COAL of AFRICA LIMITED
MbeuYashu

GREATER SOUTPANSBERG MOPANE PROJECT

ENVIRONMENTAL IMPACT ASSESSMENT

AND

ENVIRONMENTAL MANAGEMENT PROGRAMME

DMR References: **LP 30/5/1/2/2/10029 MR**
LP 30/5/1/2/2/10030 MR
LP 30/5/1/2/2/10031 MR
LP 30/5/1/2/2/10032 MR
LP 30/5/1/2/2/10033 MR
LP 30/5/1/2/2/10034 MR
LP 30/5/1/2/2/10035 MR
LP 30/5/1/2/2/10036 MR

NOVEMBER 2013

GREATER SOUTPANSBERG

MOPANE PROJECT

SECTION 1

ENVIRONMENTAL MANAGEMENT PROGRAMME

REGULATION 50

PROJECT DETAILS

Name of Project	**Greater Soutpansberg - Mopane Project**
DMR Reference Numbers	LP 30/5/1/2/2/10029 MR
	LP 30/5/1/2/2/10030 MR
	LP 30/5/1/2/2/10031 MR
	LP 30/5/1/2/2/10032 MR
	LP 30/5/1/2/2/10033 MR
	LP 30/5/1/2/2/10034 MR
	LP 30/5/1/2/2/10035 MR
	LP 30/5/1/2/2/10036 MR
Name of Applicant	
LP 30/5/1/2/2/10029 MR	Regulus Investment Holdings (Pty) Ltd
LP 30/5/1/2/2/10030 MR	Kwezi Mining Exploration (Pty) Ltd
LP 30/5/1/2/2/10031 MR	Kwezi Mining Exploration (Pty) Ltd
LP 30/5/1/2/2/10032 MR	Chapudi Coal (Pty) Ltd
LP 30/5/1/2/2/10033 MR	Coal of Africa Limited
LP 30/5/1/2/2/10034 MR	Coal of Africa Limited
LP 30/5/1/2/2/10035 MR	Kwezi Mining Exploration (Pty) Ltd
LP 30/5/1/2/2/10036 MR	Kwezi Mining Exploration (Pty) Ltd
Responsible person	Baldwin Khosa
Designation	Regulatory Affairs Manager
Physical address	The Campus, Gabba Building (2nd floor) 57 Sloane Street, Bryanston
Postal Address	PO Box 69517, Bryanston, 2021
Telephone	011 575 4363
Facsimile	086 562 1335
E-mail	Baldwin.khosa@coalofafrica.com

Environmental Consultant	Jacana Environmentals cc
Responsible person	Marietjie Eksteen
Physical address	7 Landdros Mare Street, Polokwane
Postal Address	PO Box 31675, Superbia, 0759
Telephone	(015) 291 4015
Facsimile	(015) 291 5035
E-mail	marietjie@jacanacc.co.za

Public Participation Consultant	Naledi Development Restructured (Pty) Ltd
Responsible person	Lizinda Dickson
Physical address	143 Zambezi Avenue, Sinoville
Postal Address	PO Box 13509, Sinoville, 0129
Telephone	(012) 543 9093
Facsimile	(012) 543 9619
E-mail	lizinda@naledidev.co.za

Impact specialist consultants

Soils, land use and capability	Gudani Consulting - EcoSoil Consortium
Surface and Groundwater	WSM Leshika Consulting (Pty) Ltd
Biodiversity	Phaki Phakanani Environmental Consultants
Aquatic systems	Scientific Aquatic Services
Noise	Gudani Consulting
Air Quality	Royal Haskoning DHV
Heritage Resources	Mbofho Consulting and Projects
Socio-Economic	Naledi Development Restructured (Pty) Ltd
Macro-Economic	Mosaka Economic Consultants cc

TABLE OF CONTENT

1 DESCRIPTION OF THE BASELINE ENVIRONMENT 1

1.1 PROJECT LOCATION 1
1.1.1 Surface Ownership..5
1.1.2 COMMUNITIES..5
1.1.3 Land Claimants / Traditional Authority..5

1.2 DESCRIPTION OF THE BIOPHYSICAL ENVIRONMENT 11
1.2.1 Climatic Data..11
1.2.1.1 Regional Climate 11
1.2.1.2 Temperature 11
1.2.1.3 Winds...14
1.2.1.4 Mean Annual Precipitation and Mean Monthly Rainfall 16
1.2.1.5 Run-off and Evaporation...18
1.2.2 Soils...21
1.2.2.1 Parent Material...21
1.2.2.2 Land Types 22
1.2.2.3 Soil Forms 24
1.2.2.3.1 Red apedal soils 24
1.2.2.3.2 Yellow-brown apedal soils...25
1.2.2.3.3 Neocutanic soils...25
1.2.2.3.4 Carbonate soils 25
1.2.2.3.5 Neocarbonate soils...25
1.2.2.3.6 Pedocutanic soils 25
1.2.2.3.7 Shallow rocky soils...26
1.2.2.3.8 Fernwood soils 26
1.2.3 Pre-Mining Land Capability...28
1.2.4 Present Land Use 31
1.2.5 Biodiversity (Flora and Fauna) 33
1.2.5.1 Flora...33
1.2.5.1.1 Biome 33
1.2.5.1.2 Veld types...34
1.2.5.1.3 Vegetation communities and sensitivity mapping 36
1.2.5.1.4 Protected and endemic flora...38
1.2.5.1.5 Introduced or exotic/alien plants...40
1.2.5.2 Fauna 43
1.2.5.2.1 Mammals...43
1.2.5.2.2 Avifauna..43
1.2.5.2.3 Reptiles...45
1.2.5.2.4 Amphibians..46
1.2.5.2.5 Invertebrates 47
1.2.5.2.6 Faunal sensitive areas 52
1.2.5.3 Biodiversity and Ecosystem Processes 53
1.2.5.3.1 National Biodiversity Assessment (NBA, 2011) 53
1.2.5.3.2 Biodiversity Proxy 53
1.2.5.4 Ecosystem Services 53

1.2.6 Aquatic environment 57
1.2.6.1 Ecoregions 57
1.2.6.2 Ecostatus 57
1.2.6.3 Ecological Importance 61
1.2.6.4 Wetland Assessment 61
1.2.6.5 Present Ecological State and Recommended Ecological Class 63
1.2.7 Surface water 66
1.2.7.1 Locality and Background Information 66
1.2.7.2 Surface Water Quality 67
1.2.7.3 Current Land Use 70
1.2.7.4 Drainainage System and Main Stem Hydrology 71
1.2.7.5 Flood Peak Calculations 73
1.2.7.5.1 Statistical analysis 73
1.2.7.5.2 Deterministic methods 74
1.2.7.5.3 Selected floods for the Sand River 75
1.2.7.5.4 Flood peak determination of major tributaries 75
1.2.8 Groundwater 79
1.2.8.1 Hydrocensus 79
1.2.8.2 Piezometry and Groundwater Flow 80
1.2.8.3 Impact of regional geology on the hydrogeology of the project area 81
1.2.8.3.1 The Jutland Section 81
1.2.8.3.2 The Voorburg Section. 81
1.2.8.4 Groundwater Quality 82
1.2.8.4.1 Macro-chemistry 82
1.2.8.4.2 Micro-chemistry 86
1.2.8.5 Groundwater Use 88
1.2.8.5.1 Voorburg Section 88
1.2.8.5.2 Jutland Section 89
1.2.8.6 Regional Groundwater Flow 89
1.2.9 Air Quality 93
1.2.9.1 Baseline Air Quality 93
1.2.9.1.1 Agricultural activities 93
1.2.9.1.2 Veld fires 93
1.2.9.1.3 Domestic fuel burning 94
1.2.9.1.4 Quarries 95
1.2.9.2 Ambient Monitoring 96
1.2.9.2.1 Dust fallout monitoring 96
1.2.9.2.2 Particulate matter 96
1.2.10 Ambient Noise 98
1.2.10.1Noise Criteria of Concern 98
1.2.10.2Existing Ambient Sound Levels 100
1.2.10.2.1 Measurement procedure 100
1.2.10.2.2 Limitations: Acoustical Measurements and Assessments 100
1.2.10.2.3 Ambient sound measurements 101
1.2.10.2.4 Results – SANS 10103:2008 Rating Level 102
1.2.11 Visual Assessment 106
1.2.11.1Aesthetics 106
1.2.11.2Visual Character of the Area 106

1.3 ENVIRONMENTAL ASPECTS THAT MAY REQUIRE PROTECTION OR REMEDIATION 108
1.3.1 Sensitive Landscapes 108
1.3.1.1 River systems 108
1.3.1.2 Wetlands 108
1.3.2 Formal Conservation Initiatives in the Region 109
1.3.2.1 Vhembe Biosphere Reserve 109
1.3.2.2 Protected areas 110
1.3.2.3 Ground Hornbill research and conservation project 111

1.4 DESCRIPTION OF LAND USE, CULTURAL AND HERITAGE ASPECTS AND INFRASTRUCTURE 113
1.4.1 Land Use Activities on Site and Neighbouring Properties 113
1.4.2 Cultural and Heritage Resources 116
1.4.2.1 Theoretical Framework 116
1.4.2.1.1 The Stone Age Culture 116
1.4.2.1.2 The Iron Age Culture 117
1.4.2.1.3 Other Heritage Concepts 120
1.4.2.2 Results 121
1.4.2.2.1 Current Conservation Status of Heritage Resources in the Project Area 121
1.4.2.2.2 Summary Data on Heritage Resources 122
1.4.3 Infrastructure (Built Environment) 124

1.5 SENSITIVE RECEPTOR MAP 125

1.6 SPECIALIST STUDIES 127

2 PROPOSED MINING OPERATION 128

2.1 MINERAL TO BE MINED 128

2.2 EXTENT OF THE OPERATION 132

2.3 MINING OPERATIONS 134
2.3.1 mining Methodology 134
2.3.2 Mining schedule 135
2.3.3 Coal Processing 138
2.3.3.1 Design Overview 138
2.3.3.2 Product Handling 142
2.3.4 Infrastructure 142
2.3.4.1 Access Roads 143
2.3.4.2 Mining Roads 144
2.3.4.3 Mine residue dumps 144
2.3.4.4 Topsoil dumps and berms 144
2.3.4.5 Storm water Management 144
2.3.4.5.1 Clean Water Run-off 145
2.3.4.5.2 Dirty Water Run-off 145
2.3.5 Bulk Power Supply 145
2.3.6 Bulk Water 146
2.3.7 Logistics 147

2.4 MINE RESIDUE MANAGEMENT 148

2.4.1 Non-Mining Waste 148
2.4.2 Mining (Industrial) Waste 149
2.4.3 Sewage Effluent 149

2.5 LIST OF MAIN MINING ACTIONS, ACTIVITIES OR PROCESSES 152

2.6 APPLICABLE LEGISLATION 153

2.7 IMPLEMENTATION SCHEDULE 157

3 DESCRIPTION OF POTENTIAL IMPACTS ASSOCIATED WITH ACTIVITY .. 158

3.1 LIST OF POTENTIAL IMPACTS 158
3.1.1 Soils, Land Use and Land Capability 161
3.1.1.1 Construction and Operational Phases 161
3.1.1.2 Post-Mining Land Capability 162
3.1.1.2.1 Land capability requirements 162
3.1.1.2.2 Land capability potential (i.e. potential land use) 162
3.1.1.3 Other Potential Impacts 164
3.1.2 Biodiversity 164
3.1.2.1 Vegetation 164
3.1.2.1.1 Loss of vegetation 164
3.1.2.1.2 Loss of floral species of special concern 164
3.1.2.1.3 Increased risk of alien invasion 165
3.1.2.1.4 Increased risk of soil erosion 165
3.1.2.1.5 Disruptions to ecological corridors and loss of biodiversity conservation areas 165
3.1.2.1.6 Aridification of the area as a result of mine de-watering 165
3.1.2.2 Fauna 166
3.1.2.2.1 Limited food availability for Cape Vulture 166
3.1.2.2.2 Habitat destruction 166
3.1.2.2.3 Fragmentation of habitats 166
3.1.2.2.4 Faunal mortality through mining operations 167
3.1.2.2.5 Habitat creation (negative) 167
3.1.3 Aquatic Environment 168
3.1.3.1 Loss of In-stream Flow, Aquatic Refugia and Flow Dependent Taxa 168
3.1.3.2 Impacts on Water Quality Affecting Aquatic Ecology 170
3.1.3.2.1 Increased sediment load in the Sand River 170
3.1.3.2.2 Impaired water quality due to pollutants discharged from processing plant 170
3.1.3.2.3 Impaired water quality due to pollutants in run-off from stockpiles 170
3.1.3.2.4 Impaired water quality due to pollutants in water discharged from opencast pits 171
3.1.3.2.5 Impaired water quality due to petrochemical spills 171
3.1.3.2.6 Heavy metal contamination 171
3.1.3.3 Loss of Aquatic Habitat 171
3.1.3.4 Loss of Aquatic Biodiversity and Sensitive Taxa 172
3.1.3.5 Loss of Wetland and Riparian Habitat 172
3.1.3.6 Changes to Wetland Ecological and Sociocultural Service Provision 172
3.1.4 Surface Water 173
3.1.4.1 Impacts on Quantity 173
3.1.4.1.1 Impact on Sand River flood-line 173

3.1.4.1.2 Impact of the proposed development on site streams and drainage lines 174
3.1.4.1.3 Impact of the proposed mining development on surface water runoff 177
3.1.4.1.4 Potential impacts of utilizing or developing a surface water supply source 177
3.1.4.2 Impacts on Quality 177
3.1.4.2.1 Increased sediment load in Sand River 178
3.1.4.2.2 Impaired water quality due to pollutants discharged from dirty areas 178
3.1.5 Groundwater 179
3.1.5.1 Groundwater Inflows 180
3.1.5.1.1 Inflows into Voorburg and Jutland Section 181
3.1.5.2 Cumulative Drawdown 181
3.1.5.3 Groundwater Impact Assessment for Mopane Project 186
3.1.6 Sensitive Landscapes 186
3.1.6.1 Conservation Initiatives / Protected Areas 186

3.2 CUMULATIVE IMPACTS 187

3.3 POTENTIAL FOR ACID-MINE DRAINAGE 190

4 ALTERNATIVE LAND USE OR DEVELOPMENTS THAT MAY BE AFFECTED........ 191

4.1 CURRENT LAND USE 191

4.2 ALTERNATIVE LAND USE OPTIONS 191

4.3 DEVELOPMENT ALTERNATIVES – CONCEPT STUDY 192
4.3.1 Mine Infrastructure 192
4.3.1.1 Infrastructure Layout Options 192
4.3.1.2 Option 1: Independent Mines 194
4.3.1.2.1 Voorburg Section 194
4.3.1.2.2 Jutland Section 195
4.3.1.3 Option 2: Combined Mining Facilities 196
4.3.2 Product Transport 197
4.3.3 Mine Residue Management 198
4.3.3.1 Slurry Management 198
4.3.3.2 Discard Management 198

4.4 DEVELOPMENT ALTERNATIVES – FEASIBILITY STUDY 198

5 POTENTIAL SOCIAL AND CULTURAL IMPACTS 199

5.1 SOCIO-ECONOMIC ENVIRONMENT 199
5.1.1 Air Quality 199
5.1.1.1 Construction Phase 199
5.1.1.2 Operational Phase 203
5.1.1.3 Decommissioning Phase 206
5.1.1.4 Methane Emissions 211
5.1.2 Ambient Noise 212
5.1.2.1 Construction Phase 212

5.1.2.2 Results: Operational Phase 217
5.1.2.2.1 Operation of the Opencast – year 2019 217
5.1.2.2.2 Operation of the Opencast - 2030 (mining at Voorburg and Jutland Sections) 221
5.1.3 Visual and aesthetic IMPACT 224
5.1.3.1 Visual Exposure 224
5.1.3.2 Factors impacting on the Sense of Place 226
5.1.4 Social impacts 226

5.2 CULTURAL AND HERITAGE 228
5.2.1 National and Provincial Heritage Sites (Monuments) 228
5.2.2 Graves and Burial Grounds 229
5.2.3 Heritage sites 229

5.3 QUANTIFICATION OF IMPACT ON DIRECTLY AFFECTED PERSONS 229

6 ASSESSMENT AND EVALUATION OF POTENTIAL IMPACTS 230

7 COMPARATIVE ASSESSMENT OF LAND USE AND DEVELOPMENT ALTERNATIVES 257

7.1 CURRENT LOCAL ECONOMIC ACTIVITIES 257

7.2 PROPERTY VALUES 261

7.3 COST BENEFIT ANALYSIS – ECONOMIC VIABILITY 261

7.4 MACRO-ECONOMIC IMPACT ANALYSIS 263

7.5 CONCLUSION 265

8 LIST OF SIGNIFICANT IMPACTS AND PROPOSED MITIGATORY MEASURES... 266

8.1 CONSIDERATION OF CONCERNS RAISED BY STAKEHOLDERS 266

9 STAKEHOLDER ENGAGEMENT 287

10 ADEQUACY OF PREDICTIVE METHODS AND KNOWLEDGE GAPS 289

10.1 ACCESS CONSTRAINTS 289

10.2 TIME CONSTRAINTS 289

10.3 LIMITATIONS ON AVAILABLE BASELINE DATA 290
10.3.1 Groundwater 290
10.3.2 Surface water 291
10.3.3 Socio- and Macro-Economic assessments 291

11 MONITORING AND MANAGEMENT OF ENVIRONMENTAL IMPACTS 292
11.1 MONITORING REQUIREMENTS 292
11.2 ROLES AND RESPONSIBILITY 294
11.3 MONITORING MANAGEMENT AND REPORTING 295
12 TECHNICAL AND SUPPORTING INFORMATION 296
12.1 SPECIALIST REPORTS 296
12.2 REFERENCES 296
13 ANNEXURES 303

LIST OF TABLES

Table 1: Surface properties included in NOMR application 7
Table 2: Temperature data for Tshipise for the period from 1994 to 2006 12
Table 3: Mean monthly rainfall distribution of site rainfall (Zone A7C) 17
Table 4: Mean monthly quaternary rainfall (mm) 17
Table 5: Catchment data (from WR2005) 19
Table 6: Sand River naturalized run-off 20
Table 7: Simulated average naturalized monthly run-off for quaternary catchments A71J and A71K 20
Table 8: Monthly evaporation distribution 20
Table 9: Summary of different soil physical properties of the soil groups 27
Table 10: Criteria for Pre-Development Land Capability 28
Table 11: Areas of land capability classes on respective farms in the study area 30
Table 12: Agricultural potential classification of land capability classes according to agricultural classification system 30
Table 13: List of applicable conservation status (status indicated in table below) 38
Table 14: Exotic and weed plant species found within the site 40
Table 15: Reptile Species of Special Concern (SSC) that have been identified 46
Table 16: Table of Invertebrate Species having Ecological Importance 51
Table 17: Classification of river health assessment classes in line with the RHP 57
Table 18: Summary of the ecological status of quaternary catchments A71J, A71K and A72B based on Kleynhans (1999) 58
Table 19: Assigned REC Classes 63
Table 20: Water quality measured at Dorothy (Station A7H009) 68
Table 21: Water quality measured at Waterpoort (Station A7H001) 68
Table 22: Water samples collected by WSM Leshika in 2013 69

