as inlets/outlets, culverts, causeways, gabion structures, concrete dish drains and associated head walls will be evaluated and reported to the Technical Manager if corrective action is required.

Table 63 : Stormwater System - Frequency of Inspections

SYSTEM CATEGORIES	DESCRIPTION	INSPECTION & MAINTENANCE TYPE	FREQUENCY
Manholes (Catch-pits)	A manhole is a structure that allows access into a closed conduit. Manholes can be located in the roadway and greenbelts areas of a development.	• Inspect for damaged or missing block and mortar • Inspect for debris within the structure • Typical cleaning • Problem areas as determined by the Municipality shall be cleaned	Annually/after heavy rains
Closed Conduit	A closed conveyance designed to carry stormwater runoff, which includes culvert, closed drains and pipes.	• Typical cleaning of closed drains and stormwater pipes ranging from 300mm to 1200mm in diameter. • Culvert cleaning • Video inspections (<i>Future capital plans</i>) • Problem areas as determined by the Municipality shall be cleaned	Annually & in response to blockages/ after heavy rains
Basin Outlet Structures	Outlet structures are used to regulate storm water discharge from detention ponds & basins into receiving waterways or an offsite storm system	• Check inlets and outlets for clogging • Clean inlets and outlets as necessary. • Remove sediment if accumulation reaches 1m & above or if re- suspension is observed • Inspect pipes to verify that the outlet is not damaged	Annually & when necessary/after heavy rains
Gutters & kerbing	Are located in paved/surfaced roadways to convey stormwater into manholes, catch basins & other associated inlets.	• Inspections for debris, sand, leaves and any other sediment types. • Street and kerbing sweeping • Replacement of damaged sections and kerbing.	In conjunction with Roads Maintenance Programme or other



K.3.6.4 Emergency Works

Disaster management/ community services jointly with Technical Services takes the responsibility for responding to Emergency Requests for assistance with drainage problems, such as flooding, on municipal and private properties within a reasonable period not exceeding 24 hours.

K.3.6.5 Complaints

Complaints and reports from the community should be recorded on a Complaints Register. A qualified or competent road official should be assigned to conduct a visual inspection to determine the extent of damage or defect within 3 working days. See the example of a Complaints Register under Routine Road Maintenance.

CHAPTER L : IMPLEMENTING A PAVEMENT MANAGEMENT SYSTEM (PMS)

L.1 INTRODUCTION TO PMS

A road network needs to be regularly assessed and maintained to meet the needs of the road user as a safe and efficient means of travel. Neglect to do so will result in not only loss of life, injuries and damage, but also increased vehicle operating costs leading to spiralling consumer costs and inflation. The effect of a deteriorating road on the cost of operating a vehicle is illustrated in the graph below. Research carried out in SA and abroad has also demonstrated that delaying road maintenance is false economy, because the longer such maintenance is left undone, the higher the eventual cost to restore the road to an acceptable condition. An essential tool and systematic procedure specifically intended to assist road authorities in optimising the maintenance of their road networks is a PMS.

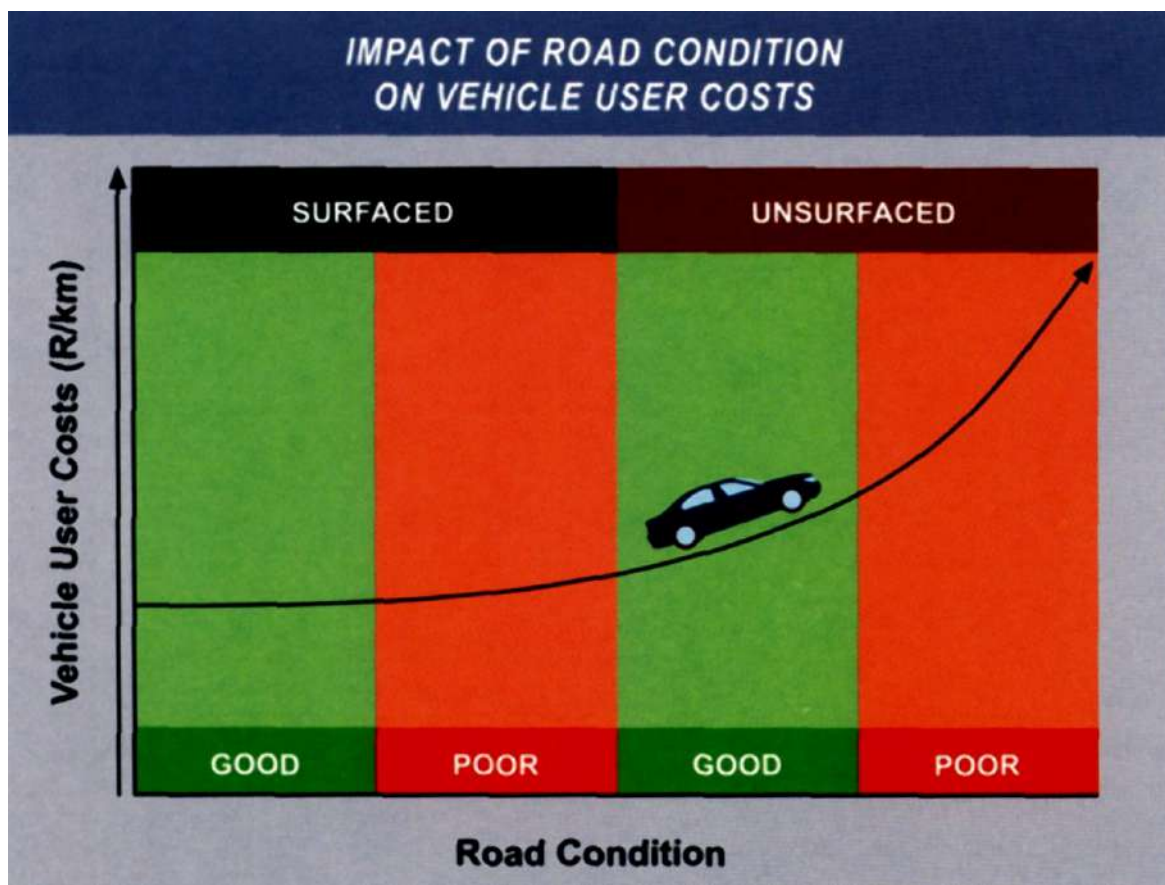


Figure 81: Impact of Road condition on vehicle user costs (Sabita Info Sheet #8)