Table 23: Results of statistical analysis of flood data at Waterpoort (Gauge A7H001) (peak flow rate in m^3/s) 73
Table 24: Adjustment of statistical results at Waterpoort to the site 74
Table 25: Sand River catchment characteristics at the site 74
Table 26: Estimated peak flows for the Sand River 75
Table 27: Selected flood peaks for the Sand River at Voorburg 75
Table 28: Catchment data and calculated flood peaks for the selected streams 76
Table 29: DWA WQT classification – Macro-chemistry 82
Table 30: Macro chemistry results 83
Table 31: Micro-chemistry with DWA-WQT Classification 86
Table 33: Micro-chemistry with DWA-WQT Classification 87
Table 33: Voorburg Section: Groundwater use per farm 88
Table 34: Jutland Section: Summary of groundwater use per farm 89
Table 35: Acceptable zone sound levels for noise in districts (SANS 10103) 100
Table 36: Day/night-time measurement locations (Datum type: WGS 84) 102
Table 37: Summary of noise district rating levels 105
Table 38: Activity-based legal requirement assessment (high-level) for Mopane Project 154
Table 39: List of all potential environmental impacts for the Mopane Project 158
Table 40: Summary of the impact of mining on agricultural potential and land capability 162
Table 41: Estimated impact of proposed mine on surface water runoff in quaternary catchment area A71K (based on worst case scenario with no rehabilitation in place) 177
Table 42: Maximum predicted ambient ground level concentration (µg/m3) of Particulate Matter during the construction phase 200
Table 43: Maximum predicted ambient ground level concentration ($\mu g/m^3$) of Particulate Matter during the operational phase 203
Table 44: Maximum predicted annual ground level concentration ($\mu g/m^3$) of Particulate Matter during the operational phase 203
Table 45: Impact Rating methodology 230
Table 46: Environmental Impact Risk Matrix 232
Table 47: Social Impact Risk Matrix 243
Table 48: List of significant environmental impacts identified during the EIA, together with proposed mitigation measures 267
Table 49: List of significant environmental impacts identified during the SEIA, together with proposed mitigation measures 277

LIST OF FIGURES

Figure 1: Location of Greater Soutpansberg Projects 2
Figure 2: Mopane Project – Locality Map 3
Figure 3: Location of Voorburg and Jutland Sections 4
Figure 4: Surface properties included in NOMR applications 6
Figure 5: Mopane Project Land Claimants map 10

Figure 6: Mean annual maximum temperature....13
Figure 7: Mean annual minimum temperature....13
Figure 8: Period wind rose for the Mopane project area for the period Jan 2008 – Dec 2012....14
Figure 9: Wind class frequency distribution....15
Figure 10: Stability class frequency distribution....16
Figure 11: Sand River Basin mean annual precipitation....17
Figure 12: Distribution of mean monthly precipitation in mm....18
Figure 13: Quaternary catchments affected by the proposed development....19
Figure 14: Parent materials of the study area....21
Figure 15: Land-types of the study area....24
Figure 16: Soil groups (associations) and forms of the study area....26
Figure 17: Land capability of the surveyed area....29
Figure 18: Present land cover of the demarcated study area....32
Figure 19: Vegetation of the site and surrounding area (Mucina and Rutherford, 2006)....35
Figure 20: Vegetation communities - Voorburg Section....41
Figure 21: Vegetation communities - Jutland Section....42
Figure 22: Biodiversity Proxy of the Mopane Project area and surrounds....54
Figure 23: Ecosystem Services of the Mopane Project area and surrounds....55
Figure 24: Ecoregions associated with the Mopane Project area (Mucina and Rutherford, 2006)....56
Figure 25: Present Ecological State of the wetland systems at Voorburg Section....64
Figure 26: Present Ecological State of the wetland systems at Jutland Section....65
Figure 27: Mopane Project in relation to the lower quaternary catchments areas of the Sand River 67
Figure 28: Water quality monitoring points....70
Figure 29: Major rivers and general drainage direction in Mopane Project area....71
Figure 30: Voorburg Section drainage lines and major flood-lines....72
Figure 31: Jutland Section drainage lines....72
Figure 32: Catchment areas....76
Figure 33: Presentation of flood peak results....77
Figure 34: 1:100 year flood-lines of the major streams in relation to the mining areas....78
Figure 35: Mopane Project hydrocensus borehole locations....79
Figure 36: Piezometric contour map showing general groundwater flow direction....80
Figure 37: % frequency distribution of TDS for the 3 major rock types....84
Figure 38: Durov classification of water....85
Figure 39: Durov water types plotted on the geology....86
Figure 40: Steady state water levels under current conditions (metres above mean sea level)....91
Figure 41: Steady state water levels under virgin conditions (metres above mean sea level....92
Figure 42: Veld Fire risk map....94
Figure 43: Makhado Colliery dust fallout monitoring Aug 10 – Apr 13....96
Figure 44: Makhado PM monitoring results July 2012 – April 2013....97
Figure 45: Period wind rose for the Makhado Grimm for the July 2012 – April 2013 monitoring period....98
Figure 46: Criteria to assess the significance of impacts stemming from noise....99
Figure 47: Localities of ambient sound level measurements....103
Figure 48: Topography map indicating location of hills and ridges....107
Figure 49: Protected areas and conservation initiatives within the Vhembe Biosphere Reserve....112

Figure 50: Socio-economic study area 113
Figure 51: Agricultural activities 114
Figure 52: Hunting facilities and/or activities 114
Figure 53: Houses, labour houses and other structures 115
Figure 54: Water sources - dams, boreholes and drinking holes 116
Figure 55: Priority heritage sites in the Voorburg Section (Left to right - Farms Vera Plots Banff, Delft, Ancaster and Voorburg) Yellow = Burials, Green = other sites 123
Figure 56: Priority heritage sites in the Jutland Section (Farms Cohen, Honeymoon, Jutland, Hermanus, Verdun, Pretorius 1 & 2, Vrienden, Van der Bijl, and Kitchener). Yellow = Burials, Green = other sites 124
Figure 57: Sensitive receptor map for Mopane Project 126
Figure 58: Regional geology in relation to the GSP projects 129
Figure 59: Mopane Project geology 131
Figure 60: Mopane Project geological cross-section 131
Figure 61: Mining and infrastructure layout for Mopane Project 133
Figure 62: Mining layout and schedule for the Voorburg Section 136
Figure 63: Mining layout and schedule for the Jutland Section 137
Figure 64: Expansion block flow diagram - Coal Beneficiation Plant 139
Figure 65: Coal beneficiation plant - block flow diagram DMS 140
Figure 66: Coal beneficiation plant - block flow diagram Fines Plant 141
Figure 67: Mopane Project Infrastructure Hub layout plan 143
Figure 68: Position of the proposed rail loop and siding on the farm Pretorius 531 MS 148
Figure 69: Voorburg Section mine residue layout 150
Figure 70: Jutland Section mine residue layout 151
Figure 71: Project schedule for Mopane Project over the next 10 years 157
Figure 72: Sand River 1:100 year flood-line and 100m buffer 174
Figure 73: Mining layout plan - Voorburg Section 175
Figure 74: Mining layout plan - Jutland Section 176
Figure 75: Mine abstraction from the aquifer and impact on the aquifer 180
Figure 76: Inflows into the Mopane open pits 181
Figure 77: Cumulative drawdown in Year 16 182
Figure 78: Cumulative drawdown in Year 38 183
Figure 79: Cumulative drawdown in Year 49 184
Figure 80: Cumulative drawdown in Year 61 185
Figure 82: Jutland and Voorburg Sections in relation to existing infrastructure 193
Figure 83: Option 1 - Independent Voorburg Section 195
Figure 84: Option 1 – Independent Jutland Section 196
Figure 85: Maximum predicted Daily concentration (µg/m^3) of Particulate Matter 201
Figure 86: Maximum Predicted Annual ground level concentration (µg/m^3) of Particulate Matter 202
Figure 87: Maximum cumulative Predicted daily ground level concentration (µg/m^3) of Particulate Matter 204
Figure 88: Maximum cumulative Predicted annual ground level concentration (µg/m^3) of Particulate Matter 205
Figure 89: Maximum predicted hourly concentration (µg/m^3) of particulate matter from Blasting Activities 207

Figure 90: Maximum predicted daily concentration (µg/m^3) of particulate matter from blasting activities 208
Figure 91: Maximum predicted annual concentration (µg/m^3) of particulate matter from blasting activities 209
Figure 92: Dust fallout impacts recorded during the Operational phases of the Mopane Project ... 210
Figure 93: Conceptualised locations of noisy construction activities – larger site 213
Figure 94: Construction noise: Projected Construction Noise Levels as distances increase between NSDs and locations where construction can take place – illustrative scenario 214
Figure 95: Construction noise: Projected Road Traffic Noise Levels as distances increase between a conceptual NSD and road (carrying 12 light and 12 heavy vehicles per hour travelling at 60 km/hr on a gravel road) 215
Figure 96: Projected Construction Noise Levels in contours of equal sound levels 216
Figure 97: Operational phase – First year of operation, conceptual activities: Overview 219
Figure 98: Night-time operations: Projected noise contours – Start of mining operations 220
Figure 99: Operational phase – Year 2030, conceptual activities: Overview 222
Figure 100: Night-time operations: Projected noise contours – Year 2030 mining operations 223
Figure 101: Viewshed analysis for the Mopane Project area 225
Figure 102: Farm categories for macro-economic analyses 258
Figure 103: Properties accessed during specialist investigations 289

Glossary of Terms

TERM / ABBREVIATION	MEANING
ABA	Acid Base Accounting
AGIS	Agricultural Geo-referenced Information System
AMD	Acid Mine Drainage
AQA	National Environmental Management: Air Quality Act 39 of 2004
ARD	Acid Rock Drainage
ARS	Acute Respiratory Syndrome
BCM/h	Bank Cubic Meters per hour
Biome	A broad ecological unit representing major life zones of large natural areas – defined mainly by vegetation structure and climate
BMWP	British Biological Monitoring Working Party
CARA	Conservation of Agricultural Resources Act 43 of 1983
CBA	Cost Benefit Analysis
CLN	Customer Load Network
CoAL	Coal of Africa Limited
COPT	Chronic Obstructive Pulmonary Disease
CRR	Comments and Response Report
dBA	Decibels
DEA	Department of Environmental Affairs
DEMC	Desired Ecological Management Class
DMR	Department of Mineral Resources
DM	Dense Medium
DMS	Dense Medium Separator
DWA	Department of Water Affairs
DWS	Discouraged Work Seekers
Ecological integrity	Overall functioning of the ecological system as a whole
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity Classification
EMC	Ecological Management Class
EMP	Environmental Management Programme
ESA	Earlier Stone Age
ESP	Exchangeable sodium percentage
ESS	Ecosystem Services

TERM / ABBREVIATION	MEANING
EUR	Expanded Unemployment Rate
FAII	Fish Assemblage Integrity Index
FZ	Fractured Zone
GDP	Gross Domestic Product
GPS	Global Positioning system
GSP	Greater Soutpansberg Project
HIA	Heritage Impact Assessment
IAPs	Interested and Affected Parties
IDPs	Integrated Development Plans
IHAS	Invertebrate Habitat Assessment System
IHIA	Intermediate Habitat Integrity Assessment
ISP	Internal Strategic Perspective
IUCN	International Union for Conservation of Nature and Natural Resources
IWUL	Integrated Water Use Licence
IWWMP	Integrated Water and Waste Management Plan
K2C	Kruger to Canyon Biosphere
LCC	Land Claims Commissioner
LEDET	Limpopo Department of Economic Development, Environment and Tourism
LEMA	Limpopo Environmental Management Act 7 of 2003
LM	Local Municipality
LMB	Limpopo Mobile Belt
LOM	Life of Mine
LSA	Late Stone Age
Mamsl	Meters above mean sea level
MAE	Mean Annual Evaporation
MAP	Mean Annual Precipitation
MAR	Mean Annual Run-off
Mbcm	Million Bank Cubic Metres
MIA	Mining Infrastructure Area
MPRDA	Mineral and Petroleum Resources Development Act 28 of 2002
MRA	Mining Right Application
MSA	Middle Stone Age
Mtpa	Million Tonnes Per Annum
MTS	Main Transmission Station

TERM / ABBREVIATION	MEANING
MSC	Mining Consulting Services
NBA	National Biodiversity Assessment
NEMA	National Environmental Management Act 107 of 1998
NEMBA	National Environmental Management: Biodiversity Act 10 of 2004
NEMWA	National Environmental Management: Waste Act 59 of 2008
NFA	National Forest Act 84 of 1998
NFEPA	National Freshwater Ecosystem Priority Areas
NGDB	National Groundwater Database
NHRA	National Heritage Resources Act 25 of 1999
NMD	Neutral Mine Drainage
NOMRA	New Order Mining Right Application
NOMR	New Order Mining Right
NWA	National Water Act 36 of 2008
NWCS	National Wetland Classification System
PEMC	Present Ecological Management Class
PES	Present Ecological State
PFD	Process Flow Diagram
POC	Probability of occurrence
PRECIS	Pretoria Computer Information Systems
QDS	Quarter Degree Square
RBCT	Richards Bay Coal Terminal
RDL	Red Data List
RDM	Resource Directed Measures
RE	Risk estimation
REC	Recommended Ecological Category
RHP	River Health Programme
RLT	Rapid Load-Out Terminal
ROM	Run of Mine
SAM	Social Accounting Matrix
SANBI	South African National Biodiversity Institute
SAR	Sodium Absorption Ration
SASS5	South African Scoring System version 5
SDF	Spatial Development Framework
SEIA	Socio-Economic Impact Assessment
SoER	State of the Environment Report

TERM / ABBREVIATION	MEANING
SSC	Species of Special Concern
SUR	Strict Unemployment Rate
TDS	Total Dissolved Solids
TFR	Transnet Freight Rail
TOPS	Threatened or Protected Species
TWQ	Target Water Quality
UNESCO	United Nations Education, Science and Cultural Organizations
VBR	Vhembe Biosphere Reserve
WBR	Waterberg Biosphere Reserve
WMA	Water Management Area
WQO	Water Quality Objective
WQT	Water Quality Threshold
WZ	Weathered Zone

1 DESCRIPTION OF THE BASELINE ENVIRONMENT

1.1 PROJECT LOCATION

The Mopane Project forms part of the Greater Soutpansberg Project (GSP) situated to the north of the Soutpansberg in the Limpopo Province. Figure 1 depicts the locality of the various GSP projects, from which it is evident that they are within close vicinity of each other, permitting possible rationalisation of infrastructure.

Similar applications for New Order Mining Rights (NOMRs) in terms of Section 22 of the Mineral and Petroleum Resources Development Act 28 of 2002 (MPRDA) have been submitted by Coal of Africa Limited (CoAL), Chapudi Coal (Pty) Ltd (Chapudi), Kwezi Mining Exploration (Pty) Ltd (Kwezi) and Regulus Investment Holdings (Pty) Ltd (Regulus) based on the prospecting rights held by them in the Mopane Project area. The objective is to have a consolidated project with economically minable blocks which are contiguous.

Therefore, in parallel to the NOMR applications, the applicants will be applying for the consent of the Minister of Mineral Resources, to:

- Simultaneously with the granting of the NOMRs, cede certain of the mining rights from CoAL, Chapudi and Kwezi to Regulus in terms of Section 11 of the MPRDA; and
- After cession of the mining rights, consolidate these into one mining right for the Mopane Project in terms of Section 102 of the MPRDA.

CoAL is a shareholder of MbeuYashu (Pty) Ltd, with a shareholding of 74%. The remaining 26% is held by Rothe Investments (Pty) Ltd, a Black Economic Empowerment company as contemplated in the Mining Charter. MbeuYashu in turn holds a 100% shareholding in Chapudi and Kwezi. CoAL is also the holder of 100% of the issued shares in Regulus.

The Mopane Project has shown a robust return in challenging market conditions. The primary product, semi-soft coking coal, has demand in both South Africa and internationally, whilst the secondary thermal product (export grade and Eskom grade) adds significant value as a product booster. Coupled with the rest of the assets in the province, the Mopane Project is uniquely placed to contribute significantly and responsibly to developing Limpopo's mineral wealth.

The Mopane Project is situated in the magisterial district of Vhembe, in the Limpopo Province, approximately 40 km (direct) and 63 km (via road) north of the town Makhado and 7 km west of Mopane in the Musina and Makhado Local Municipal areas. The nearest town is Musina, situated approximately 30 km to the north – refer to Figure 2 and Figure 3. Musina and Makhado are connected by well developed road infrastructure.

The Mopane Project, consisting of the Voorburg and Jutland Sections (Figure 3), is well situated with respect to major infrastructure, including rail, road and power. The Mopane Railway Station is situated between the Voorburg and Jutland Sections to the east and is linked to the N1 with a surfaced road of 7 km length. The Jutland Section is traversed by the R525 road between Mopane and Alldays. Private roads to connect mine infrastructure will need to be established.

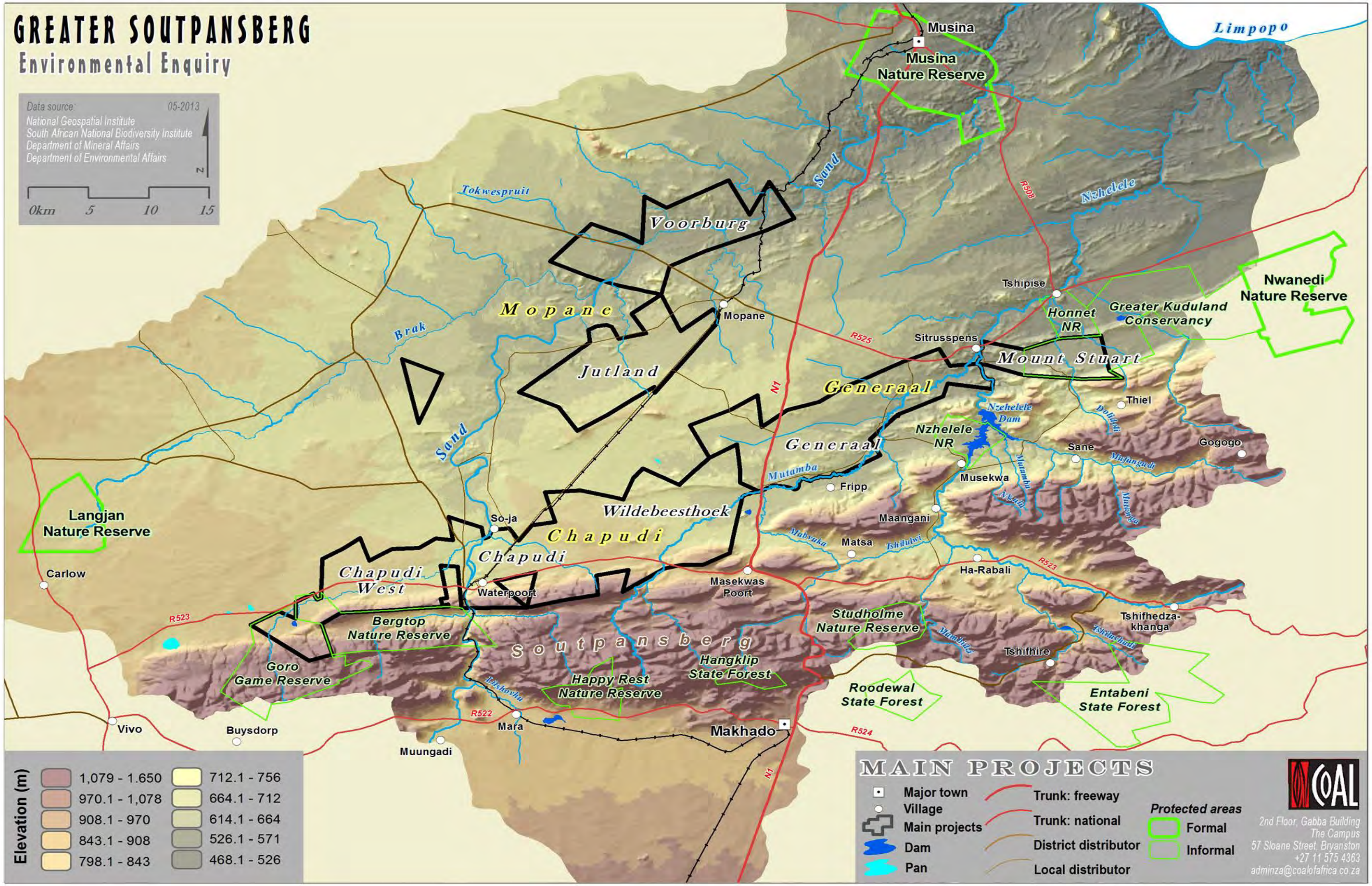


Figure 1: Location of Greater Soutpansberg Projects

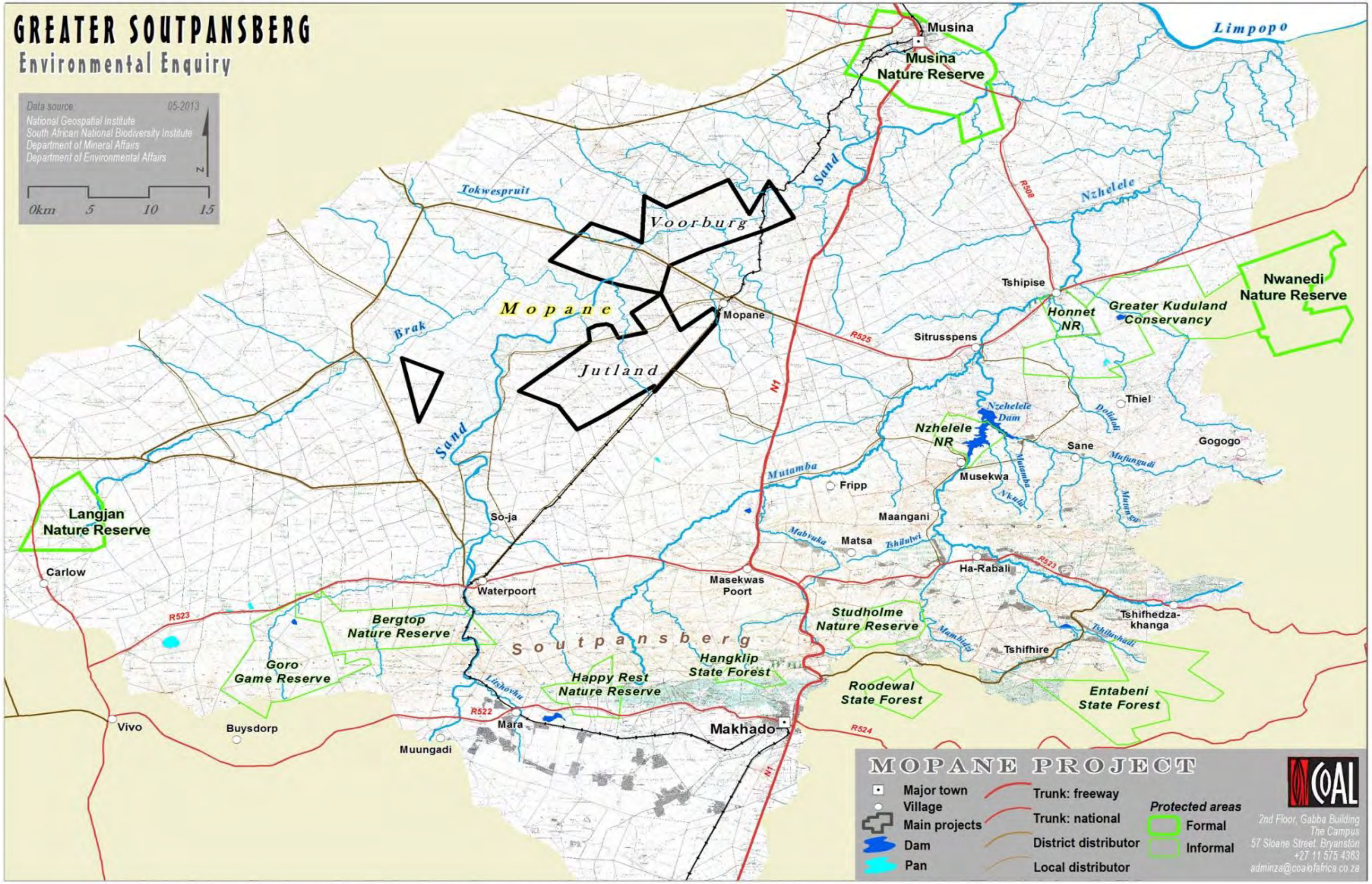


Figure 2: Mopane Project – Locality Map

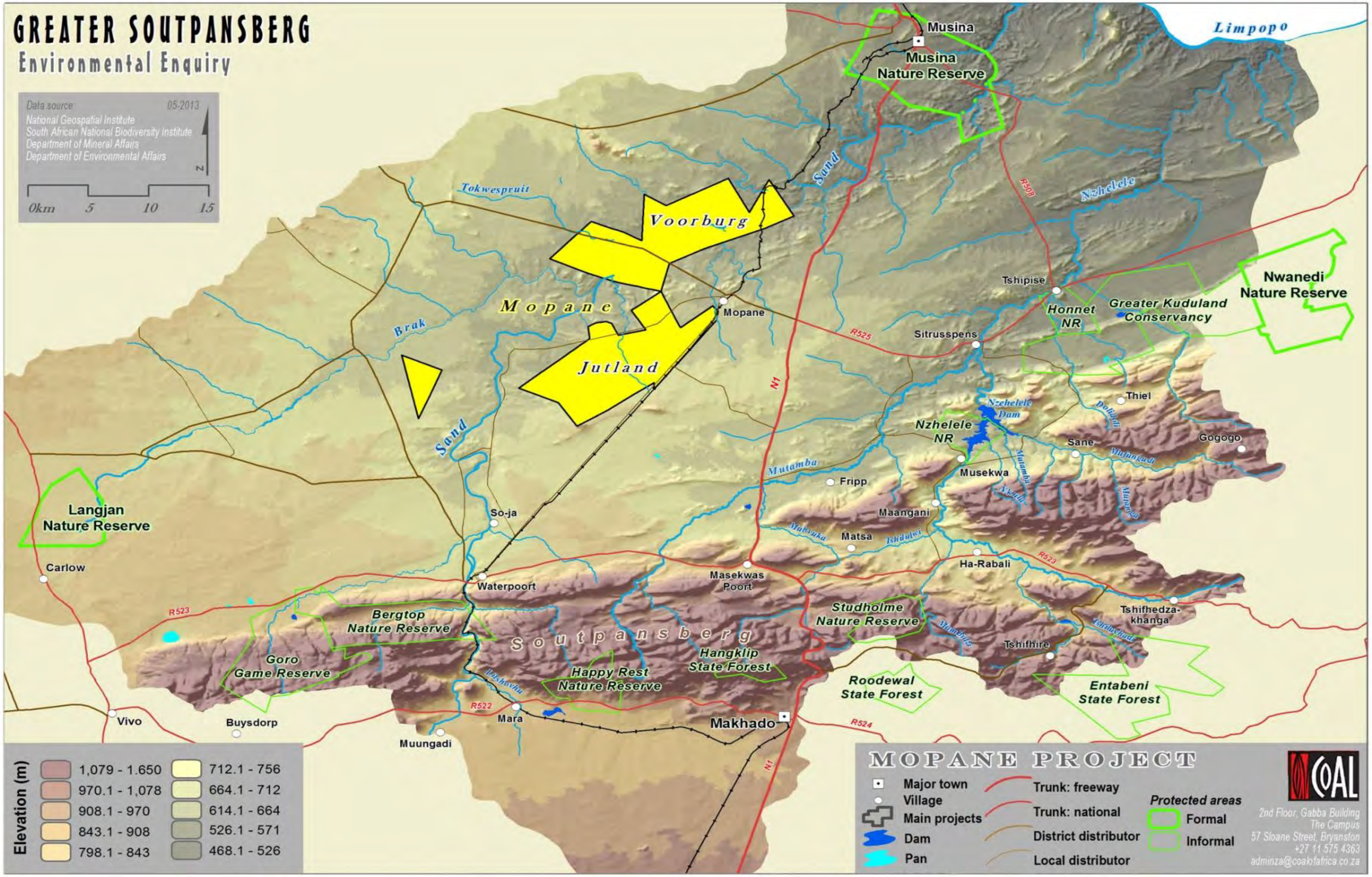


Figure 3: Location of Voorburg and Jutland Sections

1.1.1 SURFACE OWNERSHIP

The area covered by the NOMR applications includes twenty-one (21) farms as listed in Table 1 below. The majority of the properties are privately owned. The properties included in NOMR applications are shown in Figure 4 – refer to shaded properties within the Mopane Project area.

1.1.2 COMMUNITIES

There are no rural communities in the vicinity of the Mopane Project. The only settlement is that of the Mopane Town. There is a proposed development next to the Mopane Town for the development of 1 000 erven proposed by the Municipality. This development has recently obtained Environmental Authorisation.

1.1.3 LAND CLAIMANTS / TRADITIONAL AUTHORITY

MbeuYashu has consulted with the Regional Land Claims Commissioner (LCC) in Limpopo regarding the gazetted land claims for the farms covered by the Mopane Project and its surrounds.

Table 1 below depicts the claims which have been submitted to the Regional LCC by the various communities. This information has been mapped (refer to Figure 5) to show its relevance to the project. According to the Regional LCC the Mulambwane Community claimed a number of farms, while the Tshivhula and Leshivha Communities have claimed one farm (Ursa Minor 551 MS).

A request has been sent to the Regional LCC for pronouncement on the report which was compiled by the University of Venda on the land claims in the area. To date, no response has been received.

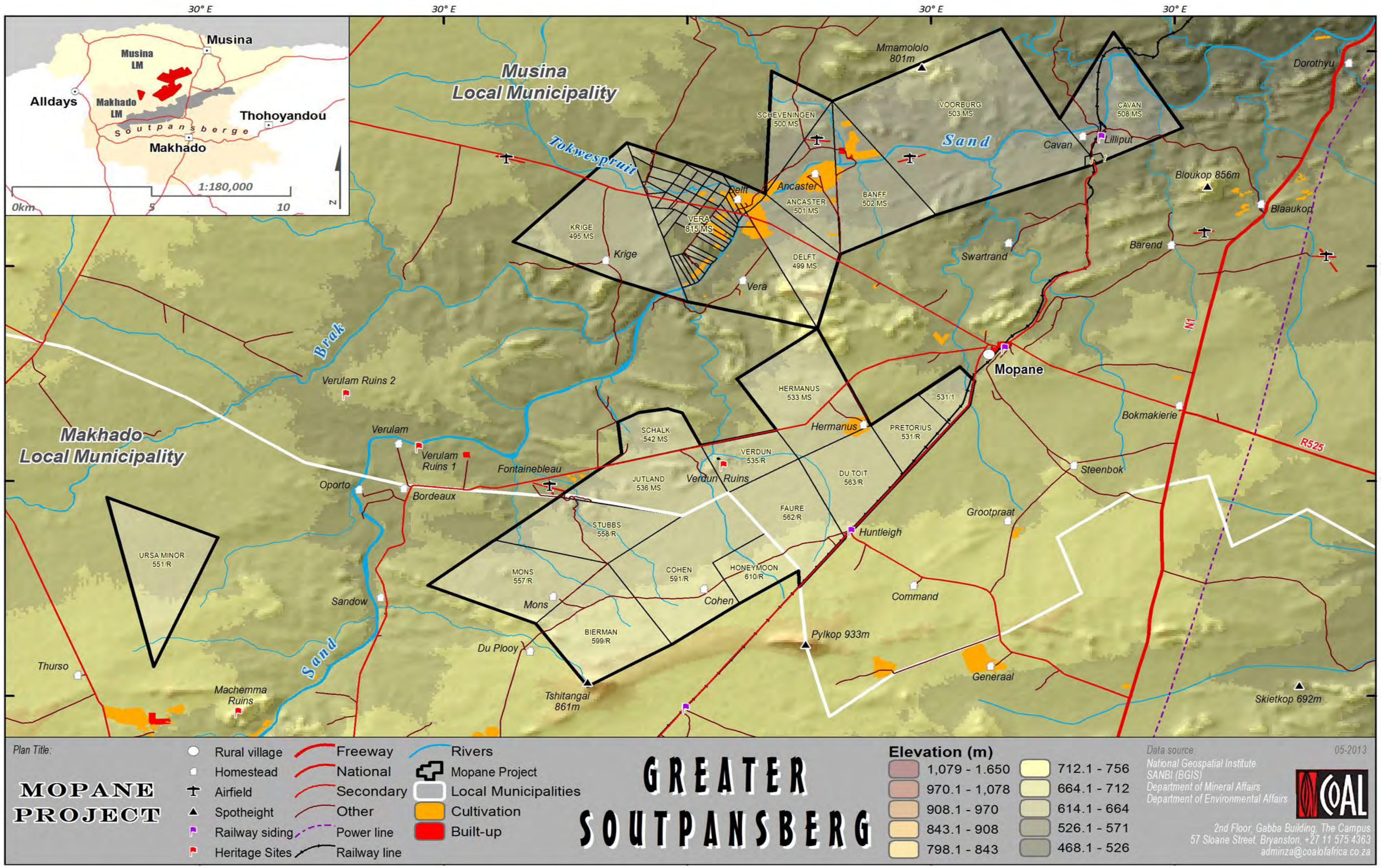


Figure 4: Surface properties included in NOMR applications

Table 1: Surface properties included in NOMR application

DMR Ref No	Applicant	Farm	Portion	Landowner	Title Deed Number	Extent (ha)	Land Claimant
10029MR	Kwezi	Bierman 559MS	All	Phindaba Prop (Pty) Ltd	T170516/2003	1293.1107	No Land Claimant
		Du Toit 563MS	RE	Souis Hendrie van der Walt	T22372/1963	927.1422	Mulambwane
		Faure 562MS	All	PJ Kotze	-	1032.5437	Mulambwane
		Hermanus 533MS	All	J W Van Der Merwe Trust	T89670/2005	1384.504	No Land Claimant
		Otto 650MS (now Honeymoon 610MS)	RE	Otto-Cohen Boerdery (Pty) Ltd	T3629/1986	1357.3673	Mulambwane
		Pretorius 531MS	RE	Limpopo Provincial Government	-	tbc	Mulambwane
		Pretorius 531MS	Ptn 1	JL du Preez & Seuns Verhurings cc	T1056/1940	260.133	Mulambwane
		Verdun 535MS	RE	Honeymoon Trust	T70649/1999	510.6131	No Land Claimant
10030MR	Kwezi	Vera 815MS	Ptn 1	Willem Johannes Jacobus Maree	T69055/2011	49.1488	Mulambwane
		Vera 815MS	Ptn 3	Pioen 1102 (Pty) Ltd	T6146/1992	22.6326	Mulambwane
		Vera 815MS	Ptn 4	Alfred Charles & Rouxnel White Hanekom	T146454/2007	22.9248	Mulambwane
		Vera 815MS	Ptn 5	Alfred Charles & Rouxnel White Hanekom	T51244/2001	26.9883	Mulambwane
		Vera 815MS	Ptn 6	Gerrit & Lettie van Deventer	T11715/1973	39.9825	Mulambwane
		Vera 815MS	Ptn 7	Alfred Charles & Rouxnel White Hanekom	T51244/2001	23.343	Mulambwane
		Vera 815MS	Ptn 8	Alfred Charles & Rouxnel White Hanekom	T51244/2001	29.3407	Mulambwane
		Vera 815MS	Ptn 9	Mutshaeni Boerdery cc	T86292/2010	28.4369	Mulambwane
		Vera 815MS	RE of Ptn 10	LP Swuhana	T55737/1988	43.0026	Mulambwane
		Vera 815MS	Ptn 13	Marthinus Hendrik Erwee	T142822/2004	21.562	Mulambwane
		Vera 815MS	Ptn 14	HJ Steyn	T64048/2007	21.562	Mulambwane
		Vera 815MS	Ptn 15	Sarel George Marais	T98222/1997	21.562	Mulambwane
		Vera 815MS	Ptn 16	Alfred Charles & Rouxnel White Hanekom	T51245/2001	21.562	Mulambwane
		Vera 815MS	Ptn 17	Ina du Toit	T84131/1994	21.562	Mulambwane
		Vera 815MS	Ptn 18	Torive Safaris	T142822/2004	21.562	Mulambwane
		Vera 815MS	Ptn 19	Torive Safaris	T142822/2004	21.4679	Mulambwane

DMR Ref No	Applicant	Farm	Portion	Landowner	Title Deed Number	Extent (ha)	Land Claimant
		Vera 815MS	Ptn 20	Torive Safaris	T67566/2006	22.7762	Mulambwane
		Vera 815MS	Ptn 21	Torive Safaris	T84131/1994	21.562	Mulambwane
		Vera 815MS	Ptn 22	Jacobus Barend du Preez	T84131/1994	21.562	Mulambwane
		Vera 815MS	Ptn 23	Maddison Square Prop (Pty) Ltd	T84131/1994	21.562	Mulambwane
		Vera 815MS	Ptn 24	Torive Safaris	T62333/1988	21.562	Mulambwane
		Vera 815MS	Ptn 26	Mutshaeni Boerdery cc	T13652/1992	21.562	Mulambwane
		Vera 815MS	Ptn 27	Gerrit & Lettie van Deventer	T11716/1973	21.562	Mulambwane
		Vera 815MS	Ptn 29	Etiene Pieter Cornelius de Jong	T87535/2006	21.562	Mulambwane
		Vera 815MS	Ptn 30	Emmanuel Christian School	T6470/2008	21.562	Mulambwane
		Vera 815MS	Ptn 35	Alfred Charles & Rouxnel White Hanekom	T66954/2011	26.3914	Mulambwane
		Vera 815MS	Ptn 36	A B Singh Family Trust	T85460/2008	tbc	Mulambwane
		Vera 815MS	Ptn 37	A B Singh Family Trust	T85460/2008	tbc	Mulambwane
		Vera 815MS	Ptn 38	A B Singh Family Trust	T67205/2007	tbc	Mulambwane
		Vera 815MS	Ptn 39	Sarel George Marais	T74871/2004	tbc	Mulambwane
		Vera 815MS	Ptn 40	David Gordon Clark	T84128/2005	tbc	Mulambwane
		Vera 815MS	Ptn 41	A B Singh Family Trust	T28500/2001	tbc	Mulambwane
		Vera 815MS	Ptn 44	Pieter Lodewikus & Moira Ina du Toit	T164229/2003	tbc	Mulambwane
		Vera 815MS	Ptn 45	Pieter Lodewikus & Moira Ina du Toit	T164229/2003	tbc	Mulambwane
		Vera 815MS	Ptn 46	Pieter Lodewikus & Moira Ina du Toit	T75693/2001	tbc	Mulambwane
		Vera 815MS	Ptn 48	Derick & Aletta Elizabetha Cloete	T24288/2008	22.4069	Mulambwane
		Vera 815MS	Ptn 49	Johan Botha Trust	T63903/2011	21.4783	Mulambwane
		Vera 815MS	Ptn 50	Willem Hendrik Hogan	T123941/1999	22.4182	Mulambwane
		Vera 815MS	Ptn 51	Nthangeni Richard & Dorah Tshiwela Maanda	T165320/2004	23.581	Mulambwane
		Vera 815MS	Ptn 52	Edward George Scott	T31091/2008	21.499	Mulambwane
		Vera 815MS	Ptn 54	Betcor Boerdery cc	T16103/1988	24.7925	Mulambwane
10031MR	Kwezi	Scheveningen 500MS	All	Scottco (Pty) Ltd	T11044/1996	575.4311	No Land Claimant