L.2 PMS AS PART OF A ROAD MANAGEMENT SYSTEM (RMS)

The Technical Recommendations of Highways (TRH) or TRH22 of 1994 defines a Road Management System (RMS) as a set of procedures aimed at maximising the of a road network.

These procedures are used by the managers of the road network, with the aid of computerised facilities, to produce information and evaluate alternative strategies in a specific analysis period and to incorporate feedback mechanisms regarding the various attributes, criteria and constraints involved in optimising the following:

- Maintenance of existing facilities.
- Improving facilities to required standards (according to changing circumstances and demands).
- Establishing new facilities when needed.



L.3 RMS SUBSYSTEMS

The planning function of management is addressed by the Road Management System, which comprises the following main sub-systems (Report 589/1, 1989):

- Pavement Management System (PMS).
- Geometric Management System (GMS).
- Gravel Road Management System (GRMS) & Unpaved Road Management System (URMS)
- Maintenance Management System (MMS).
- Bridge Management System (BMS).
- Traffic counting procedures and systems.
- Accident reporting procedures and systems.
- New road management system. (i.e. system of planned new roads with priorities)

L.4 DEFINITION OF PMS

A PMS can be defined as the systematic and effective definition of the state of a collection of roads and a coordinated set of activities, all directed toward achieving the best value possible for the available public funds in the interests of and economical transport by road.

L.5 PMS COMPONENTS

Most formal definitions of a PMS agree on the following key components:

- **Road Inventory.**
The fundamental framework of a PMS is a description of the road network, including road status and function, the pavement structure type, usage (traffic) and past surveillance and action programmes.
- **Pavement condition surveys.**
Regular, planned inspections of the road surface to record items such as the riding quality (evenness) of the road surface, and the degree and loss of texture all of which will facilitate the timely and appropriate remedial or pre-emptive actions to be adopted.
- **Database for recording all related pavement information.**
Databases should enable the orderly storage and retrieval of information in formats that will facilitate analysis of the performance of the network and, hence, appropriate intervention programmes.
- **Analysis scheme.**
Analysis schemes are those rules used to interpret data in meaningful ways. Outputs would typically comprise performance prediction, life-cycle costing analysis and optimisation of rules.
- **Decision criteria.**
Decision criteria are those rules developed to guide pavement management decisions. As PMS has evolved, decision criteria have become more complex and now account for items such as user delay, vehicle operating costs and, in limited cases, environmental and societal effects.
- **Implementation procedures.**
Implementation procedures are those methods used to apply management decisions to roadway sections.

L.5.1 PMS Road Inventory

Certain road inventory information could be recorded or verified on site for each segment. This information is fully described in TMH 22 and may include the items described in **Table 64** below.

These items are necessary to be included in a GIS Database.



Table 64: PMS Road Inventory items

ITEM	DESCRIPTION
Road Number / Road Name:	Rural: MR16 (Main Road 16) Urban: Nelson Mandela Drive
Section Number / Link:	Rural: MR16/10 (Main Road 16, Section 10). Urban: A link is usually the length of road or street from one intersection or interchange to the next.
Segment Start and End:	Rural: Start and end distance of the segment for which one assessment rating (See Table A.3) is recorded, to the nearest 0.01 km. Urban: Physical description of the segment start and end points i.e. street names (if no kilometre distances are available)
Name of Assessor:	Used for quality assurance purposes.
Date:	Date of the assessment YYYY/MM/DD
Segment Length:	Length of segment to the nearest 0.01 km. Urban: length is measured from mid intersection to mid intersection.
Segment Width:	Average width recorded to the nearest 0.1m. For unpaved roads, the width of the travelled way must be recorded.
Untraveled Way Width:	The average width of the untraveled way must be recorded to the nearest 0.1m.
Start Time:	Time at start of the assessment for the road number.
End Time:	Time at end of assessment for the road number.
Direction of assessment:	Rural: Direction of Increasing or decreasing kilometres. Urban: North / East / South / West
Road Classification:	The road is classified according to the TRH 26 RCAM.
Ownership:	The level of authority being National, Provincial or Local.
Terrain:	Flat - The route mostly follows level areas with few inclines and grades less than 3%. Rolling - Grades are approximately 4% -7% with some curves. Mountainous - Grades are typically more than 7% with numerous sharp curves.
Node Type	Intersection: X , T-Junction: T , T-Junction Left: TL , T-Junction Right: TR , Towns/Villages: V , Change of Pavement: CP , Start of Paved Segment: SP , End of Paved Segment: EP , Borders/Boundaries: BO , Max. Segment Length used as segment end: MX , No Node- Start of Segment: ST , No Node – End of Segment: EN

L.5.1.1 Segment Lengths

It is not the purpose of the assessment to identify uniform sections of distress on the road and to complete an assessment form for each of these uniform sections. The road network should be evaluated according to the standard segment lengths that are given it is recommended that the authority predefined segments over their complete network, and not leave this to the individual assessors. This will ensure improved consistency from one assessment to the next.



Table 65: Segment Lengths for Different Road Pavement Types

Type of Road Pavement	Standard Assessment Length (km)	
	Rural	Urban
Flexible	2.0	Block lengths (max 0.5 km)
Concrete	0.2	0.2
Block	0.2	0.2
Unpaved	5.0	Block lengths (max 0.5 km)
Note : Assessment lengths should not exceed $\pm 50\%$ of standard		

L.5.2 Implementing Pavement Condition Surveys

Pavement condition surveys shall be based on Technical Methods for Highways (TMH):

L.5.2.1 Procedure for pavement visual assessment

The procedure for visual assessment is limited by the following criteria:

- Visual assessment should preferably be carried out in or towards the end of the rainy season and in the cooler months.
- Surveys should be completed within limited periods (preferably two to three months). Based on experience the average daily length of survey for rural roads should not exceed 100km for paved roads, 150 km for gravel roads and 20km for urban roads.
- The assessors shall drive at a speed of less than 20km/h, and they shall drive on the shoulder.

Assessments can be carried out by one certified assessor or one certified assessor and an assistant. Assistants should be used when complexity or safety are an issue. If the assistant is a certified assistant assessor, then the assistant assessor is expected to carry out the assessments with the assessor providing guidance and checking quality. The accuracy of the assessor's rating will be influenced by the frequency of stops made to examine the road.

When the road is wet, it is difficult to observe distress, and this leads to erroneous ratings; visual surveys shall therefore be carried out under dry conditions only. Similarly, when a road is under construction, assessment will only be carried out on completed sections of the new road and available portions of the existing road. The reason why certain segments cannot be assessed should be recorded on the relevant assessment form.

During the visual assessment of a segment, dots must be made on the assessment form in the appropriate positions to indicate the degree of any type of distress that is observed. At the end of a segment, these dots are used to mark an average degree and extent of distress for each type of defect. After completing the form, the assessor should also check road segment inventory information.

Paved shoulders (untraveled ways) are inspected as part of the road surface. The assessment should cover the full paved width. On multi-lane roads, the assessment should concentrate on the worst lane, which typically is the slow lane.



L.5.2.2 Training of Pavement Visual Assessors

Training of candidate-assessors must be undertaken before the Visual Assessor Accreditation. This training should be presented by an accredited trainer who have at least 5 years of continuous assessment experience. A list of accredited trainers can be obtained from COTO.

First time candidates wishing to become assessors must have at least 2 years of appropriate road engineering experience and/or an S3 or Further Education and Training (FET) qualification in civil engineering. First time candidates must have a thorough understanding of the manuals before they start the training.

The training programme must include the following theoretical and practical aspects:

- An overview of the objectives of the visual assessment together with a brief description of the data processing procedures and applications of the final results.
- An overview of the method of assessment, including descriptions of various types of distress and ratings for each type. The use of colour slides to show examples is recommended.
- An overview of the format of the assessment sheets.
- The practical training consists of both combined assessments and practical informal testing. Combined assessments should cover three or four segments per pavement type, preferably showing different degrees of distress.

The method of rating should be discussed, and the ratings compared at the end of each segment between candidate and accredited trainer. If a candidate's ratings are not acceptable after these segments, then additional segments should be rated together until there is a thorough understanding of the assessments. Once candidate achieves thorough understanding, then practical informal testing should cover three or four segments per pavement type.

For these sections the candidate and the accredited trainer will individually rate each segment and compare results at end of each segment. If a candidate's ratings are not acceptable after these segments, then additional segments should be rated together until there is a thorough understanding of the assessments.

L.5.2.3 Accreditation of Pavement Visual Assessors and Assistants

A national Visual Assessor Accreditation will be held annually. The accreditation programme will be for each pavement type will include the following:

- A written test to check on the candidates/assessor's knowledge of the standard visual assessment manual. Only candidates/assessors who pass these tests should be allowed to participate in the practical testing.
- The candidates/assessors should individually assess at least 10 road segments per pavement type showing varying degrees of distress. The results of these assessments must be within the criteria prescribed by the trainer.

The accreditation will be for each pavement type and shall remain valid for a 3-year period provided that the assessor successfully carries out regular assessments each year. Only Assessors who have a valid accreditation will be allowed to carry out visual assessments.



L.5.2.4 Procedures to be followed during Pavement Visual Assessments.

The following procedures should be adhered to. This is not a complete list, and the relevant legislation should be complied with:

- Weekly safety checklists.
- Monthly inspections.
- Timely notices of violations.
- Up to date permission forms for accessing roads and using hazards lights and markers.
- Written procedure for routine inspection

- Formal listing of elements that constitute safe driving:
 - Maximum number of hours in a duty period set at 8.
 - Operating times set to between daybreak and sunset.
 - Scheduled breaks every 3 hours.

- Formal elements for vehicle safety:
 - Regular preventative maintenance checks.
 - Regular checks on vehicles' safety equipment.
 - Formal reports to supervisors on any shortcomings.
 - Obeying the rules of the road at all times.

- Formal elements of PPE:
 - Regular checks on the condition of PPE.
 - Routine training of PPE usage.
 - Medical aid kit always available and always kept fully stocked.

L.5.2.5 Equipment and Inventory to be Used During Pavement Visual Assessment

Table 66 outlines the basic equipment needed for visual assessment.