DMR Ref No	Applicant	Farm	Portion	Landowner	Title Deed Number	Extent (ha)	Land Claimant
10032MR	Chapudi	Banff 502MS	All	Mazicom cc	T63823/2011	1133.3331	No Land Claimant
		Delft 499MS	RE	Theo Pienaar	-	445.215	No Land Claimant
		Delft 499MS	Ptn 1	Wynand & Christa Marais	T14520/2007	92.6471	No Land Claimant
		Delft 499MS	Ptn 2	Paul Smit Eiendomme	T78704/2012	342.6128	No Land Claimant
		Krige 495MS	All	Brodsky Trading 268 (Pty) Ltd	T110860/2006	1855.1812	No Land Claimant
		Schalk 542MS	All	Douw & Elzie Steyn	T100182/1994	482.4793	No Land Claimant
10033MR	CoAL	Voorburg 503MS	All	Koos Minnaar Trust	T35499/1989	3978.0501	No Land Claimant
10034MR	CoAL	Ancaster 501MS	RE	Scottco (Pty) Ltd	T11044/1996	322.7532	No Land Claimant
		Ancaster 501MS	Ptn 1	LTT Algemene Handelaars cc	T17967/2011	231.2636	No Land Claimant
		Ancaster 501MS	Ptn 2	LTT Algemene Handelaars cc	T17967/2011	253.8313	No Land Claimant
		Ancaster 501MS	Ptn 3	LTT Algemene Handelaars cc	T17967/2011	25.696	No Land Claimant
		Cavan 508MS	RE	Republic of South Africa	T15860/1959	1218.5746	Mulambwane
		Cavan 508MS	Ptn 1	Transnet	T9529/1991	4.6424	Mulambwane
		Cavan 508MS	Ptn 2	Transnet	T15861/1959	1.3567	Mulambwane
		Cohen 591MS	All	Karl Osmers Boerdery (Pty) Ltd	T3627/1986	1771.9635	Mulambwane
		Jutland 536MS	All	Partnum Inv 139 cc	T36426/2006	1051.3264	No Land Claimant
10035MR	Regulus	Mons 557MS	All	Lukas & Dina van der Merwe	T131832/2003	1198.6552	No Land Claimant
		Stubbs 558MS	All	Lukas & Dina van der Merwe	T131832/2003	1033.8113	No Land Claimant
10036MR	Kwezi	Ursa Minor 551MS	All	Mollevel Plase Trust	T6304/1998	1277.8886	Tshivhula \Leshivha

tbc: To be confirmed

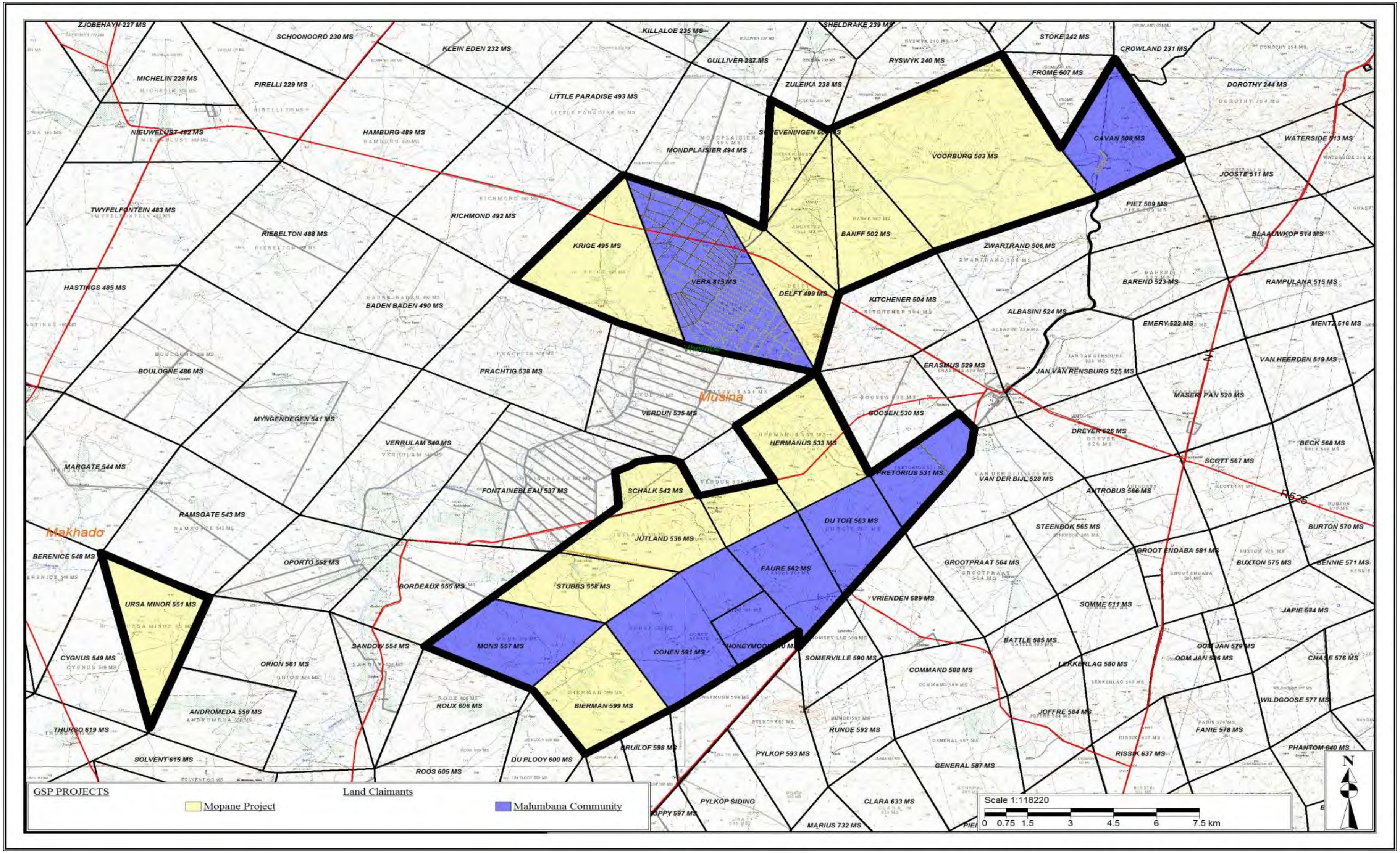


Figure 5: Mopane Project Land Claimants map

1.2 DESCRIPTION OF THE BIOPHYSICAL ENVIRONMENT

A number of specialist studies were performed for the Mopane Project, in line with the Plan of Study presented in the Scoping Report for the Mopane Project, June 2013. These are attached as Annexures as listed below.

Annexure	Aspect	Independent Consultant
ANNEX-1	Soils, Land Use & Capability	Gudani Consulting - EcoSoil Consortium
ANNEX-2	Surface Water	WSM Leshika Consulting (Pty) Ltd
ANNEX-3	Groundwater	WSM Leshika Consulting (Pty) Ltd
ANNEX-4	Biodiversity	Phaki Phakanani Environmental Consultants
ANNEX-5	Aquatic Systems	Scientific Aquatic Services
ANNEX-6	Ambient Noise	Gudani Consulting
ANNEX-7	Air Quality	Royal Haskoning DHV
ANNEX-8	Heritage Resources	Mbofho Consulting and Projects
ANNEX-9	Socio-Economic Aspects	Naledi Development Restructured (Pty) Ltd
ANNEX-10	Macro-Economic Aspects	Mosaka Economic Consultants cc

This Section is a summary of the baseline information provided in the specialist reports, and should be read in conjunction with the specialist reports.

1.2.1 CLIMATIC DATA

1.2.1.1 Regional Climate

The Mopane Project area is situated in a semi-arid zone to the north of the Soutpansberg. The regional climate is strongly influenced by the east-west orientated mountain range which represents an effective barrier between the south-easterly maritime climate influences from the Indian Ocean and the continental climate influences (predominantly the Inter-Tropical Convergence Zone and the Congo Air Mass) coming from the north.

The rainfall in this area usually varies between 300 to 400 mm in summer, while experiencing very dry winters. The area is characterized by cool, dry winters (May to August) and warm, wet summers (October to March), with April and September being transition months. Temperature range from 0.9°C to 39.9°C and the area is generally frost free.

The mountains give rise to wind patterns that play an important role in determining local climates. These wind effects include wind erosion, aridification and air warming.

1.2.1.2 Temperature

Average monthly minimum and maximum temperatures for the Tshipise weather station (No 0766277 1) some 32 km south-east of the Mopane Project area is shown in Table 2 below. Average daily maximum and minimum summer temperatures (November to February) at the weather station range between ~33°C and ~20°C, while winter temperatures (May to August) range between ~28°C and ~7°C respectively. The high average temperatures are reflected by the fact that the minimum average daily summer temperature is a high 20°C and the minimum average daily winter temperature does not dip below 7°C.

Table 2: Temperature data for Tshipise for the period from 1994 to 2006

Month	Temperature (° C)			
	Highest Recorded	Average Daily Maximum	Average Daily Minimum	Lowest Recorded
January	42.2	32.8	21.5	12.6
February	41.4	32.3	21.5	14.9
March	42.9	31.5	20.1	13.0
April	40.9	30.1	16.3	5.7
May	42.3	27.9	11.2	1.7
June	34.3	25.6	8.2	-0.4
July	34.1	25.0	7.3	-1.2
August	37.4	27.8	10.3	1.7
September	41.2	27.7	12.9	3.6
October	41.4	29.1	16.5	8.0
November	42.5	32.2	20.1	11.1
December	43.4	33.1	21.0	13.8
Year	43.4	29.6	15.6	-1.2

Source: Weather SA (Station No 0766277 1)

The Department of Agriculture's Agricultural Geo-referenced Information System (AGIS) hosts a wide spectrum of spatial information maps for public use. The two figures below, Figure 6 and Figure 7 indicate the maximum and minimum annual temperature for the region that was obtained from their natural resources atlas on climate.

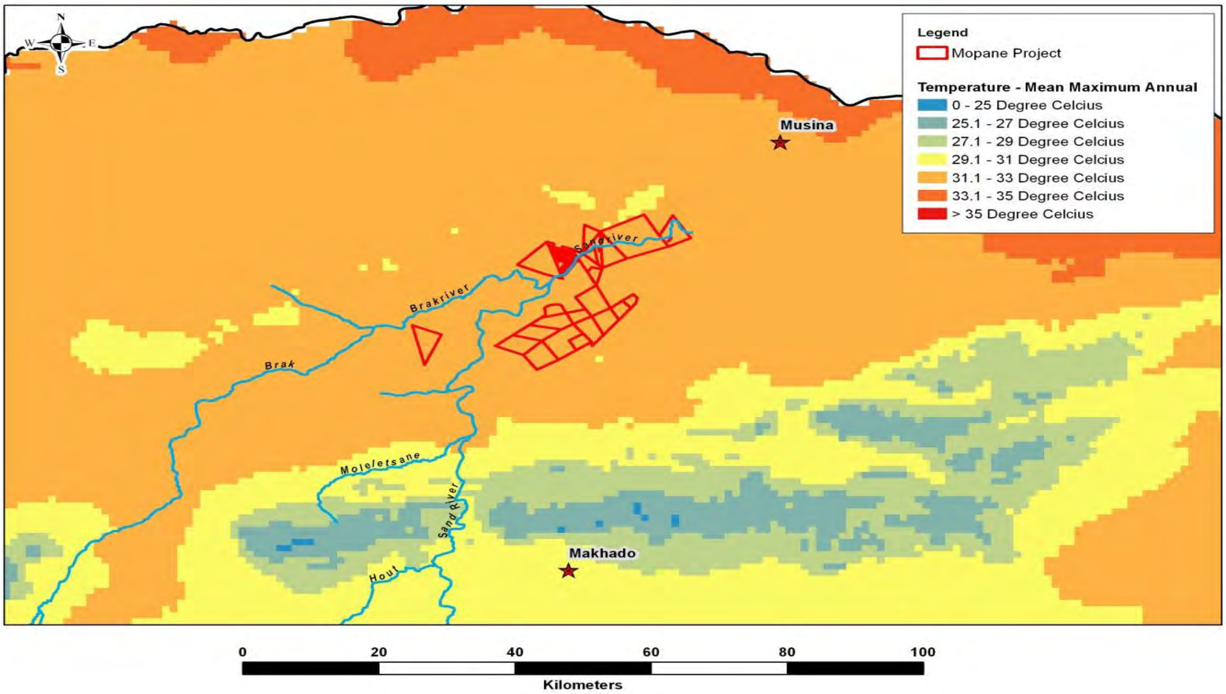


Figure 6: Mean annual maximum temperature

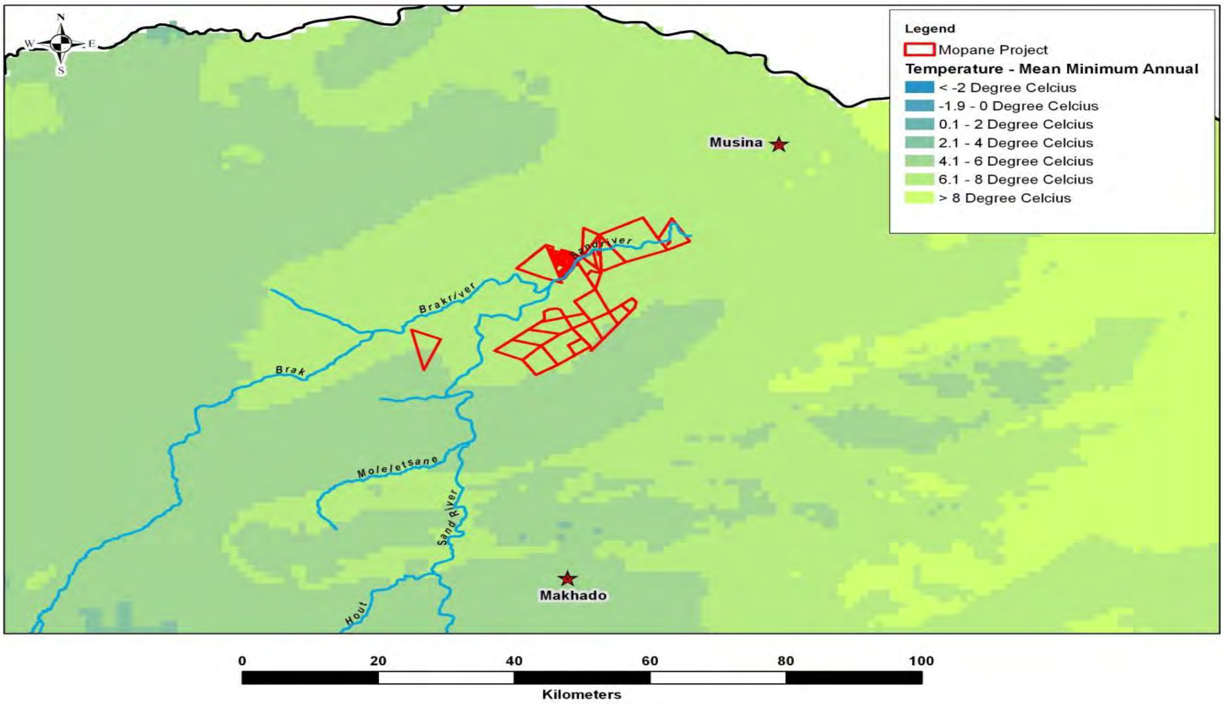


Figure 7: Mean annual minimum temperature

1.2.1.3 Winds

A period wind rose for the Mopane Project area is presented in Figure 8. Wind roses comprise of 16 spokes which represents the direction from which winds blew during the period. The colours reflect the different categories of wind speeds. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories.

Based on an evaluation of the meteorological data obtained from the South African Weather Services, the following deductions regarding the prevailing wind direction and wind frequency can be assessed. Looking at Figure 8 below, the predominant wind direction within the Mopane Project area is mainly from the south eastern region. Secondary winds are noted from the eastern region. At the site, 0.1 % of the time, calm conditions existed over the area. The highest frequency of wind speeds lie between 0.5 -2.1 m/s which occurred for 42% of the time (Figure 9). The second highest wind class 2.1 to 3.6 m/s occurs 34% of the time.

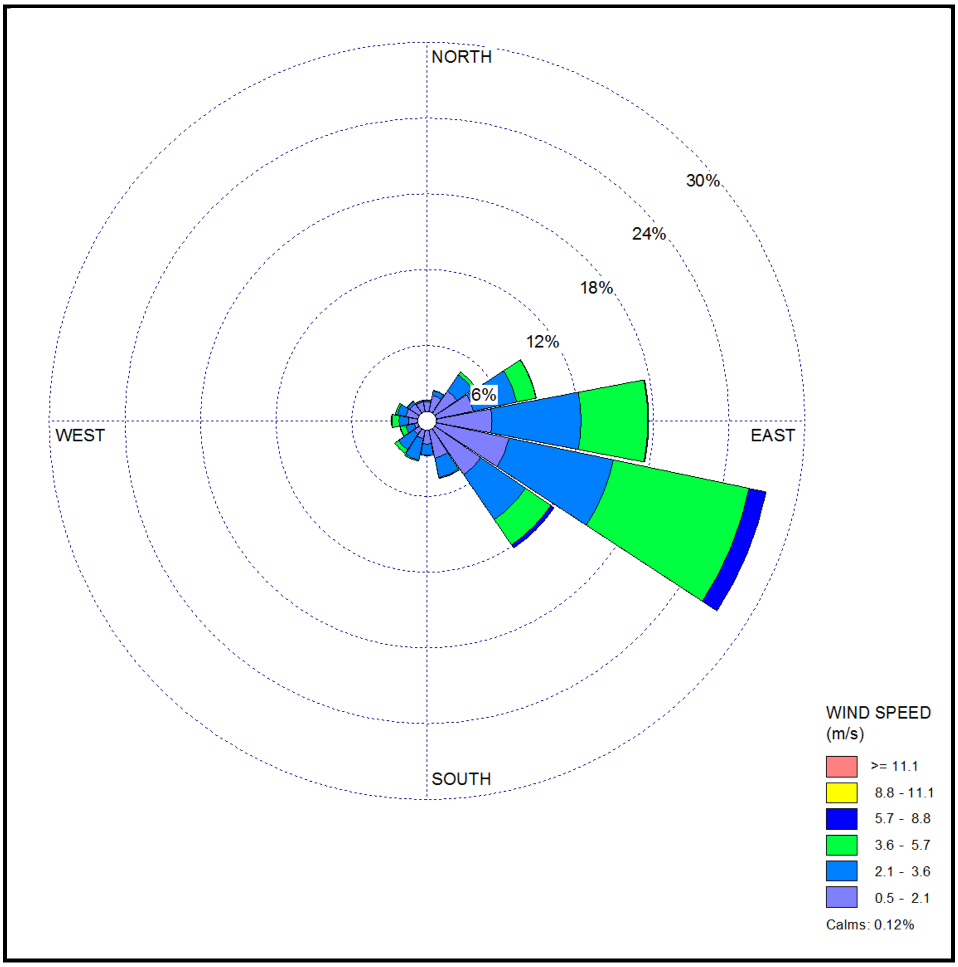


Figure 8: Period wind rose for the Mopane project area for the period Jan 2008 – Dec 2012

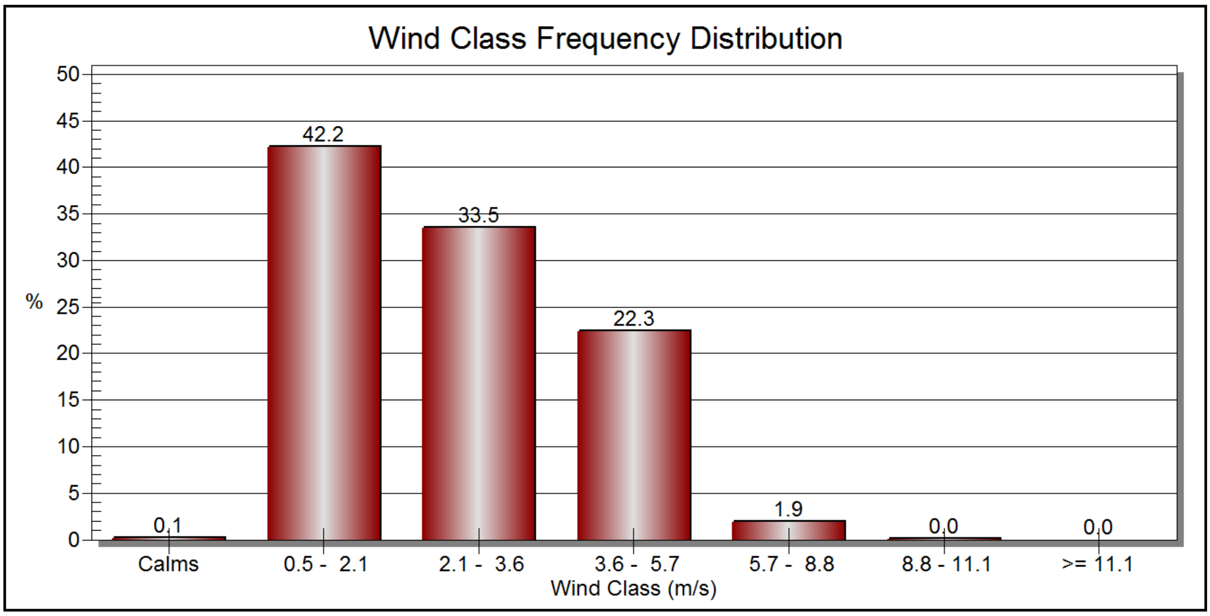


Figure 9: Wind class frequency distribution

Atmospheric stability is commonly categorized into six stability classes. These are briefly described in the table below. The atmospheric boundary layer is usually unstable during the day due to turbulence caused by the sun's heating effect on the earth's surface. The depth of this mixing layer depends mainly on the amount of solar radiation, increasing in size gradually from sunrise to reach a maximum at about 5-6 hours after sunrise. The degree of thermal turbulence is increased on clear warm days with light winds. During the night-time a stable layer, with limited vertical mixing, exists. During windy and/or cloudy conditions, the atmosphere is normally neutral. A neutral atmospheric potential neither enhances nor inhibits mechanical turbulences. Unstable atmospheric condition enhances turbulence, whereas stable conditions inhibit mechanical turbulence. Figure 10 illustrates the stability class frequency distribution. The site experienced very stable conditions.