Table 66: Basic Pavement Visual Assessment Equipment

Vehicle Mounted	Comments	Actions
Flashing light	Amber or yellow rotating, strobe or LED light	Beware of slow moving vehicle, which may stop suddenly and unexpectedly
Signs	Black text on yellow background (adhesive or magnetic)	Usually "Road Inspection"
Permission Letter	Letter from relevant authority	Permission to assess roads in a certain area and for a predetermined time
Personal protection equipment	Comments	Actions
Footwear	Closed shoe.	No bare feet to minimise injury and reduce driving accidents
Safety Apparel	High visibility clothing or vests	Worn at all times when inspecting roads to alert road users of pedestrian on travelled way
Equipment	Comments	Actions
Maps of road network	Scale and detail to suit assessments	Size to suit assessments, usually A2 or A3 in size
Measuring Wheel	Short distance, low accuracy measuring	To measure width of road
Screw driver	Road surfacing assessments	Used to extract surfacing stone
Geological pick	Unpaved road assessments	Digging and loosening gravel
Stationery		

L.5.2.6 Visual Assessment of Flexible Pavements

a) Current surfacing

If required by the authority, the assessor records the surfacing type currently visible on the surface by using one of the abbreviations from the shortlist in **Table 67**. If necessary, other codes specified by the individual road authorities could be added to the list.

Table 67: TRH 14 Codes for Different Surfacing Types

Code	Description
AC	Asphalt surfacing - continuously-graded.
AG	Asphalt surfacing - gap-graded.
AS	Asphalt surfacing – semi-gap-graded.
AO	Asphalt surfacing - open-graded.
S1	Surface Treatment – single seal
S2	Surface Treatment – multiple seal
S3	Sand Seal
S4	Cape Seal / Single seal and slurry
S5	Slurry Seal

**b) Macro Texture**

The macro texture, especially the texture depth, plays an important role in skid resistance under wet conditions. The macro texture depends on the aggregate size and the quantity of binder in the layer. The macro texture can be expressed as fine, fine-medium, medium, medium-coarse or coarse, or varying, if it varies across the width of the road.

c) Voids

The size of the aggregate and the quantity of binder have a direct influence on the available interconnected surface voids in a surfacing.

d) Surfacing failures

Surface failure is the loss of the aggregates and binder in the surfacing layer and therefore results in the exposure of the underlying layer. Surfacing failure excludes structural failures.

Typical examples of surfacing failure are surface related potholes caused by:

- Delamination of the surfacing due to surfacing hardening and cracking.
- Loss of the surfacing due to poor seal construction.
- Localised loss of surfacing due to poor bonding with the underlying layer.
- Distress due to salt damage to the surfacing, and
- Mechanical damage.

e) Surfacing patching

Surfacing patching can be described as minor patching with no distinct joint cuts on asphalt patches. Patches that are cut square or with distinct square edges are deemed structural.

f) Surfacing cracks

Surfacing cracking relates to cracking only in the bituminous surfacing. Surface cracks are more commonly found in dense surfacing such as sand seals, slurry seals and are more easily observable on finely textured surfaces.

Surface treatments older than about eight years may have areas of crocodile cracking over most of the road width, especially the fast lane on multi-lane highways. Surfacing cracks are normally not confined to the wheel paths, as is the case with traffic associated crocodile cracks. This behavioural feature should be used to help distinguish surface cracks from crocodile cracks.

g) Aggregate loss

Aggregate loss is the loss of the surfacing aggregate, usually because of traffic abrasion. Aggregate loss is mostly construction related and occurs shortly after construction or during the first cold period/winter due to insufficient binder, wrong grade of binder, contaminated stone aggregates or aggregates with poor adhesion properties.

In the case of thin surface treatments, aggregate loss could eventually result in exposure of the underlying layer (then defined as a surfacing failure), and if this is an unbound base layer, potholing will occur. In the case of asphalt surfacing, the surfacing gradually disintegrates and eventually cracks, spalls, and deteriorates into potholes.

In assessing the degree of aggregate loss, the following must be considered:

- A single surface treatment consists of one layer of single-size stone aggregates and consequently any aggregate loss exposes the underlying layer. In the case of multiple



surface treatments, ravelling is characterised by loss of the fine aggregates on the surface, followed by loss of the larger aggregates in successively exposed layers. Asphalt surfacing's consists of a mixture of aggregates of various sizes and often also include a final layer of pre-coated aggregates.

- Tell-tale signs of aggregate loss can be seen on the side of the road. However, the aggregate at the side of the road may be evidence of previous aggregate loss. The loss of excess aggregate ("over-chipping") should not be regarded as aggregate loss.

h) Binder condition (Dry/Brittle)

Bituminous binders in surface treatments and asphalts become dry and brittle with time. In surface treatments, with relatively thick films, there is an initial loss of the lighter, more volatile oils and aromatics and an increase in oxidation of the surface of the film. These oxidised products partially dissolve in water and tend to shrink, exposing fresh surfaces after each rainfall, allowing the oxidation to penetrate deeper into the binder film.

i) Surface deformation (Shoving)

This is a common defect in urban areas at intersections where acceleration and/or braking forces of trucks cause shoving of the surfacing. Surface deformation can occur in the longitudinal and or transverse directions.

j) Block cracks

Block cracks are normally caused by the shrinkage of treated (stabilised) pavement layers. The cracks are not confined to the wheel paths. The cracks have a definite block pattern, although the longitudinal and transverse cracks do not always meet.