A	Very unstable	calm wind, clear skies, hot daytime conditions
B	Moderately unstable	clear skies, daytime conditions
C	Unstable	moderate wind, slightly overcast daytime conditions
D	Neutral	high winds or cloudy days and nights
E	Stable	moderate wind, slightly overcast night-time conditions
F	Very stable	low winds, clear skies, cold night-time conditions

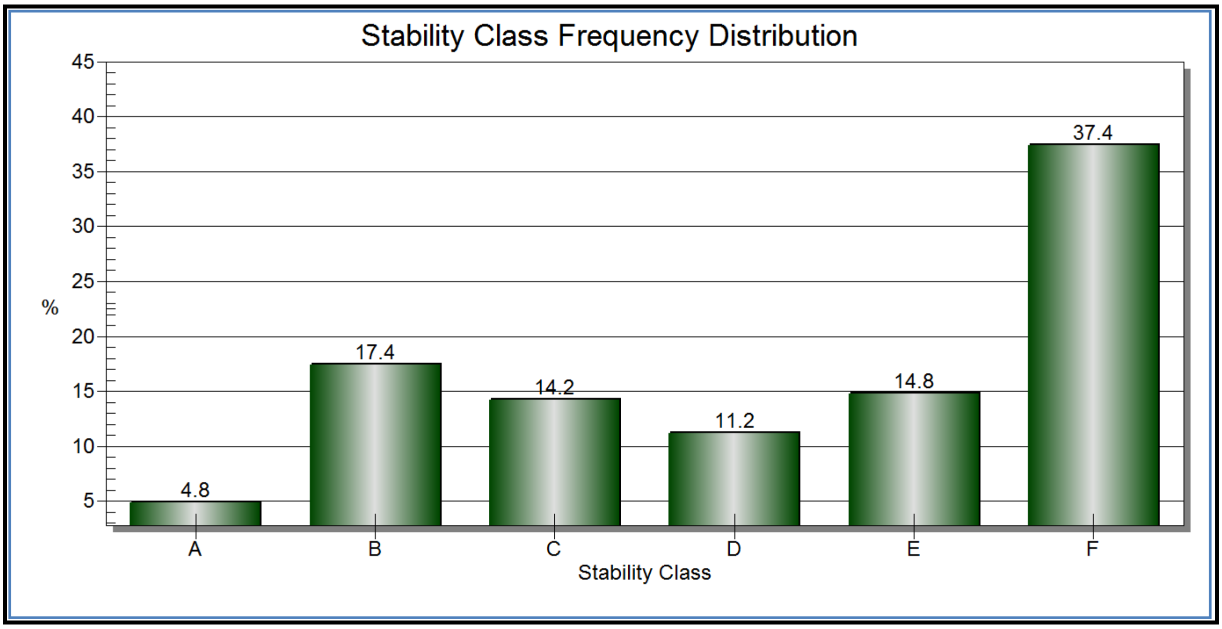


Figure 10: Stability class frequency distribution

1.2.1.4 Mean Annual Precipitation and Mean Monthly Rainfall

The Mopane Project is situated within the Sand River Basin, which is a tributary of the Limpopo River. The Sand River originates south of Polokwane in a cold semi-arid zone summer rainfall area of 500 to 600 mm precipitation. In the hot-arid zone to the north of the Soutpansberg, however, the rainfall decreases to 200 -300 mm. High precipitation occurs on the Soutpansberg which creates high local run-off. The Basin's mean annual precipitation (MAP) distribution is shown in Figure 11 below.

Note that the region is also within the impact zone of tropical cyclones occurring in the Indian Ocean which may cause high-intensity rainfalls leading to peak run-off events. These events occurred here for example in 1958 (Astrid), 1976 (Danae), 1977 (Emily) and 2000 (Eline) (Van Bladeren and Van der Spuy, 2000).

The Mopane Project falls however within the hot-arid zone to the north of the Soutpansberg that has a MAP in the low 300mm range.

The project spans across three quaternary catchments A71J, A71K and A72B, defined in the WR2005 Study (Middleton and Bailey, 2009). All three quaternary catchments are located in Rainfall Zone A7C. The mean monthly precipitation values are given in Table 3 below. The maximum monthly rainfall of 20.49% occurs in January and the lowest of 0.31% in August. The monthly distribution pattern of rainfall in the three quaternary catchments is shown in Table 4.

Table 3: Mean monthly rainfall distribution of site rainfall (Zone A7C)

Rainfall Zone	Mean Monthly Precipitation (% Distribution)											
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
A7C	7.37	14.96	17.25	20.49	17.07	11.84	5.21	2.04	1.14	0.67	0.31	2.40

(Source: Middleton, B.J. and A.K. Bailey (2009). Water Resources of South Africa, 252005 Study. WRC Rep No TT381. Pretoria)

The absolute monthly rainfall (% distribution x MAP) in the site quaternary catchments are shown in Table 4. The average rainfall for the three catchments have been determined and the maximum rainfall of 71mm occurs in January and the lowest of 1mm in August. The data in the table is shown in the bar chart below (Figure 12).

Table 4: Mean monthly quaternary rainfall (mm)

Quaternary Catchment	Mean Annual Precipitation (mm)	Rainfall Zone	Mean Monthly Precipitation (mm)											
			OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
A71J	396	A7C	29	59	68	81	68	47	21	8	5	3	1	10
A71K	305	A7C	22	46	53	63	52	36	16	6	3	2	1	7
A72B	344	A7C	25	51	59	70	59	41	18	7	4	2	1	8
Average	**348**		**26**	**52**	**60**	**71**	**59**	**41**	**18**	**7**	**4**	**2**	**1**	**8**

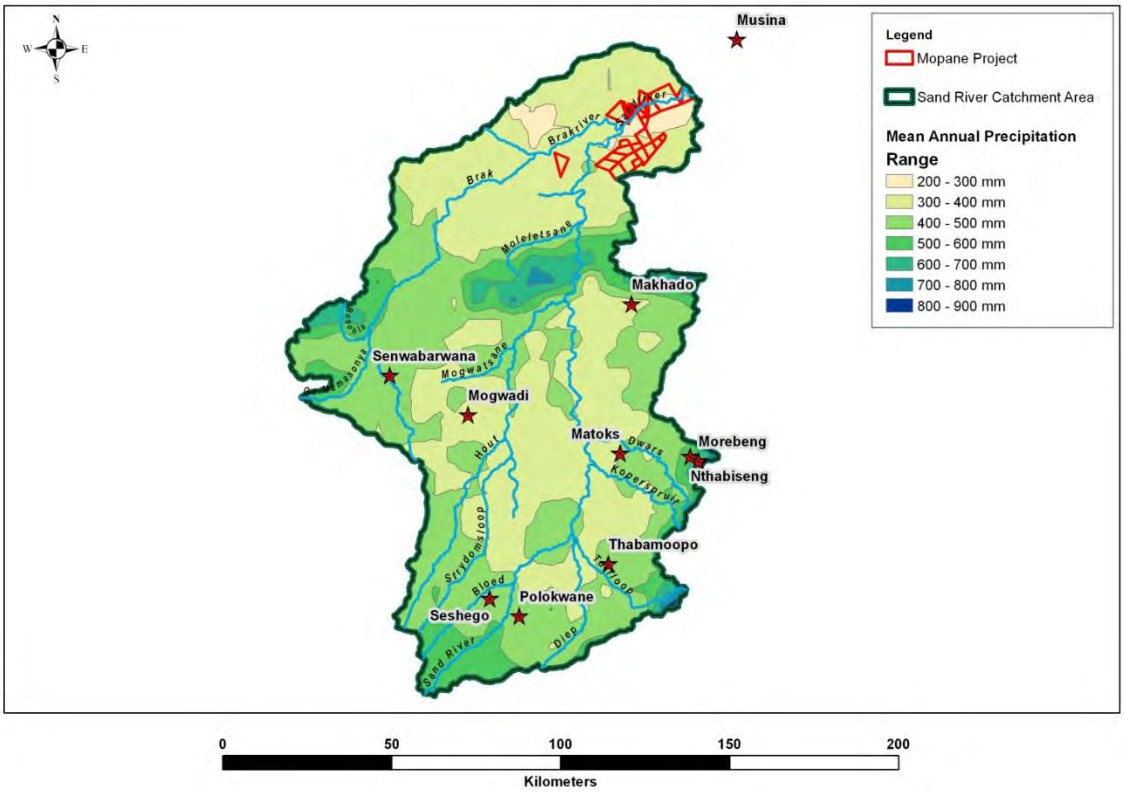


Figure 11: Sand River Basin mean annual precipitation

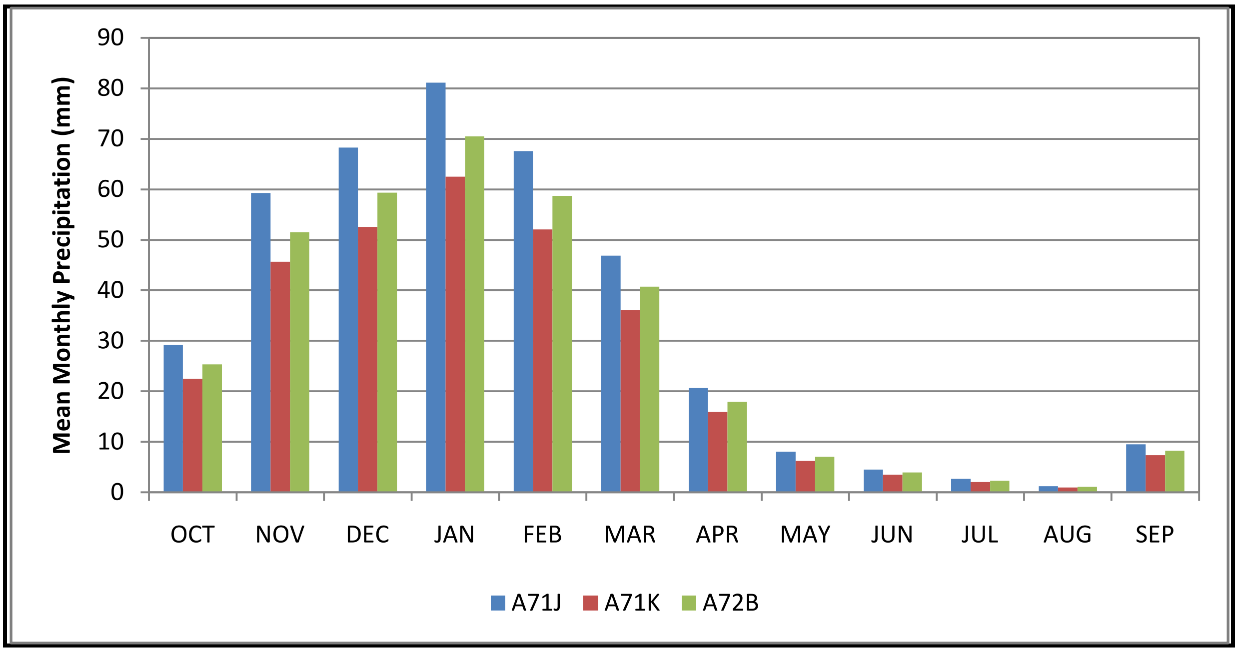


Figure 12: Distribution of mean monthly precipitation in mm

The rainfall data that will be used in the flood peak determinations would be taken from SA Weather Services' rain gauge 765007 at "Bandur", which is only about 20 km west of the site. This station has a record length of 40 years and a MAP of 284 mm. Its mean maximum annual daily rainfall value (or 'M2') is 50 mm. This value is used in one of the flood peak estimation methods, the so-called Alternative Rational Method (Kruger, 2006). The station MAP of 284 mm is 18% less than the average MAP of catchments A71J, A71K and A72B shown in Table 4 above. This illustrates the variability in rain gauge data which can sometimes not be explained by physical features such as a higher location. In this instance the lower value probably reflects the lower rainfall generally experienced towards the west. Other flood peak estimation methods based on the MAP would use the average values given in Table 4.

1.2.1.5 Run-off and Evaporation

The quaternary catchments in the region of the proposed development as defined in the WR90 Study (Midgley et al, 1994) are shown in Figure 13. The Mopane Project area is situated within catchment areas A71J, A71K and A72B. The total net catchment area at the point where the Sand River exits the site, is 12 759 km^2.

The upper reaches of the Sand River flow from mountainous terrain between Polokwane and Mokopane about 175 km south of the site.

The catchment hydrological data of this summer rainfall region are summarized in Table 5 below. Note that catchments A71J and A72B include endoreic areas, i.e. areas which do not contribute run-off to defined continuous streams. The MAR values are based on the net catchment areas shown in the table.

Run-off data were generated on a quaternary catchment area scale in the WRSM2000 model, an enhanced version of the original Pitman rainfall-run-off model, since there are no reliable long term measured flow data. Note that the MAR in the Sand River is not reflected in the table since it shows the naturalized run-off generated within the catchment. To obtain the present run-off, all surface water uses in the catchment area must be subtracted.

Table 5: Catchment data (from WR2005)

Quaternary catchment	Net area (km^2) A	Mean Annual Precipitation (mm) MAP	Mean Annual Run-off (mm) MAR	Mean Annual (gross) Evaporation (mm) MAE (Zone 1B)	Irrigation area (ha)	Forest area (ha)
A71J	905	396	9.69	1800	286	0
A71K	1668	305	4.49	2000	7	0
A72B	1269	344	5.66	1950	154	0

The naturalized run-off in the Sand River at the outlet of quaternary catchment A71K have been compiled from data in WR2005 and the resultant MAR is 80.96 million m^3/a as shown in Table 6. The naturalized unit run-off, based on the net catchment area of 12 759 km^2, amounts to 6.3 mm. Note that the DWA Internal Strategic Perspective (ISP) document gives the unit run-off for the Sand River as a mere 1 mm, but this may be based on current conditions, i.e. it includes for abstractions.

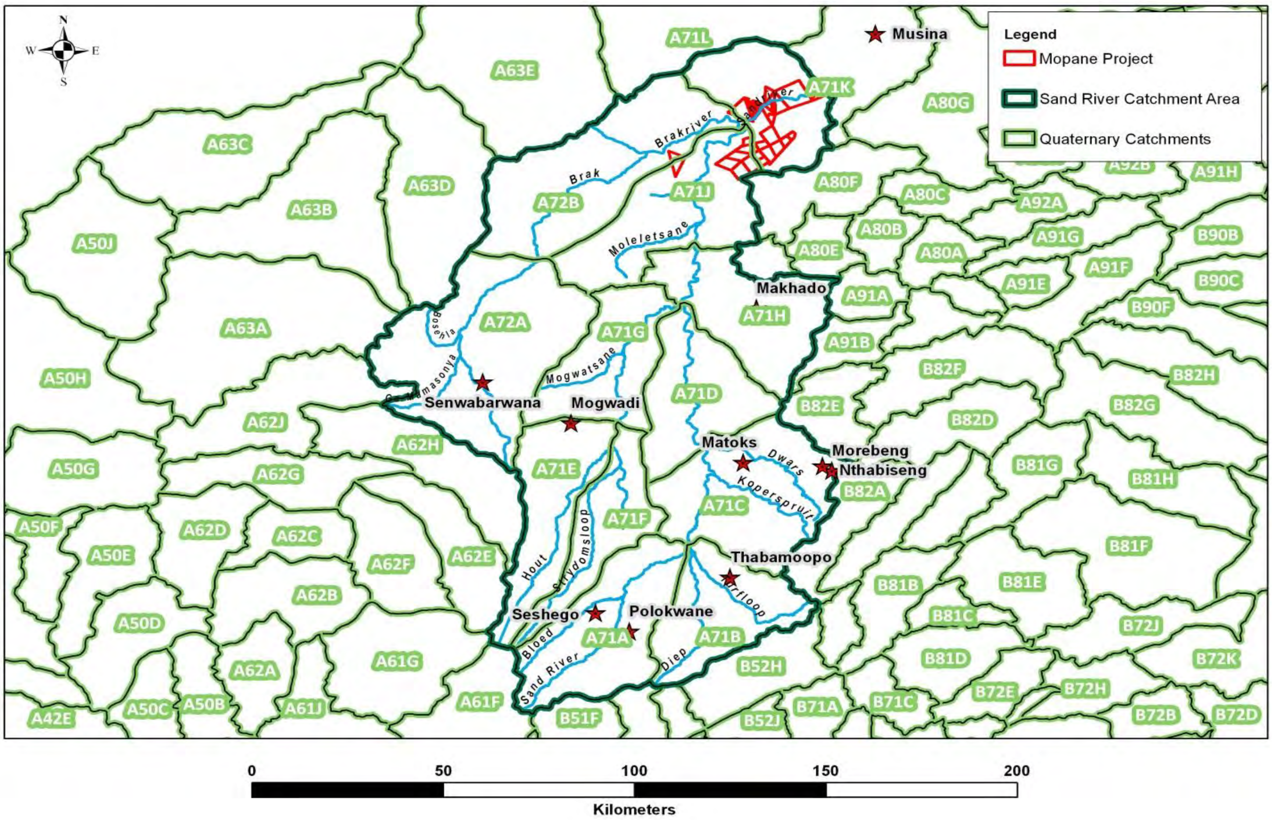


Figure 13: Quaternary catchments affected by the proposed development

Table 6: Sand River naturalized run-off

Quaternary Catchment (km^2)	Net Catchment Area (km^2)	River(s)	Naturalized MAR (million m^3/a)
A71A	1 144	Sand and Bloed	8.75
A71B	882	Diep and Turfloop	6.25
A71C	1 331	Sand, Dwars and Kopersspruit	7.16
A71D	892	Sand	3.73
A71E	893	Hout	4.01
A71F	683	Strydomsloop	2.63
A71G	875	Hout and Mogwatsane	4.46
A71H	894	Sand	11.37
A71J	905	Sand and Moleletsane	8.77
A72A	1 323	Brak, Ga Mamasonya and Bosehla	9.14
A72B	1 269	Brak	7.19
A71K	1 668	Sand	7.5
Total Net Catchment Area	**12 759**	**Total MAR (million m^3/a)**	**80.96**

The mean monthly naturalized run-off data for the two major affected catchments, A71J and A71K, is shown in Table 7.

Table 7: Simulated average naturalized monthly run-off for quaternary catchments A71J and A71K

Quaternary Catchment	Area (km^2)	Mean Monthly Natural Run-off (mm)												MAR (mm)
		OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	
A71J	905	0.14	0.30	0.42	2.37	4.30	1.42	0.19	0.12	0.11	0.11	0.10	0.10	9.69
A71K	1668	0.09	0.19	0.26	0.92	1.93	0.69	0.11	0.07	0.06	0.06	0.06	0.06	4.49

Mean Annual Evaporation data is given in Table 5, while the monthly evaporation pattern (as percentages of the total) is given in Table 8 below.

Table 8: Monthly evaporation distribution

Month	Evaporation (%)
October	10.46
November	10.03
December	10.68
January	10.43
February	8.49
March	8.49
April	6.94
May	6.55
June	5.40
July	6.08
August	7.42
September	9.03

Source: WR90, evaporation zone 1B, based on data from Albasini Dam

1.2.2 SOILS

1.2.2.1 Parent Material

The regional parent materials of the area are illustrated in Figure 14. The following materials are found in the area and may have an influence on the soil properties.

- Amphibolite, serpentine (mafic and ultramafic rock) of the Messina stratification, Beit Bridge Complex. It is igneous rock with polycyclic deformation.
- Granulite (from siliciclastic rock) is metamorphic rock from the Malala Drift or Mount Dowe Group, Beit Bridge Complex with polycyclic deformation.
- Marble, calc-silicate rocks are metamorphic rocks of the Gumbu Group, Beit Bridge Complex with polycyclic deformation
- Siliciclastic rocks are sedimentary rocks of the Solitude or Clarens Formation, Karoo supergroup.
- Chamokite - found in the area but not present on the farms under investigation
- Granite Gneiss- found in the area but not present on the farms under investigation
- Mafic and ultramafic volcanic rocks- found in the area but not present on the farms under investigation

Footprints are mainly on Siliciclastic rocks and the southern footprints are on marble, calc-silicate rocks.

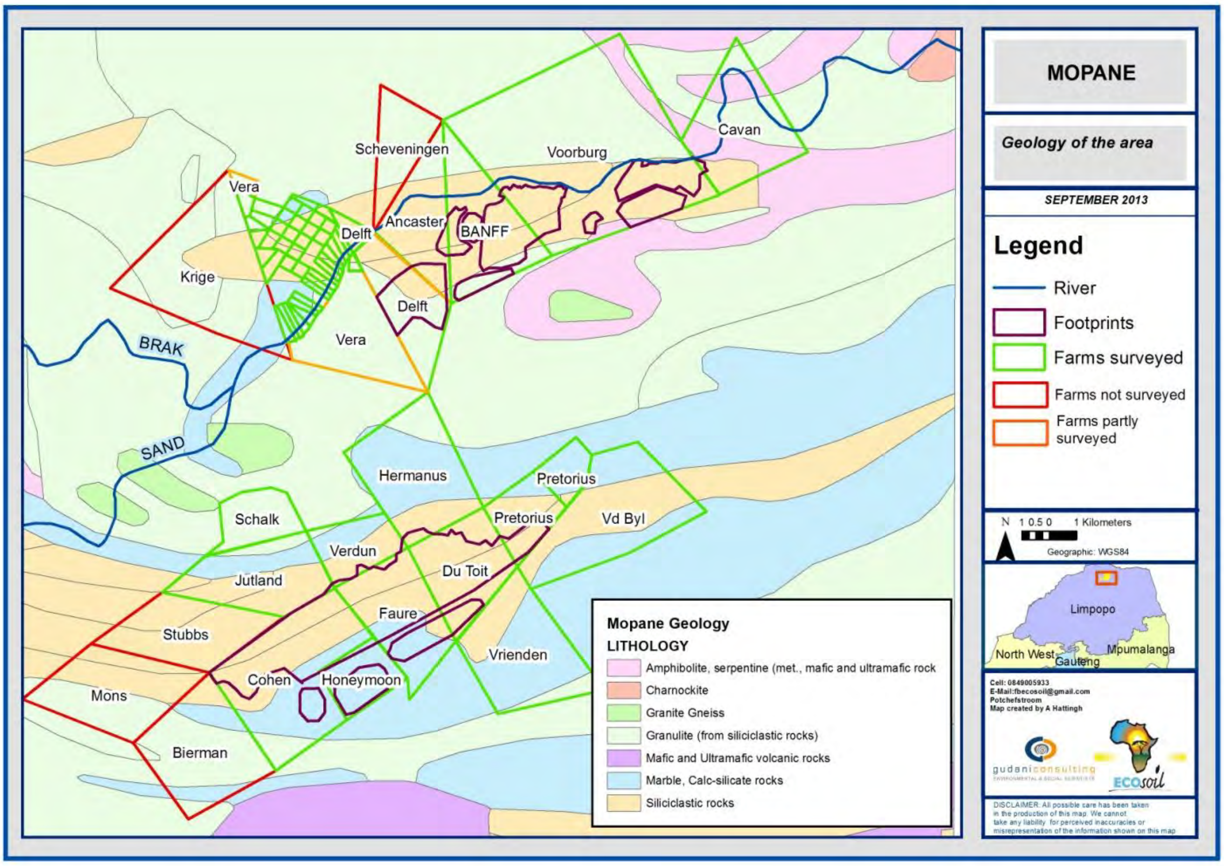


Figure 14: Parent materials of the study area

1.2.2.2 Land Types

Seven land types are found in the study area (Figure 15). Land types found in the study area, in the ranking order of area covered, are:

Ah89:

- Red-yellow apedal, freely drained soils. Red and yellow colours, high base status, usually < 15% clay.
- The majority of the area namely 15058ha falls within this class.
- Parent material is: Beit bridge complex, Malala drift formation; leucogneiss, metaquartzite, and amphibolite; gumbu gneiss, marble, gneiss; metaquartzite and amphibolite.
- Soil depth: 450mm - 750mm.
- Profile available water (PAW) content is between 41 - 60 mm, indicating low potential soils.

Ae266:

- Red-yellow apedal, freely drained soils. High base status > 300 mm deep (no dunes).
- 1378ha.
- Parent material is: Bulai gneiss and metaquartzite, gneiss and amphibolite of the Beit Bridge complex.
- Soil depth: 450mm - 750mm.
- Profile available water (PAW) content is between 41 - 60 mm, indicating low potential soils.

Fc483:

- Glenrosa and/or Mispah forms (other soils may occur). Lime generally present in the entire landscape.
- 1277ha.
- Parent material is: metaquartzite, magnetite quartzite, amphibolite and metapelite of the Mount dowe group, Beit Bridge complex; migmatite grey and leucocratic pyroxene-bearing gneiss of the Sand river gneiss.
- Soil depth: 450mm - 750mm.
- Profile available water (PAW) content is between 21 - 40 mm indicating very low potential soils.

Fc574:

- Glenrosa and/or Mispah forms (other soils may occur). Lime generally present in the entire landscape.
- 948ha.
- Parent material is: basalt of the Letaba formation in the Lebombo group - Karoo sequence. leucogneiss, amphibolite, metapelite of the Malala drift group.
- Soil depth: 450mm - 750mm.
- Profile available water (PAW) content is between 21 - 40 mm indicating very low potential soils.

IB312:

- Rocky areas with miscellaneous soils.
- 804ha.
- Parent material is: quartzite, conglomerate, sandstone and shale of the Stayt formation, Soutpansberg group; argillaceous sandstone of the Clarens formation, Karoo sequence.
- Soil depth: < 450mm.
- Profile available water (PAW) content is between 21 - 40 mm indicating very low potential soils.

Fa 646:

- Glenrosa and/or Mispah forms (other soils may occur). Lime rare or absent in the entire landscape.
- 602Ha.
- Parent material is: metaquartzite, leucogneiss and pink gneiss of the Mount Dowe group and Beit Bridge complex.
- Soil depth: < 450mm.
- Profile available water (PAW) content is between 21 - 40 mm indicating very low potential soils.

Ae305:

- Red-yellow apedal, freely drained soils. red, high base status > 300 mm deep (no dunes).
- 587ha.
- Parent material is: mainly sand of the quaternary system.
- Soil depth: >750mm.
- Profile available water (PAW) content is between 41 - 60 mm, indicating low potential soils.

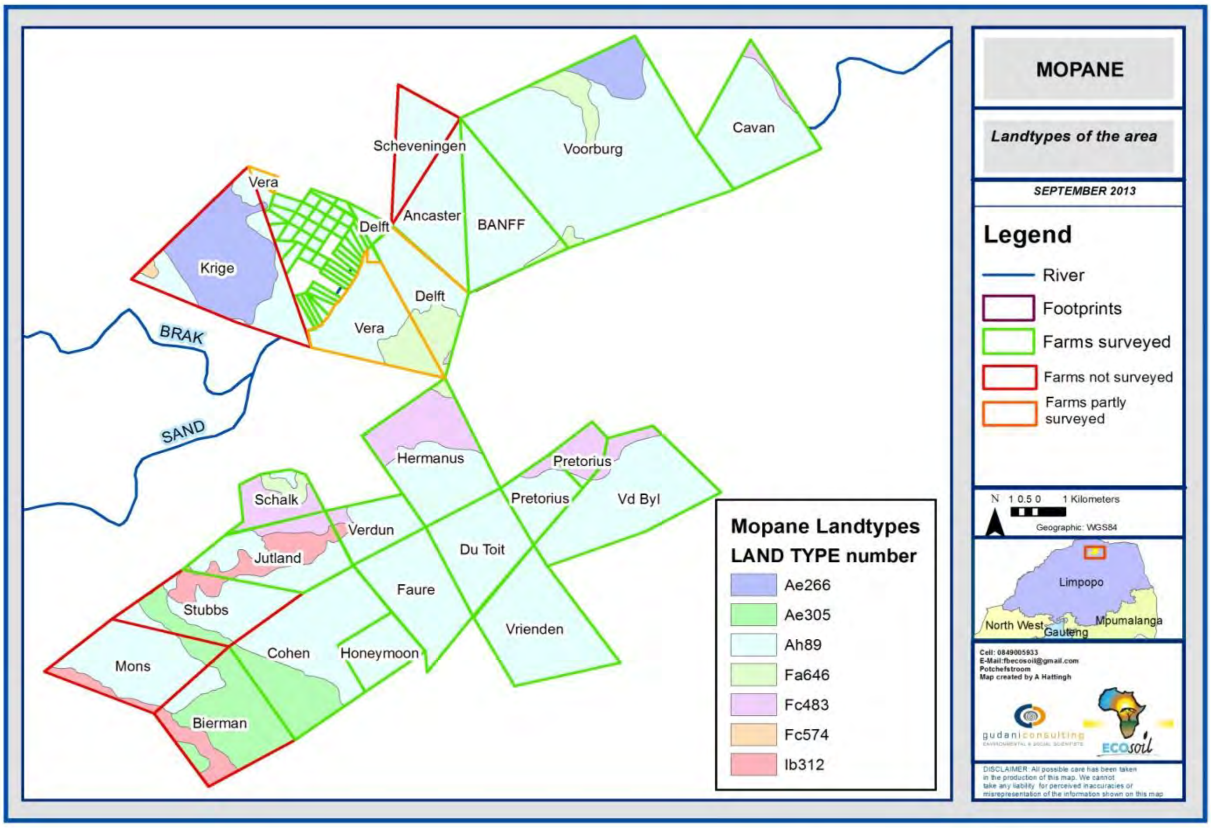


Figure 15: Land-types of the study area

1.2.2.3 Soil Forms

The soils vary significantly in physical and chemical composition over the different areas. They are strongly influenced by the underlying rocks (geology) from which they are derived, as well as by their position in the landscape and the origin of the parent material (in-situ versus colluvium derived).

The major soil forms that have generally the same characteristics were grouped together in soil associations. The associations occurring on the proposed development and the number of soil form occurrences (in brackets), are as follow:

1.2.2.3.1 Red apedal soils

- Hutton (Hu) [327] soils: Have an Orthic A-Horizon over a Red Apedal B Horizon over unspecified materials, like hard or weathered rock, or gravel.
- Plooysburg (Py) [9] and Kimberley Ky [4] soils: Have an Orthic A-Horizon over a Red Apedal B Horizon over a hardpan- or soft carbonate horizon respectively.
- Bloemdal (Bd) [1] soils: Is similar to the Hutton soils from, but has signs of wetness in the subsoil.

The depth of the apedal red soils in this study area ranges between 50cm to deeper than 150cm (average 75cm). Clay content of the top soil is between 3 and 35% (mean 15%), and at 50cm the clay content varies between 3 and 45% (mean 22%).

1.2.2.3.2 Yellow-brown apedal soils

- Clovelly (Cv) [22] soils: Have an Orthic A Horizon over a Yellow Brown Apedal B Horizon over unspecified materials, like hard or weathered rock, or gravel.
- Askham (Ak) [1] soils: Have an Orthic A Horizon over a Yellow Brown Apedal B Horizon over hardpan carbonate.

The average depth of the apedal yellow soils in this study area ranges from 10-120cm with a mean of 62cm. They have a mean clay content of 14% (ranging between 5 and 30) in the top soil and 23% at 50cm depth (ranging from 5 to 50%) They are present on the mid- and foot-slopes.

1.2.2.3.3 Neocutanic soils

- Oakleaf (Oa) [105] soils: Have an Orthic A Horizon over a Neocutanic B-Horizon over unspecified materials, without signs of wetness in the subsoil.
- Gamoep (Gm) [3] and Etosha (Et) [7] soils: Have an Orthic A Horizon over a Neocutanic B-Horizon over a hardpan- or soft carbonate horizon respectively.

In this study area the average depth of the neocutanic soils range from 40-150cm (mean 88cm). Clay content in the top soils of these soils varies between 9 and 35% (mean 18%) and between 11 and 45% at 50cm depth (mean 26%).

1.2.2.3.4 Carbonate soils

- Coega (Cg) [133] and Brandvlei Br [7] soils: Have an Orthic A Horizon over a hardpan- or soft carbonate horizon respectively.

The depth ranges from 5-45cm (mean 17cm). The clay content in the top soil ranges between 8 and 35% (mean 17%). These soils were seldom deeper than 45cm in this study area.

1.2.2.3.5 Neocarbonate soils

- Augrabies (Ag) [66] soils: Have an Orthic A-Horizon over a Neocarbonate B on unspecified materials.
- Prieska (Pr) [18] and Addo (Ad) [2] soils: Have an Orthic A Horizon over a Neocutanic B on a Hardpan- or Soft carbonate horizon respectively.

The depth ranges from 35cm to deeper than 150cm (mean 85cm). The clay content in the top soil ranges between 8 and 35% (mean 17%) and at 50cm depth it is between 18 and 35% (mean 31%).

1.2.2.3.6 Pedocutanic soils

- Swartland (Sw) [27] soils: Have an Orthic A-Horizon over a Pedocutanic B- horizon on Weathered rock (saprolite).
- Valsrivier (Va) [14] soils: Have an Orthic A-Horizon over a Pedocutanic B-Horizon without signs of wetness in the sub-soil.

The depth ranges between 40—110cm (mean 66cm). The clay content in the top soil is between 13 and 50% (mean 29%) and at 50cm depth it is between 30 and 60% (mean 37%).

1.2.2.3.7 Shallow rocky soils

- Mispah (Ms) [263] soils: Have an Orthic A-Horizon over hard rock.
- Glenrosa (Gs) [189] soils: Have an Orthic A-Horizon on a Lithocutanic B-Horizon.

The average depth of these soils ranges from 0 to 65cm (mean 21cm). The clay content in the A-Horizon varies between 5 and 55% (mean 15%) and at 50cm depth it varies between 25 and 55% (mean 53%).

1.2.2.3.8 Fernwood soils

- Fernwood (Fw) [2] soils: Have an Orthic A-Horizon over an E-Horizon on unspecified material.

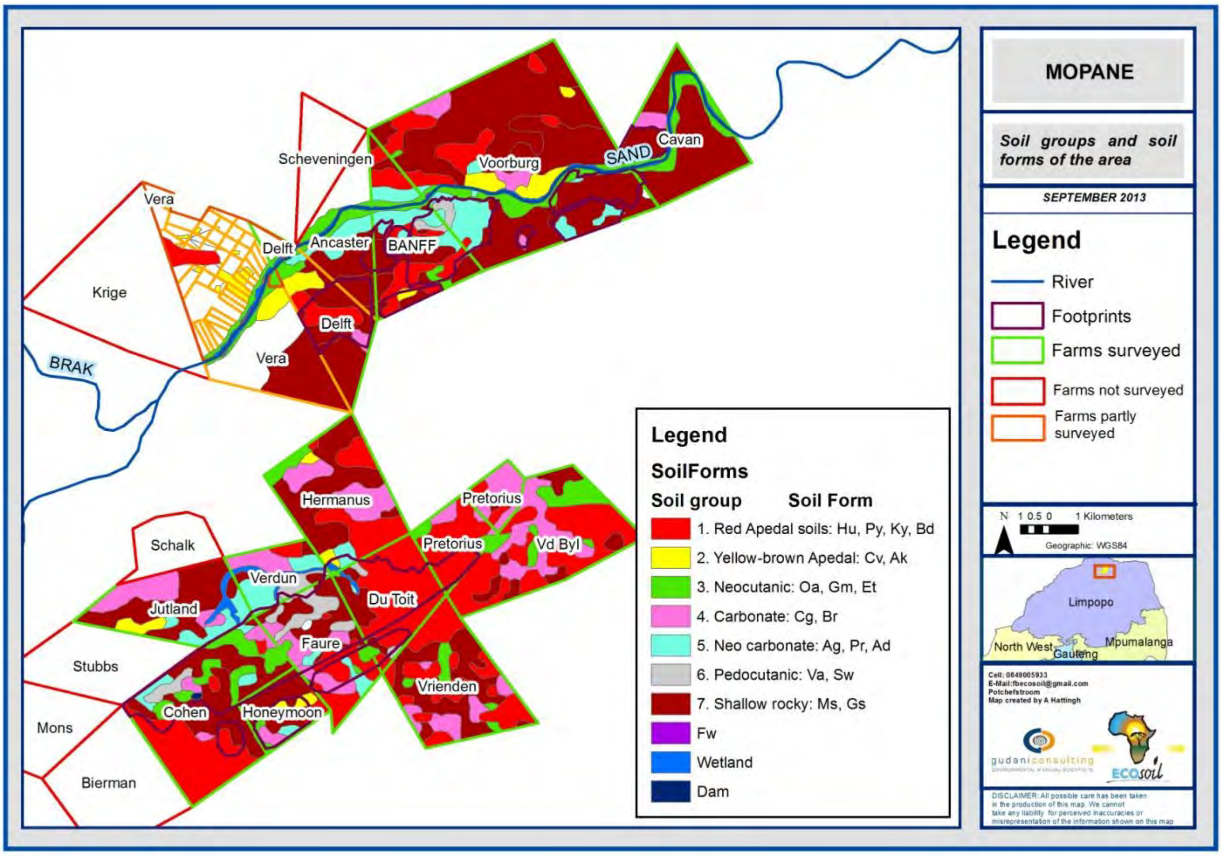


Figure 16: Soil groups (associations) and forms of the study area

Although soil forms can give a slight indication of soil capability, it cannot give an indication of agricultural potential. Soil forms give an indication of expected soil colour, properties and soil forming processes.

- Large areas of the farms Vd Byl, Pretorius, Du Toit, Hermanus, Cohen, Vrienden and Faure are covered with Hutton soil forms. When deep and when climate permits these soils can be considered as high potential. However this is not the case in the project area and the potential of these soils are degraded to Class IV due to climatic constraints.

- Relatively small areas of Yellow Apedal soils are found on localized areas on the farms Voorburg, Honeymoon and Jutland as well as on Vera and Delft. Only a small area of the footprint of Honeymoon is covered by yellow apedal soils. These soils are generally considered as having high agricultural potential where climatic conditions (e.g. rainfall) are favourable. Unfortunately this is not the case at Mopane. The agricultural potential is therefore downgraded.
- Neocutanic soils are mainly found on the floodplains along the river banks.
- Shallow rocky soils are dominant in the farms Voorburg, Cavan, Banff, and the southern parts of the farms Vera, Delft and Ancaster.
- Neo Carbonate soils are found in significant areas around the Sand River on the farms Voorburg, Banff and Ancaster.