Block cracks do not necessarily indicate a significant deterioration of the pavement, but a potential for deterioration. Traffic action may lead to the formation of secondary cracks, which could eventually lead to severe distress.

k) Longitudinal Cracks

These cracks are not restricted to the wheel paths and may be due to poor construction techniques, settlement of embankments or active clay subgrades. These are line cracks running longitudinally along the pavement. Although these cracks are not normally caused by traffic, traffic action or lack of maintenance may cause them to deteriorate further.

l) Slip Cracks

These cracks are related to the movement of embankments and to embankment foundations. They often occur in circular/parabolic patterns and are not restricted to wheel paths. The cracks may occur at embankments and approaches to bridges and box culverts. These cracks normally require major routine maintenance and, if left unattended, may lead to road failure, especially in the case of high embankments.

m) Transverse cracks

Transverse cracks are line cracks across the pavement. They are often the first manifestation of shrinkage in a cement-stabilised base or subbase. Transverse cracks can also be a sign of temperature-associated fatigue and seasonal effects. They are normally not related to structural problems, but further deterioration of the pavement may occur with the ingress of water through the cracks. These cracks often also occur at drainage structures or where services have been installed subsequent to initial construction by the pavement layers. They could indicate poor compaction of the material in the immediate vicinity of the cracks.



n) Crocodile (fatigue) cracks

Crocodile cracking is often limited to the wheel paths. Crocodile cracks normally occur as a result of fatigue failure of surfacing or base layers and are related to the inability of the pavement to carry the traffic load. They may also occur in the wheel paths of dry brittle surfacing layers caused by traffic action. In such cases there is initially no sign of rutting but this can occur if the cracks permit the ingress of water into the pavement layers. Crocodile cracks also occur in isolated patches where failure is caused by poor drainage and sealed in moisture.

In some cases, crocodile cracking could start as fine, irregular longitudinal cracks in the wheel paths which grow progressively closer and eventually interconnect to form the familiar crocodile pattern. These initially fine, irregular longitudinal cracks should however be classified as longitudinal cracks for the purpose of the assessment. Crocodile cracking also occurs as secondary cracking around primary line cracks.

Surface treatments older than about eight years may have areas of cracking with crocodile pattern over most of the road width, and not just confined to the wheel paths, especially the fast lane on multi-lane highways. In these cases the cracking is more likely surfacing cracking resulting from binder shrinkage. Surfacing cracks are normally not confined to the wheel paths, as is the case with traffic associated crocodile cracks. This behavioural feature should be used to help distinguish surface cracks from crocodile cracks. However, when in doubt, record the distress as crocodile cracking.

o) Pumping

Pumping occurs when pore pressure under traffic loading pump fine material from within the pavement to the surface, normally through existing cracks. Pumped out fines are visible along the cracks on the surfacing and there is usually a thin layer of fines next to the cracks after recent rains. Pumping of fines is affected by rainfall and cracks should therefore be inspected carefully for signs of pumping.

p) Rutting

Rutting results from compaction or deformation through the action of traffic and is limited to the wheel paths. When the rutting is fairly wide and even shaped, the problem is normally in the lower pavement layers. When rutting is narrower and more sharply defined, the problem normally lies within the upper pavement layers.

q) Undulation/ Settlement

Undulation is a wavy form of deformation of the type usually associated with the settlement (especially differential settlement) of embankments at culverts and bridges or mole activity. It is often associated with adverse foundation conditions, e.g. in-situ foundation materials with a slow rate of consolidation or heaving clays affected by changes in moisture conditions.

r) Potholes

Potholes (loss of material from the base layer) refer to structural failures and exclude surfacing failures.

Potholes are generally a secondary form of distress that develops from cracking or extreme loss of aggregate and progress from the top of the road downwards. They are traffic induced and normally develop from structural cracking in the wheel paths. Moisture enters into the pavement resulting in potholes.



s) **Functional Assessment**

Comfort, safety and speed of travel are the variables which define the level of service a road user generally perceives.

The functional features used to define this perception are:

- **Roughness (Riding Quality)**
The roughness of a pavement is defined as the extent to which road users, through the medium of their vehicles, experience a ride that is smooth and comfortable, or bumpy and therefore unpleasant or perhaps unsafe.
- **Skid Resistance**
Skid resistance is the ability of the road surface to prevent skidding when wet, in all manoeuvres executed by vehicles.
- **Surface drainage**
The surface drainage of a road is a measure of the general ability of the road to keep the riding surface clear of water. This is related to the speed at which water runs off during rain and to the extent of the ponding of water during and after rain. It is an important factor which affects the skid resistance and the volume of water sprayed on to other vehicles. The function of good surface drainage is also to keep the road surface clear of grit washed onto the road from the verges.
- **Side drainage**
Although a side drainage problem is not a pavement distress type and therefore not an indication of pavement condition, problems with the side drains could lead to premature pavement failure. Side drainage problems could include overgrown side drains, blocked side drains, or non-existent side drains.
- **Unpaved Shoulder Condition**
The unpaved shoulder is rated in terms of the availability of the shoulder as a safe recovery area. Several problems might render the unpaved shoulder unsafe, for example the erosion of the shoulder by water, wearing out by traffic, level differences between edge of carriageway and shoulder, the width of the shoulder is too narrow, the cross-sectional slope of the shoulder is too steep, or sight distances are obstructed by overgrown vegetation.
- **Edge defects**
Edge defects are more common on narrow roads due to traffic moving closer to the edges, and are categorised as follows:
 - Edge breaks are caused by the breaking away of the surfacing at the outside edges of the surfacing. This is often due to poor unpaved shoulder maintenance.
 - Short transverse cracks are initiated at the edge of the road and migrate inwards.
 - Longitudinal cracking within 300mm of the edge of the road.
 - Drop-off caused by erosion.



L.5.2.7 Visual Assessment of Unpaved Roads

The following items will be used as guidelines pertaining specifically to the visual condition assessment of unpaved roads.

Unpaved roads can be categorised into three types:

- Tracks
- Earth roads
- Gravel roads (formed roads with imported gravel wearing course)



Figure 82: Types of Unpaved Roads

Visual assessments on unpaved roads should preferably be carried out in the dry season, as many of the important defects are not easily identified when the road is wet. During network level assessments, the **assessors should drive at a speed not exceeding 40 km/h** when gathering data and should include at least one stop on each segment for a closer assessment of the material quality, layer thickness and general performance. The assessment of defects is generally restricted to the trafficked portions of the road and excludes the shoulders and windrows left during blading.