Table 9: Summary of different soil physical properties of the soil groups

Properties	Soil Group 1	Soil Group 2	Soil Group 3	Soil Group 4	Soil Group 5	Soil Group 6	Soil Group 7
Soil association	Red Apedal	Yellow - brown Apedal	Neo-cutanic	Carbonate	Neo-carbonate	Pedo-cutanic	Shallow, rocky
Soil forms	Hu, Py, Ky, Bd	Cv, Ak	Oa, Gm, Et	Cg, Br	Ag, Pr, Ad	Sw, Va	Ms, Gs
Dominant soil	Hutton	Clovelly	Oakleaf	Coega	Augrabies	Swartland	Mispah
Soil family	1200	1200	1120	1000	1120	1122	1100
Soil Depth cm	50-150	10-120	40-150	5-40	35-120	40-110	0-40
Mean rooting depth cm	75	62	88	17	85	66	21
Infiltration rate	Moderate 10-15mm/h	Fast 15-20mm/h	Slow 5-10mm/h	Very Slow <5mm/h	Slow 5-10mm/h	Very Slow <5mm/h	Slow 5-10mm/h
Consistency	Loose	Loose	Friable	Soft	Soft	Hard	Loose
Structure	Apedal	Apedal	Weak blocky	Weak blocky	Weak blocky	Strong blocky	
Clay % A (mean)	3-28(15)	5-30 (14)	9-35(18)	8-35(17)	3-50(19)	13-50(29)	5-55(53)
Clay % 50cm	3-45 (22)	5-31 (23)	11-45 (26)	Soil not 50cm	18-50 (31)	18-60 (34)	Soil not 50cm
PAW mm/profile	29-184 (82)	12-134 (78)	42-203 (112)	4-98 (19)	49-197 (110)	54-149 (93)	0-140 (25)
Field capacity mm	49-338 (146)	22-237 (136)	71-396 (208)	7-171 (33)	90-383 (207)	104-290 (182)	0-267 (44)
Wilting point mm	20-126 (64)	10-107 (58)	30-139 (96)	3-79 (14)	38-1390 (98)	49-141 (89)	0-128 (19)
Drainage	Fast	Fast	Poor	Poor			
Gravel/Rocks A Horizon	-	-	-	R1	-	-	R5
Gravel/rocks B1 Horizon	G1	G1	G3	R6	G3	-	R
Gravel/rocks B2 Horizon	G1	G1	G3	-	G3	G3	-
Wetness	0	0	0	0	0	W1	0
Compactability	High	High	High	Moderate	High	Moderate	Low

Properties	Soil Group 1	Soil Group 2	Soil Group 3	Soil Group 4	Soil Group 5	Soil Group 6	Soil Group 7
Erodibility	Very High	Very High	High	Very High	Very High	Very High	Very High
Potential Nematode Infestation	High	High	Moderate	Low	Low	Low	High
Irrigation classification	3	3	4	5	5	4	5
Agricultural potential	Low to Medium	Low to medium	Medium	Marginal	Low	Low	Marginal

1.2.3 PRE-MINING LAND CAPABILITY

The land capability of the study area was classified into four classes (wetland, arable land, grazing land and wilderness) according to the Chamber of Mines Guidelines (COM), 1991.

Table 10: Criteria for Pre-Development Land Capability

Criteria for Wetland

- Land with organic soils or supporting hygrophilous vegetation where soil and vegetation processes are water determined.

Criteria for Arable land

- Land, which does not qualify as a wetland.
- The soil is readily permeable to a depth of 750 mm.
- The soil has a pH value of between 4.0 and 8.4.
- The soil has a low salinity and SAR
- The soil has less than 10% (by volume) rocks or pedocrete fragments larger than 100 mm in the upper 750 mm.
- Has a slope (in %) and erodibility factor (K) such that their product is <2.0
- Occurs under a climate of crop yields that are at least equal to the current national average for these crops.

Criteria for Grazing land

- Land, which does not qualify as wetland or arable land.
- Has soil, or soil-like material, permeable to roots of native plants, that is more than 250 mm thick and contains less than 50 % by volume of rocks or pedocrete fragments larger than 100 mm.
- Supports, or is capable of supporting, a stand of native or introduced grass species, or other forage plants utilisable by domesticated livestock or game animals on a commercial basis.

Criteria for Wilderness land

- Land, which does not qualify as wetland, arable land or grazing land.

The land capability of the area (according to the COM, 1991) classification is presented in Figure 17 and is summarised per farm in Table 11.

- Wetlands are defined as: "Land with organic soils or supporting hygrophilous vegetation where soil and vegetation processes are water determined". In this study area the following criteria was used:
  - Riparian zones were not delineated, and only wetland soil parameters per definition were used.
  - Small farm dams and pans that fell between two observation points (based on the grid size in the ToR's) were not mapped.
  - Many of the drainage lines are actually erosion dongas and gullies with Oakleaf, Augrabies, Glenrosa and Coega soils and cannot be regarded as wetlands soils per definition.
- Only large water bodies on Jutland and Verdun were found.
- Footprint areas are generally covered by soils classified with a wilderness and grazing capability. The farms Cohen and Pretorius have significant areas of arable soils. The farms Banff and Cohen have small areas of arable soils. However, the potential of these arable soils are classified as class IV soils.

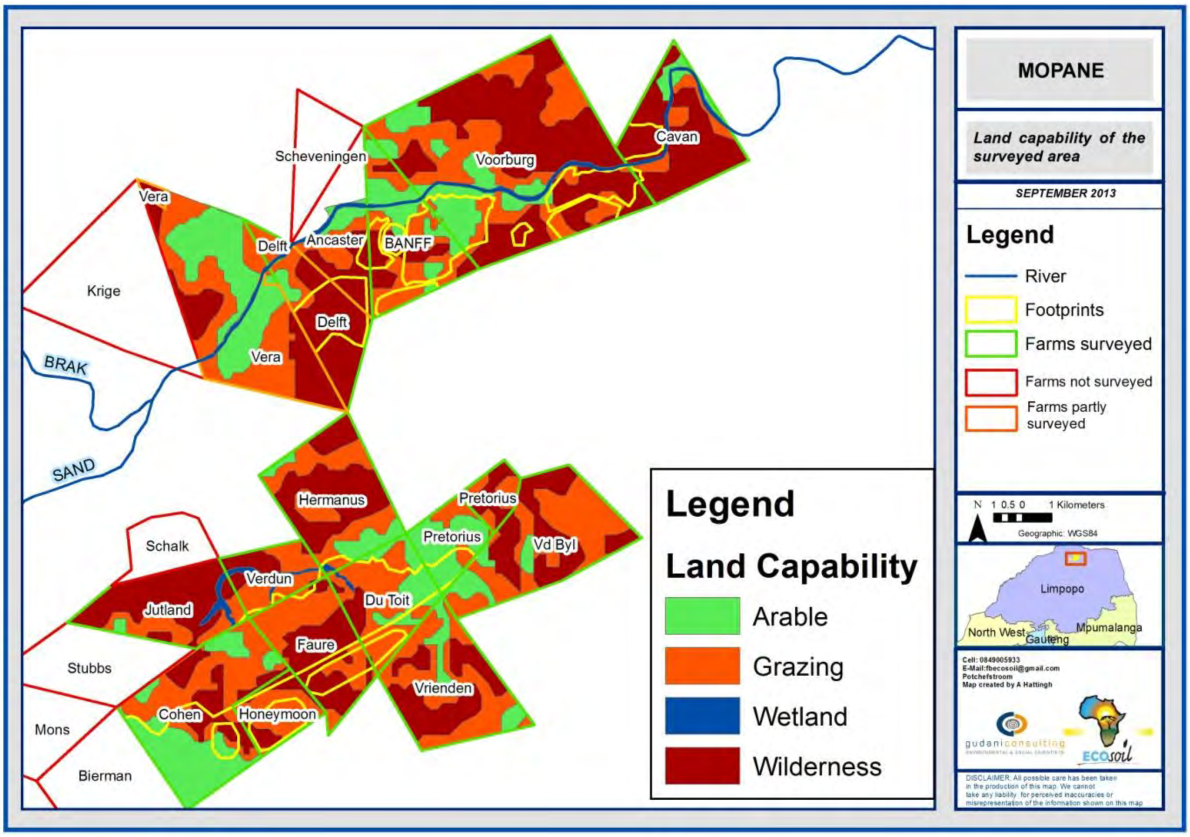


Figure 17: Land capability of the surveyed area

External factors like climate, topography, erosion factors, surface rock and water quality parameters are brought in consideration to determine the present agricultural potential, as summarized in Table 12.

Table 11: Areas of land capability classes on respective farms in the study area

Farm name	Total area (ha)	Arable	Grazing	Wetland	Wilderness
Ancaster	552	93	144	40	275
Banff	1157	341	516	17	283
Cavan	1248	110	149	77	912
Cohen	1808	761	652	0	395
Delft	887	49	187	11	640
Du Toit	935	268	563	11	93
Faure	1106	0	469	0	638
Hermanus	1398	167	498	10	723
Honeymoon	467	0	323	0	144
Jutland	1371	23	240	371	737
Pretorius	761	371	250	0	140
Vd Byl	1588	170	797	0	621
Vera	1056	307	408	21	320
Vera Small holdings	988	489	372	7	120
Verdun	516	0	314	53	149
Voorburg	4024	612	1216	88	2108
Vrienden	1384	175	656	0	553
Total	21246	3936	7754	706	8851

Table 12: Agricultural potential classification of land capability classes according to agricultural classification system

Soil Management Unit	Soil Group 1	Soil Group 2	Soil Group 3	Soil Group 4	Soil Group 5	Soil Group 6	Soil Group 7	Soil Group 8
Soil Types	Red Apedal	Yellow Apedal	Neo-Cutanic	Carbonate	Neo-Carbonate	Pedo-Cutanic	Shallow rocky	Wetland
Soil depths cm	50->150	10-120	40->150	5-45	35->150	40-110	0-65	-
Average soil depth cm	75	69	88	17	87	70	21	-
Limiting Factors	Texture, Water-holding capacity	Texture, Water-holding capacity	Erosion, Depth, Surface rock	Surface Rock, Erosion,	Surface Rock, Erosion,	Structure, Erosion	Rock, Depth	Water-logging
External Factors	Climate, Water Quality	Climate, Water Quality	Climate, Water Quality	Climate, Water Quality	Climate, Water Quality	Climate, Water Quality	Climate, Water Quality	Climate, Water Quality
Land capability	Arable, crop production	Arable crop production	Grazing	Grazing / Wilderness	Wilderness / Grazing	Grazing	Wilderness	Wetland
Agricultural potential	Low	Low	Low	Marginal	Marginal	Low	Marginal	Marginal
Agricultural Classification	4	4	4	5-6	6	4	6	8
Area %	5237ha 24.6%	565ha 2.7%	1610ha 7.6%	2116ha 10.0%	1363ha 6.4%	430ha 2.0%	9219ha 43.4ha	706ha 3.3%

In conclusion:

- Generally the soils are heavily degraded through erosion and top soil loss.
- Although there are large areas of deep soils, these areas are sub optimal due to low clay contents. As a result of low rainfall, high temperatures (high evapotranspiration), susceptibility to compaction, present erosion and erodibility the soils in the area is study is not recommended for rain fed crop production.
- Fields presently used for irrigation are susceptible to salinity and sodicity due to poor water quality with high chloride values. The relatively high salt contents currently prevents dispersion, however rain water can cause dispersion and enhance crust formation on the soils.
- Water quality for irrigation purposes is of low quality with restriction to sensitive crops. Water samples were taken during the winter and it is recommended to make a continual assessment of water quality during the year, since it can change significantly during the year.
- Shallow soils and surface rock are dominant in large areas. Areas classified for grazing have presently low basal grass cover and are dominated by Mopane shrub field and will be discussed in detail by the biodiversity report.
- Present land use is cattle and game farming, but carrying capacity is questionable due to poor physical soil quality (erosion susceptibility, shallow soils, surface rock and poor climatic conditions).
- Approximately 706 ha were identified as wetlands.
- Land capability per farm is summarized in Table 11. From this Table it can be concluded that most of the farms are largely covered by grazing and wilderness areas (total 16605 of the approximate 21 246 ha) according to the COM classification.
- Less than 4000 ha are classified as arable soils according to the COM classification. However, these soils fall into Classes 4 to 7 according to the agricultural classification system (Table 12), which recommends these soils for grazing purposes.

1.2.4 PRESENT LAND USE

There is arable crop production (predominantly vegetables) under irrigation taking place in small areas along the floodplains of the Sand River as indicated in yellow in Figure 18.

The majority of area is presently covered with low density woody species and used for grazing purposes for either cattle or game farming.

In the higher lying areas large areas are largely covered with high density woody species, especially on the farms Vera, Delft, northern Hermanus, Voorburg and Cavan. However, these high density woody species are present on almost all farms.

There are significant areas on Banff, Voorburg, Delft, Cavan, Verdun, Jutland and Cohen that has no or very scarce basal cover. This leads to severe rill and sheet erosion.

Approximately 462 ha are presently under crop production or cleared. The majority of the fields are on the flood plains of the Sand River.

The present land use of the study area can be summarized as follow:

- Commercial (or cleared) land: 462ha (149 ha irrigated and 313 ha dry land).
- Degraded: Thicket and Bushland: 155 ha.
- Thicket and Bushland: 20 000 ha (Vacant or unspecified).
- Woodlands: 629 ha.

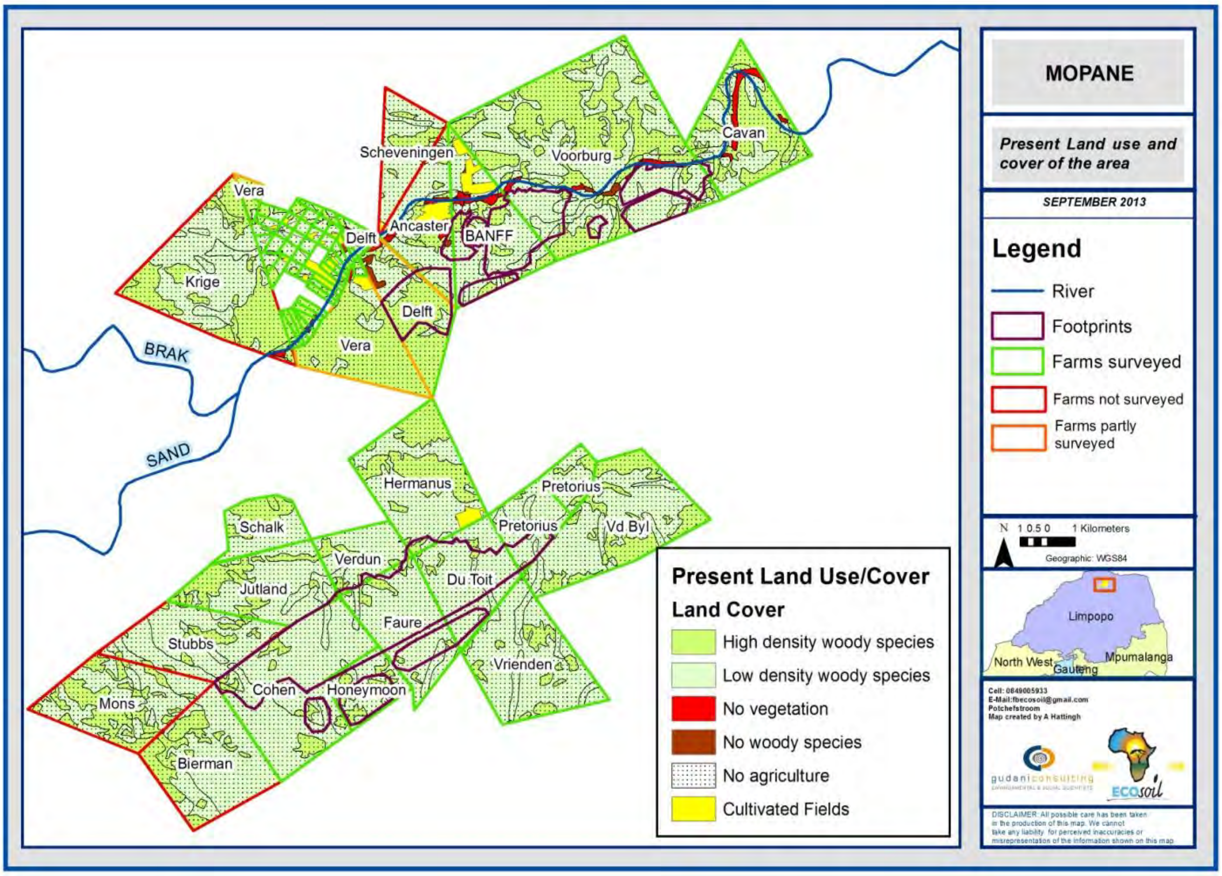


Figure 18: Present land cover of the demarcated study area

1.2.5 BIODIVERSITY (FLORA AND FAUNA)

The vegetation units within the site include Musina Mopane Bushveld on the plains and Limpopo Ridge Bushveld on the ridges as described by Mucina and Rutherford, both having a Least Threatened Conservation status and being poorly protected.

1.2.5.1 Flora

Variations in vegetation are primarily a function of the climate, topography and soil differences and therefore are these components of the resources important in assessments of vegetation.

1.2.5.1.1 Biome

A biome is a broad ecological unit that represents a major life zone extending over a large natural area (Rutherford & Westfall, 1994). It is the largest land community unit recognised at a continental or subcontinental level and mapable at a scale no larger than about 1:10 million (Rutherford & Westfall, 1994).

The vegetation of the study area belongs to the broad vegetation group the Savannah Biome (Low and Rebelo, 1996). The Savannah Biome is the largest Biome in Southern Africa, occupying 46% of its area, and over one-third the area of South Africa. It is well developed over the Lowveld and Kalahari region of South Africa and is also the dominant vegetation in Botswana, Namibia and Zimbabwe. A grassy ground layer and a distinct upper layer of woody plants (trees and shrubs) are characteristic of the Savannah Biome. Where this upper layer is near the ground (low growing) the vegetation may be referred to as Shrubveld, where it is tall and dense, as Woodland, and the intermediate stages are locally known as Bushveld.

The environmental factors delimiting the biome are complex and include (Low and Rebelo, 1996):

- Altitude ranges from sea level to 2 000 m;
- Rainfall varies from 235 to 1 000 mm per year;
- Frost may occur from 0 to 120 days per year; and
- Almost every major geological and soil type occurs within the biome.

A major factor delimiting the biome is the lack of sufficient rainfall, which prevents the upper (tree and shrub) layer from dominating, coupled with fires and grazing, which keep the grass layer dominant. Summer rainfall is essential for the grass dominance, which, with its fine material, fuels near-annual fires. In fact, almost all species are adapted to survive fires, usually with less than 10% of plants, both in the grass and tree layer, killed by fire. Even with severe burning, most species can resprout from the stem bases (Low and Rebelo, 1996).

The shrub-tree layer may vary from 1 to 20m in height, but in Bushveld typically varies from 3 to 7m. Soil depth is one of the critical factors that determine tree height in the biome. The shrub-tree element may come to dominate the vegetation through bush encroachment in areas that are being overgrazed (Low and Rebelo, 1996).

Most of the savannah vegetation types are used for grazing, mainly by cattle or game. In the southernmost savannah types, goats are the major stock. In some types crops and subtropical fruit are cultivated. These mainly include the Clay Thorn Bushveld (14), parts of Mixed Bushveld (18), and Sweet Lowveld Bushveld (21). Urbanization is not a problem, perhaps because the hot, relatively moist climate and diseases (sleeping sickness, malaria) hindered urban development in the past.