Regular assessment of the unpaved road network is required for strategic and tactical planning purposes within the Unpaved Road Management System (URMS).

The following aspects shall be included in the visual assessment of Earth and Gravel Roads:

- **Gravel Quality and Influencing Factors**
The performance of an unpaved road depends primarily on the quality of the gravel used to construct the wearing course. The properties contributing to good gravel are particle size distribution and cohesion. The gravel should have a range of particle sizes ranging from very fine up to about 40 mm in order to provide a strong framework of stones interlocked by a tight matrix of fines. An excessive number of large stones results in poor riding quality and difficulties with maintenance. The fines need to have some plasticity to provide cohesion when dry. However, plasticity should not be so high that the road becomes slippery and impassable when wet.
- a) **Gravel properties**
Evaluation of the gravel quality (to perform well as a wearing course) provides valuable information to estimate specific properties for utilisation in performance models. The minimum requirement is to classify the materials in terms of their appropriateness to carry the load and to provide a good and maintainable wearing course:



- **Maximum Size**
Maximum size refers to the maximum stone size of the wearing course material visible on the surface of the road. The material size categories that are typically used are: > 50mm, 25 – 50mm, 13 – 25mm, and < 13mm.
 - **Grading**
Grading refers to the material classification.
 - **Plasticity**
This is an indication of the amount of clay in the gravel.
- b) **Gravel quantity / Gravel layer thickness.**
The gravel layer thickness is categorised into 5-layer thickness categories.
- c) **Exposed subgrade**
The in-situ sub-grade material is often unsuitable as a wearing course and results in accessibility problems and shear failures. In flat areas, drainage of water away from the road will be retarded.
- d) **Subgrade quality**
Subgrade quality refers to the strength of the sub-grade or additional layers supporting the wearing course.
- e) **Potholes**
Potholes are round or elongated depressions in the road surface. The potholes, which affect vehicles the most, are those between 250 and 1 500mm in diameter with a depth of more than 50 to 75 mm.
- f) **Corrugations**
Corrugations can be either “loose” or “fixed”. Loose corrugations consist of parallel alternating crests of loose, fine-sandy material and troughs of compacted material at right angles to the direction of travel. Fixed corrugations on the other hand consist of compacted crests and troughs of hard, fine sandy-gravel material.
- g) **Rutting**
Ruts are parallel depressions of the surface in the wheel paths. They generally form as a result of loss of gravel from the wearing course by traffic abrasion. Ruts are assessed in terms of their capacity to retain water using a visual estimate of their average depth.
- h) **Loose Material**
Loose material (finer than 26mm) is formed by the ravelling of the wearing course gravel under traffic. This may be distributed over the full width of the road but more frequently, it is concentrated in windrows between the wheel tracks, or alongside the travelled portion of the road.
- i) **Stoniness**
Stoniness is the relative percentage of material embedded in the road that is larger than a recommended maximum size (usually 37.5mm).



j) Erosion

Erosion is the loss of surfacing material caused by the flow of water over the road. The result of erosion is run-off channels which, when occurring transversely, result in extreme roughness and dangerous driving conditions, and when occurring longitudinally (on grades), form deep “ruts”. Transverse or diagonal erosion channels can be quantified by their depth and width.

k) Functional Parameters

Functional Parameters must also be included in an Unpaved/ Gravel Maintenance System and will be described briefly. Functional performance parameters, impacting on the road user safety and costs are:

- Skid resistance/ slipperiness.
- Road roughness (riding quality) Trafficability
- Dust.
- Drifts/ drainage/ wash-away.
- Road shape defined as “Drainage on the road”.
- Road level and effective side drainage.

L.5.3 Database for recording all related pavement information.

In order for the Pavement Management & Unpaved/ Gravel Management Systems to be effective a database and graphical interface should be set up and continuously managed. The Database should contain all the parameters recorded as identified by the implementation of a PMS & Gravel Management System. The Graphical interface should be centralised and a base platform such as GIS should be used. Both the database and GIS graphical tools will provide an efficient and effective way for high level management and financial planning to be done.

L.6 CONCLUSION OF PMS/RMS TO BE IMPLEMENTED

Once all the formal requirements are met in terms of TMH22 a PMS or rather a Road Management System which includes Asphalt and Gravel Roads shall be implemented. In this report, a basic PMS were implemented since no current PMS systems were available to update.

L.7 RECOMMENDED FUTURE ROAD DESIGN GUIDELINES

In this section of the report, the future road design guidelines to be implemented are summarised below:

L.7.1 Layerworks

The layerworks mentioned below in **Table 68** have been determined for cost estimation purposes only. It is expected that the existing subgrade can contain poorly graded sand which will imply a low bearing capacity. Clayey material can be expected in the wetland areas. The layerworks were determined for each road class from the structural design catalogue shown in TRH4 and UTG3. The following layer works designs are proposed for cost estimation purposes:



Table 68: Proposed Road Layerworks

LOCAL RESIDENTIAL
30mm Continuously graded Asphalt
150mm G2 Basecourse, compaction 88% AARD
150mm C4 Stab. Subbase course, compaction 96% AASHTO
150mm Selected layer, compaction 93% AASHTO
150mm in situ roadbed, compaction 90% MOD AASHTO
COLLECTOR
40mm Continuously graded Asphalt
150mm G2 Basecourse, compaction 88% AARD
200mm C4 Stab. Subbase course, compaction 96% AASHTO
150mm Selected layer, compaction 93% AASHTO
150mm in situ roadbed, compaction 90% MOD AASHTO
ARTERIAL
40mm Continuously graded Asphalt
150mm G2 Basecourse, compaction 88% AARD
150mm C3 Stab. Subbase course, compaction 96% AASHTO
150mm C4 Stab. Subbase course, compaction 95% AASHTO
150mm Selected layer, compaction 93% AASHTO
150mm in situ roadbed, compaction 90% MOD AASHTO
INDUSTRIAL
40mm Continuously graded Asphalt
150mm G2 Basecourse, compaction 88% AARD
150mm C3 Stab. Subbase course, compaction 96% ASSHTO
200mm Stab. C4 Subbase course, compaction 95% AASHTO
150mm Selected layer, compaction 93% AASHTO
150mm in situ roadbed, compaction 90% MOD AASHTO

****Note**

It should be noted that the final layer works will be determined after soil tests at each road have been undertaken as part of the detailed design procedure. The layer works mentioned in the tables are compiled for cost estimation purposes only.

L.7.2 RECOMMENDED PAVEMENT GEOMETRY

L.7.2.1 Standards

The geometric standards recommended in this report are in accordance with the Urban Transport guidelines series for Urban Arterial (UTG1), Collector (UTG5) and Local Residential Streets (UTG7) issued by the Committee of Urban Transportation Authorities.

L.7.2.2 Road Width

It is recommended to standardize the road widths in accordance with the class of the Road where possible. In many instances it is difficult to widen the road because of the limited road reserve width, conditions of the terrain and accesses and the presence of existing services.

Table 69 below shows the recommended lane widths:



Table 69: Recommended and Existing Lane Widths

ROAD CLASS	LANE WIDTH (m)		OBSERVED			
	RECOMMENDED	MINIMUM				
Industrial	8,0	8,0	8,0	7,0	6,5	
Arterial	8,0	7,5	8,0	7,0		
Collector	8,0	7,0	7,0	6,0	5,5	
Major residential	6,0	5,5	6,0	5,5	5,0	4,5
Minor residential	5,5	4,5	5,5	5,0	4,5	4,0
Access cul-de-sac	5,5	4,5	4,5	4,0	3,5	
Access strip, driveway	4,0	3,0	3,5	3,0		

L.7.2.3 Crossfall

The recommended typical crossfall is 3% and a single crossfall is recommended for local major and minor residential roads. A cambered crossfall is recommended for wider roads such as Industrial, Arterial and Major collector roads.

L.7.2.4 Vertical Alignment

The absolute minimum gradient for a kerbed road is 0.5%. Bearing construction tolerances in mind it is desirable to keep the minimum gradient at 0.7%. This will also improve the road surface runoff velocities and flooded width.

Vertical sag curves in residential low speed roads, especially kerbed roads, in flat terrain have to be kept as short as possible in order to keep the length of the flat section of the vertical curve to a minimum.

The maximum gradient of residential roads is determined by the fall of the existing terrain as the primary function of residential roads is to provide access to the properties. Short sections with a gradient of 18% are acceptable.

The maximum gradients of major roads are mainly governed by the road class and the percentage of heavy traffic. Reference is made to the UTG documents in this regard.

L.7.2.5 Kerbing

Fig.3 barrier (heavy duty) kerbs, as specified by SANS 927, are recommended.

The minimum recommendation for Residential roads is one Fig.3 kerb on the low side and a concrete edge beam, precast or in situ, on the high side of the road. The higher-class roads are to be kerbed on both sides. It is recommended to use Fig.7 for traffic islands such as median island and slip lane islands.

L.7.2.6 Stormwater Drainage

It was observed at the site inspections that ponding occurs often at low points of the road due to dysfunctional stormwater infrastructure or to a lack of space to discharge.



Special care will be taken at the low points with regards to:

- Capacity of kerb inlets. It is suggested to use lockable stormwater grids as kerb inlet cover. This will increase the capacity if the kerb overtops at the lowest point of the road. An inlet length of 4.0m is desirable. On gradients a wider and depressed roadside channel of at least 2.0m in length should be provided in order to increase the efficiency of the kerb inlet.
- Design recurrence interval. As the road cannot provide extra capacity at low points it is proposed to use a recurrence interval of 1:10y to 1:20y, depending of the type of buildings which are threatened with flooding.
- Registration of servitude for the outfall pipe. The servitude should be preferably be 3.0m wide. The absolute minimum width should be 2.0m. A dual drainage system should be used in the servitude: A stormwater pipe and a stone pitched stormwater channel on top should be constructed in the servitude.
- Proper discharge point: An energy dissipation structure and erosion should be provided at discharge points in order to protect the natural watercourses.

L.7.2.7 PROPOSED BRIDGES

The following is proposed with regards to the existing river crossings:

- All low water river crossings to be replaced with high bridges accommodating vehicles and pedestrians. The pedestrians are to walk on a walkway separated from the roadway. An Allowance for an 8.0m wide bridge deck has been made in the cost estimates. The bridges are to be designed for a 1:100y flood with minimum of 1.0m freeboard in order to avoid debris striking the bridge deck and causing damage.
- The embankments of the approaches are to be protected against erosion by stone pitching or dump rock which is designed to withstand the velocities and turbulence up to storms of a recurrence interval 1:100y.
- If a vehicular bridge cannot be provided due to cost and/or time restraints, it is recommended to construct a pedestrian bridge in parallel to the existing bridge structure to provide a safe crossing for school children and pedestrians until the time that a high bridge accommodating vehicles and pedestrians is constructed.



CHAPTER M RISK MANAGEMENT

M.1 RISKS AND RISK MITIGATION

The following are possible risks identified by the PSC from the onset of the project: (but not limited to):

Item	POSSIBLE RISK'S BEFORE PROJECT KICK OFF	MIDVAAL ASSISTANCE DURING PROJECT
1	Limited information for the development of the RSWMP	Midvaal LM issued the PSP with sufficient information.
2	Lack of infrastructure data and information from the Municipality and other stakeholders.	Midvaal LM issued sufficient infrastructure information to the PSP.
3	Restricted access to on-site areas for collation of As-Built Data.	Midvaal LM did provide access to all area and some as-built information that was available.
4	Insufficient stakeholder involvement.	PSC was scheduled and always available.
5	Delays by the Municipality and other stakeholders in providing relevant information.	Midvaal LM issued information on time as requested by PSP.
6	Unclear information and parameters from relevant stakeholders.	Midvaal LM information was very clear and support was always available.
7	Organisational changes within Midvaal Local Municipality.	No changes in Midvaal LM
8	Unsafe river crossings and the lack of culverts.	River Crossings could be crossed but need some improvement.
9	The lack of floodline data available.	PSP provided Floodline information and investigated areas that was indicated by Midvaal LM.

M.2 FUTURE AND CURRENT RISK MANAGEMENT MATRIX

The following is a very preliminary summary and assessment of the actual management strategy for the mitigation of the above-mentioned risks:

Table 70: Tabulated Risk Management Matrix

RISK RANKING	DESCRIPTION OF RISK	LIKELIHOOD OF RISK (1 = VERY UNLIKELY) (5 = VERY LIKELY)	SEVERITY OF RISK ON IMPLEMENTATION OF PROJECT (1 = LOW SEVERITY) (5 = EXTREME SEVERITY)	POSSIBLE MITIGATION MEASURES
1	Limited information / data available from Midvaal LM and others	5	1	- DBSA to assist PSP - PSP to be deployed to MLM offices - More site visits required - Could lead to extra time required
2	Restricted access to on-site areas for collation of As-Built data	4	2	- MLM to intervene by providing resources - PSP to provide additional resources on site - Could lead to extra time
3	Delays by Midvaal LM and others in providing relevant information	3	1	- PSP to provide up front list of requirements - PSP to follow up regularly - DBSA to intervene
4	Unclear information and parameters from relevant stakeholders	3	2	- PSP to pro-actively manage data request-and-receipt procedures - Inform MLM timeously of any discrepancies



6	Insufficient stakeholder engagement	2	1	- MLM and DBSA Management team to intervene promptly.
7	Lack of Culvert crossings	4	1	PSP to identify priority projects during following phases of the project.
8	Lack of Floodline data available	5	1	Floodlines were compiled during this phase of the project.

It can hereby be confirmed that most if not all the above risks were identified timeously and dealt with in a satisfactory manner with the assistance of the entire PSC.



For and on behalf of Infraconsult Engineering:

**Infraconsult Engineering cc
Mr. M.J Jansen
PrEng M Eng (Cum Laude) B Eng FSAICE
Managing Director**

Approved and Accepted by:

(i) _____

MIDVAAL LOCAL MUNICIPALITY – Municipal Manager

(ii) _____

DBSA – Planning Head



ANNEXURE A: *FUNCTIONAL ROAD CLASSIFICATION*

SEE ELECTRONIC FOLDER



**ANNEXURE B: *EXTRACT FROM MIDVAAL LOCAL
MUNICIPALITY SDF***

SEE ELECTRONIC FOLDER



ANNEXURE C: *TRAFFIC DATA USED FOR TRAFFIC GROWTH*

SEE ELECTRONIC FOLDER



**ANNEXURE D: *BASIC ROAD MODEL (2024
CATEGORIZATION BASED ON TRAFFIC DATA)***
SEE ELECTRONIC FOLDER



ANNEXURE E: *BASIC ROAD MODEL (2044*
CATEGORIZATION BASED ON TRAFFIC DATA)
SEE ELECTRONIC FOLDER



ANNEXURE F: *TRAFFIC MODEL FORECAST DATA*

SEE ELECTRONIC FOLDER



ANNEXURE G: LOCALITY PLAN FOR ANALYSED KEY INTERSECTIONS

SEE ELECTRONIC FOLDER



ANNEXURE H: RESULTS OF THE PTV VISTRO INTERSECTION CAPACITY ANALYSES

SEE ELECTRONIC FOLDER



ANNEXURE I: TYPICAL ROAD SECTION OF LAYER WORKS

SEE ELECTRONIC FOLDER



ANNEXURE J: AERIAL VIEW: CARINA ROAD / HIBISCUS ROAD UPGRADE

SEE ELECTRONIC FOLDER



ANNEXURE K: AERIAL VIEW: ROAD K154 ROAD UPGRADE BETWEEN WATERVAL 7 WALKERVILLE

SEE ELECTRONIC FOLDER



ANNEXURE L: AERIAL VIEW: SOUTH ROAD & JUDE STREET ROAD UPGRADE IN SICELO

SEE ELECTRONIC FOLDER



ANNEXURE M: AERIAL VIEW: ORDON ROAD & EATON ROAD UPGRADE IN HENLEY-ON-KLIP

SEE ELECTRONIC FOLDER



ANNEXURE N: AERIAL VIEW: ROAD D478 UPGRADE NEAR RUSOORD SECONDARY SCHOOL

SEE ELECTRONIC FOLDER



ANNEXURE O: FLOODLINES

SEE ELECTRONIC FOLDER



ANNEXURE P: MIDVAAL LOCAL MUNICIPALITY MASTER COST ESTIMATES

SEE ELECTRONIC FOLDER



ANNEXURE Q: MIDVAAL LOCAL MUNICIPALITY MAPBOOK

SEE ELECTRONIC FOLDER