Representation of the savannah biome in conservation areas in South Africa is good in principle, mainly due to the presence of the Kruger- and Kalahari Gemsbok National Parks within the biome. However, the large areas conserved in South Africa, belies the fact that half of savannah vegetation types are inadequately conserved, in having less than 5% of their area in reserves. However, much of the area is used for game farming and can thus be considered effectively preserved, provided that sustainable stocking rates and sound environmental practices are maintained. Tourism and hunting has become important utilisation options in the savannah biome.

1.2.5.1.2 __Veld types__

According to Mucina & Rutherford (2006), the study area is situated within two veld types (Figure 19):

- Musina Mopane Bushveld; and
- Limpopo Ridge Bushveld: rocky outcrops.

Musina Mopane Bushveld

The Musina Mopane Veld is characterized by undulating to very irregular plains with some hills, at an altitude of around 600m. On areas with deep sandy soils, the *Kirkia acuminata* (white seringa) is one of the dominant tree species along with *C. mopane* (Mopane), *C. apiculatum* (Red Bushwillow) and *Grewia spp*. (Raisin bushes). The herbaceous layer is poorly developed, especially where mopane occurs in dense stands. This vegetation type is classified as poorly protected and “Least threatened” with 2% statutorily conserved in the Mapungubwe National Park, as well as the Nzhelele, Nwanedi, Musina and Honnet Nature Reserves. About 3% is transformed, mainly by cultivation, and soil erosion is moderate to high. The conservation target is 19%.

The geology consists mainly of gneisses and meta-sediments of the Beit Bridge Complex, with variable soils from deep red/brown clays to deep, freely drained sandy soils, to shallower types including skeletal Glenrosa and Mispah soil forms. The mean annual precipitation varies between 300 – 400 mm and the area is generally frost-free.

Important taxa include trees such as *C. mopane* (Mopane), *A. digitata* (Baobab), *A. nigrescens* (Knobthorn), *C. apiculatum* (Red Bushwillow), *A. senegal var. leiorhachis* (Slender Three-hook Thorn) and *Commiphora mollis* (Velvet Corkwood). Conspicuous small trees and shrubs include *G. bicolor* (White Raisin), *G. flava* (Velvet Raisin), *B. foetida subsp. rehmanniana* (Stink Shepherd’s tree) and *T. prunioides* (Lowveld Cluster-leaf). The grass layer is characterized by *Aristida spp.* (Three-awn grasses), *S. uniplumis* (Silky Bushman grass), *S. pappophoroides* (Sand Quick), B. deflexa (False Signal grass), *E. cenchroides* (Nine-awned grass) and *U. mosambicensis* (Bushveld Signal grass).

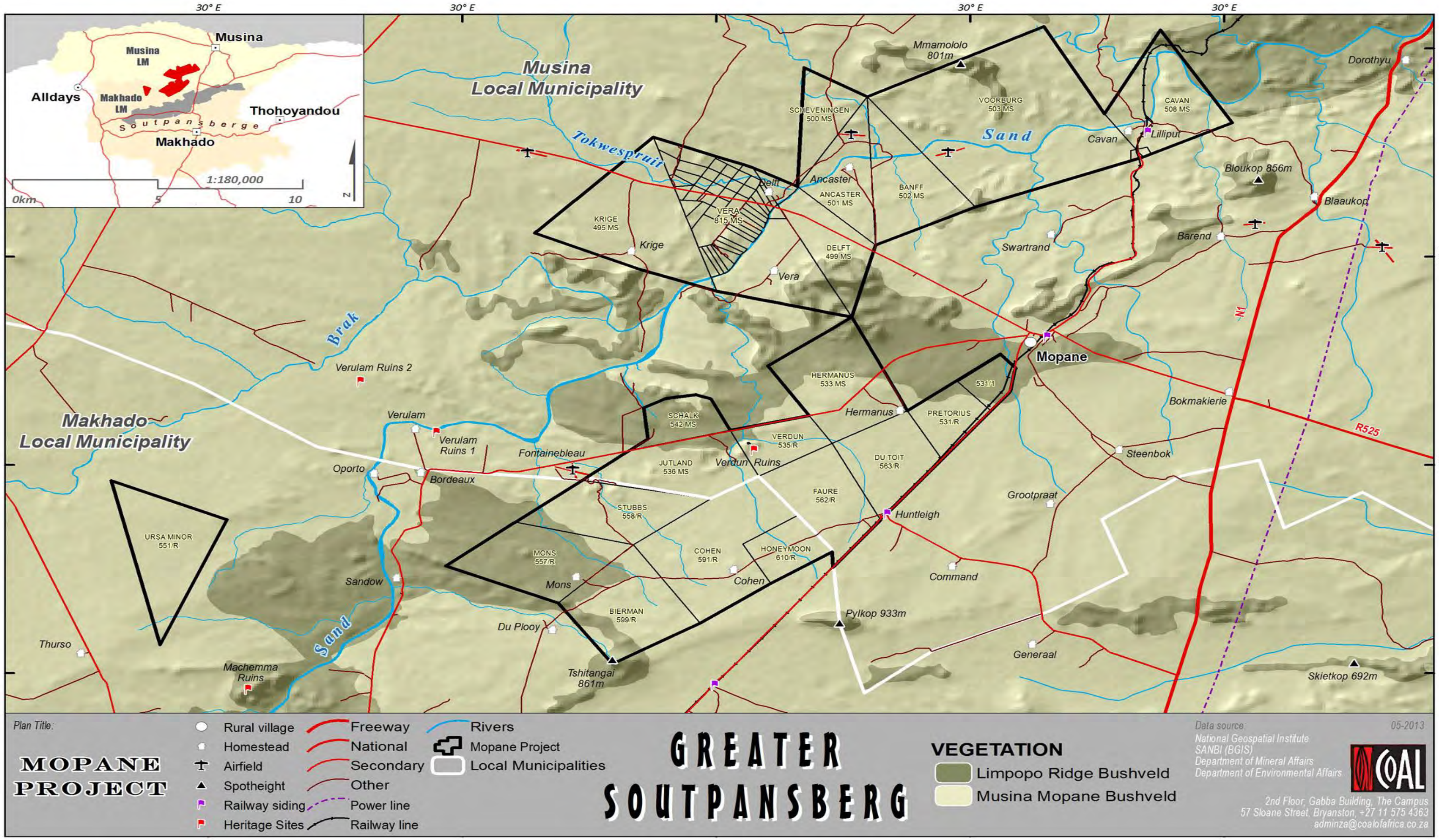


Figure 19: Vegetation of the site and surrounding area (Mucina and Rutherford, 2006)

Limpopo Ridge Bushveld

This vegetation type covers the irregular hills and ridges of much of the area in the vicinity of the Limpopo River. The altitude varies from 300 m to 700 m in the east, with some hills reaching 1 000 m in the west. The vegetation structure is moderately open savannah with a poorly developed ground layer. *K. acuminata* (White Seringa) is prominent on many of the ridges along with *A. digitata* (Baobab). On shallow calcareous gravel and calc-silicate soils, the shrub *Catophractes alexandri* is dominant. Areas of sandstone of the Clarens Formation are prominent in places such as Mapungubwe National Park. Although not as prominent as at Mapungubwe National Park, sandstone ridges also occur in the study area.

The mean annual precipitation varies from 300-400 mm and the area is generally frost-free. Important plant species include the *A. digitata* (Baobab), *S. birrea* (Marula), *C. mopane* (Mopane), *C. glandulosa* (Tall Common Corkwood), *T. prunioides* (Lowveld Cluster-leaf), *B. albitrunca* (Shepherd's tree) and various figs, e.g. *F. tettensis*.

This vegetation type is classified as moderately protected and "Least Threatened", with some 18% statutorily conserved in the Kruger and Mapungubwe National Parks. Only about 1% is transformed, mainly by cultivation and mining. The conservation target is 19%.

The study area is dominated by tree and shrub forms of *Colophospermum mopane*, *Terminalia prunoides, Commiphora spp., Grewia spp. and Boscia albitrunca.* The herbaceous layer is not well developed, probably due to low rainfall and overgrazing and consists mostly of grasses such as *Aristida congesta subsp. congesta, Aristida adscensionis, Tragus berteronianus, Bothriochloa insculpta and Microchloa caffra.*

1.2.5.1.3 Vegetation communities and sensitivity mapping

The plant species diversity is regarded as fairly low and has been supplemented with data collected from previous surveys in the area, due to the seasonal sampling limitations. A plant species list is provided in Appendix 1 of the Biodiversity Specialist Report (ANNEX-4), and can be summarised as follows:

- Trees: 40
- Shrubs: 28
- Grasses: 24
- Liana: 1
- Dwarf shrubs: 1
- Climbers: 1
- Forbs: 5
- Succulents: 5
- Sedges: 1

Different plant communities develop as a result of differences in climate, geology, topography, rockiness, drainage, soil texture, soil depth, slope, and historic management. Each plant community usually represents a different habitat, has its own inherent grazing and browsing capacity and represents a specific habitat for certain types of fauna species.

The vegetation survey was conducted during the middle of the dry season and the possibility of encountering herbaceous annuals and flowering plants was very low. The herbaceous layer, especially the grass layer, is heavily utilised and this can also influence the herbaceous species diversity. Herbaceous plants are an important food source for game, especially in the dry season and in drought periods when the grass layer is depleted. Many of these plants are annuals and also do not appear every season, and Geophytic species are dormant during dry periods. The importance of long-term monitoring actions / surveys is imperative to assess the true diversity of a specific area, especially arid areas.

The entire study area has not been mapped fully, as not all farms within the mining right application (MRA) area were accessible. The following distinct vegetation communities were identified:

The River Ecosystems - Within the study area there is basically a single river system, the permanent Sandrivier, with a number of tributaries (including the Tokwespruit and Brak rivers). River systems are always considered to be ecologically sensitive, and are thus given a very high (No-Go) sensitivity. This is due to the unique habitats they provide and support for several flora and fauna species. The river systems provide migration corridors for many species. River systems are particularly important due to the water transport and associated biological, economic, health and cultural values. The provision of clean and healthy water to people, agriculture and natural biological systems is of utmost importance in this arid region.

- The Ridges Ecosystem - These hills and ridges form part of the Soutpansberg foothills, but as they are somewhat separated from the main mountain, not so high and not so diverse in plant species composition, although there are a number of species of special concern present. They also tend to form 'islands' within the typical Mopane veld matrix and are thus considered to have a High sensitivity. The vegetation is typical mountain bushveld, with many woody species present.
- The Plateaus Ecosystem - The ridges discussed above form a flat to slightly undulating plateau on the crest of the ridge. The plateaus often have deeper soils and tend to be vegetated with grassland or sparse woodland. The area forms part of the Ridges Ecosystem and therefore also has a High sensitivity.
- Bushveld - A number of bushveld communities occurring on the level plains with distinct species assemblages can be differentiated within the study area. These communities are often highly fragmented and are often associated with slight variations in the underlying soils. Whilst it is possible to differentiate the communities using ordination techniques, they are difficult to distinctly map as the boundaries are not usually distinct and vary along a continuum. They are thus grouped together for the purposes of this report and generally have a Medium sensitivity. In general this vegetation is not rare and not threatened, except that it is often prone to droughts and then often overgrazed. There is concern on the presence of large number of the protected tree species, *Sclerocarya birrea* (Marula), *Adansonia digitata* (Baobab) and large numbers of various species of *Commiphora*.
    - *Terminalia prunoides* Bushveld
    - *Combretum apiculatum-Commiphora* Arid Bushveld
    - *Terminalia sericea* Bushveld
    - Mopane Bushveld
    - *Acacia tortilis-Cataphractus* Veld on limestone

    - *Kirkia-Acacia senegal* Bushveld
- Old Fields, Current Agriculture and Secondary regrowth - The agricultural fields and old fields have low conservation value and low sensitivity, and are, from an ecological point of view, ideal for the development of mining infrastructure

For further detail description of the vegetation communities, refer to Section 5 of the Biodiversity Specialist Report (ANNEX-4).

1.2.5.1.4 Protected and endemic flora

Table 13 lists the protected flora that could potentially occur within the site, having distributions within Limpopo and the Soutpansberg, although many may not be present at lower altitudes such as is the case regarding the Mopane site. These were investigated during the site visit; however, due to seasonal (winter) constraints during the site visit, the presence/absence of these species could not be confirmed.

Table 13: List of applicable conservation status (status indicated in table below)

**Status	Conservation Status
LEMA12	Limpopo Environmental Management Act, No. 7 of 2003. Schedule 12: Protected plants
NFA	National Forest Act, No. 84 of 1998.
RED-E	J. Golding (ed), 2002. *Southern African Plant Red Data lists* (Southern African Botanical Diversity Network Report 1). Pretoria, South Africa: National Botanical Institute – Endemic species
HAHN	Hahn, 2003. Soutpansberg Endemic Flora
RED-RDL	J. Golding (ed), 2002. *Southern African Plant Red Data lists* (Southern African Botanical Diversity Network Report 1). Pretoria, South Africa: National Botanical Institute – Red data listed
TOPS-E	Threatened or Protected Species Regulations, Govt Notice No. R152 of 23 February 2007 – Endangered species
TOPS-P	Threatened or Protected Species Regulations, Govt Notice No. R152 of 23 February 2007 – Protected species
TOPS-V	Threatened or Protected Species Regulations, Govt Notice No. R152 of 23 February 2007 – Vulnerable specie

Botanical Name	Afrikaans Name	English Name	**Status	Presence*
Acacia erioloba		Camel Thorn	RED-RDL (DE)	C
Adansonia digitata	Kremetartboom	Baobab	NFA, LEMA12	C
Adenia gummifera var. *gummifera*		Monkey Rope	RED-RDL (DE)	N
Adenium multiflorum	Impalalelie	Impala lily	LEMA12	C
Adromischus umbraticola subsp. *ramosus*			RED-RDL (DD)	N
Alepidea peduncularis			RED-RDL (DD)	N
Aloe angelica		Williespoort Aloe	HAHN	N
Aloe littoralis	Mopanie-aalwyn/Bergaalwyn	Mopane Aloe littoralis	LEMA12	N
Aloe swynnertonii		Vumba Aloe	RED-RDL (DD)	N
Aloe vossii			RED-RDL (DD)	U
Aristida scabrivalvis subsp. *contracta*	Pers-steekgras	Purple three-awn grass	RED-E	N
Balanites maughamii	Fakkelhout	Torchwood	NFA	C
Barleria holubii	Kleinblaar-barleria	Small-leaved Barleria	RED-RDL	N
Blepharis spinipes			HAHN	N
Boscia albitrunca	Witgat	Shepherd's tree	NFA	C
Bowiea volubilis subsp.		Climbing Onion	RED-RDL (VU)	N

Botanical Name	Afrikaans Name	English Name	**Status	Presence*
volubilis				
Ceratotheca saxicola			HAHN	N
Ceropegia cimiciodora			RED-RDL (VU)	N
Cineraria alchemilloides subsp. *alchemilloides*			RED-RDL (Rare)	N
Combretum imberbe	Hardekool	Leadwood	NFA	C
Combretum vendae		Venda Bushwillow	HAHN	C
Cryptocarya transvaalensis			RED-RDL (DE)	N
Curtisia dentata		Assegai	RED-RDL (NT)	N
Cyamopsis dentata			RED-E	N
Delosperma zoutpansbergense		Ice Plant	HAHN	N
Dicoma montana			HAHN RED-RDL (Rare)	N
Duvalia procumbens			HAHN	N
Elaeodendron transvaalense		Bushveld Saffron	RED-RDL (NT)	N
Encephalartos hirsutus		Venda Cycad	HAHN	N
Euphorbia aeruginosa			HAHN	N
Gunnera perpensa		River Pumpkin	RED-RDL (DE)	N
Harpagophytum procumbens	Duiwelsklou	Devil's Claw /Grapple plant	TOPS-P	N
Hibiscus waterbergensis			RED-RDL	N
Hoodia corrorii subsp. lugardii	Ghaap	Ghaap	LEMA12,TOPS-P	N
Huernia spp *Huernia nouhuysii*		Huernia (all species) – Zebraflower, Toad plant, Owl-eye, etc.	LEMA12 RED-RDL (VU)	N
Ilex mitis var. *mitis*		African Holly	RED-RDL (DE)	N
Ipomoea bisavium			HAHN RED-RDL (Rare)	N
Justicia montis-salinarum			RED-RDL (Rare)	N
Kalanchoe crundallii			HAHN	N
Khadia borealis			RED-RDL (Rare)	N
Myrothamnus flabellifolius			RED-RDL (DD)	N
Mystacidium brayboniae			HAHN RED-RDL (NT)	N
Ochna glauca	Bloublaarrooihout	Bird's eye/blue-leaved ochna	RED-RDL	N
Ocotea kenyensis		Transvaal stinkwood	RED-RDL (VU)	U
Orbea hardyi			RED-RDL (Rare)	N
Orbea maculata subsp. *maculate*			RED-RDL	N
Orbea spp		Orbea (all species)	LEMA12	N
Otholobium polyphyllum			RED-RDL	N
Panicum dewinteri			HAHN RED-RDL (NT)	N
Pavetta tshikondeni			HAHN	N
Peristrophe cliffordii		Peristrophe	LEMA12, RED-RDL, RED-E	N
Peristrophe gillilandiorum		Peristrophe	LEMA12, RED-RDL, RED-E	N
Philenoptera violacea	Appelblaar	Apple-leaf /Raintree	NFA	C
Plinthus rehmannii			RED-RDL	N
Prunus africana		Red Stinkwood	RED-RDL (VU)	U
Psoralea repens			RED-RDL	N

Botanical Name	Afrikaans Name	English Name	**Status	Presence*
Rapanea melanophloeos			RED-RDL (DE)	N
Rhus magalismontana subsp. coddii	Bergtaaibos		HAHN	N
Rhynchosia vendae			HAHN	N
Sartidia jucunda			RED-RDL (VU)	N
Sclerocarya birrea subsp. *caffra*	Maroela	Marula	NFA	C
Sesbania leptocarpa/mossambicensis			RED-E	N
Stapelia spp	Aasblom	Carrion Flower/Stapelia (all spp)	LEMA12	N
Streptocarpus caeruleus			HAHN	N
Tavaresia/Decabelone spp		Ghaap (all species)	LEMA12	N
Tylophora coddii			RED-RDL (Rare)	N
Warburgia salutaris	Peperbasboom	Pepper-bark tree	RED-RDL (EN)	N
Zoutpansbergia caerulea			HAHN	N

*** Presence: C-Confirmed; N-Not confirmed, but possibly present; U-Unlikely.**

The core of the Soutpansberg Centre of Endemism is associated with the rocky areas within the Soutpansberg Mountains, with approximately 3 000 vascular plant species andone endemic genus. Approximately 1.5% of the species recorded within the Soutpansberg Centre of Endemism are considered endemic/near-endemic species/infraspecific taxa. Of the 45 endemic or near endemic species, almost 47% of the species are succulents.

Many species are dormant or a positive identification is not possible during the winter months, and their presence/absence could not be confirmed.

1.2.5.1.5 Introduced or exotic/alien plants

Due to the low rainfall, the project area is generally free of unwanted species and is likely to remain so. Introduced and exotic plants are limited to developed, disturbed and riparian areas.

Table 14: Exotic and weed plant species found within the site

Botanical Name	Common Name	CARA Status*	Presence/Comment
Argemone subfusiformis	Mexican poppy	1	Scattered, often in disturbed areas, can become problematic if left uncontrolled
Caesalpinia gilliesii	Bird of paradise	1	
Melia azedarach	Syringa	3	Scattered, uncommon outside of riparian area and along watercourses
Ricinus communis	Castor Oil Bush	2	Scattered, often in disturbed areas, can become problematic if left uncontrolled
Sesbania punicea	Dorset pea	1	Scattered, often in disturbed areas, can become problematic if left uncontrolled

***CARA Status: Refer to relevant legislation section for clearing requirements.**

The Mexican Poppy, Castor Oil Bush and Dorset Pea can become invasive as weedy pioneers in disturbed areas and would require control during post mining rehabilitation.

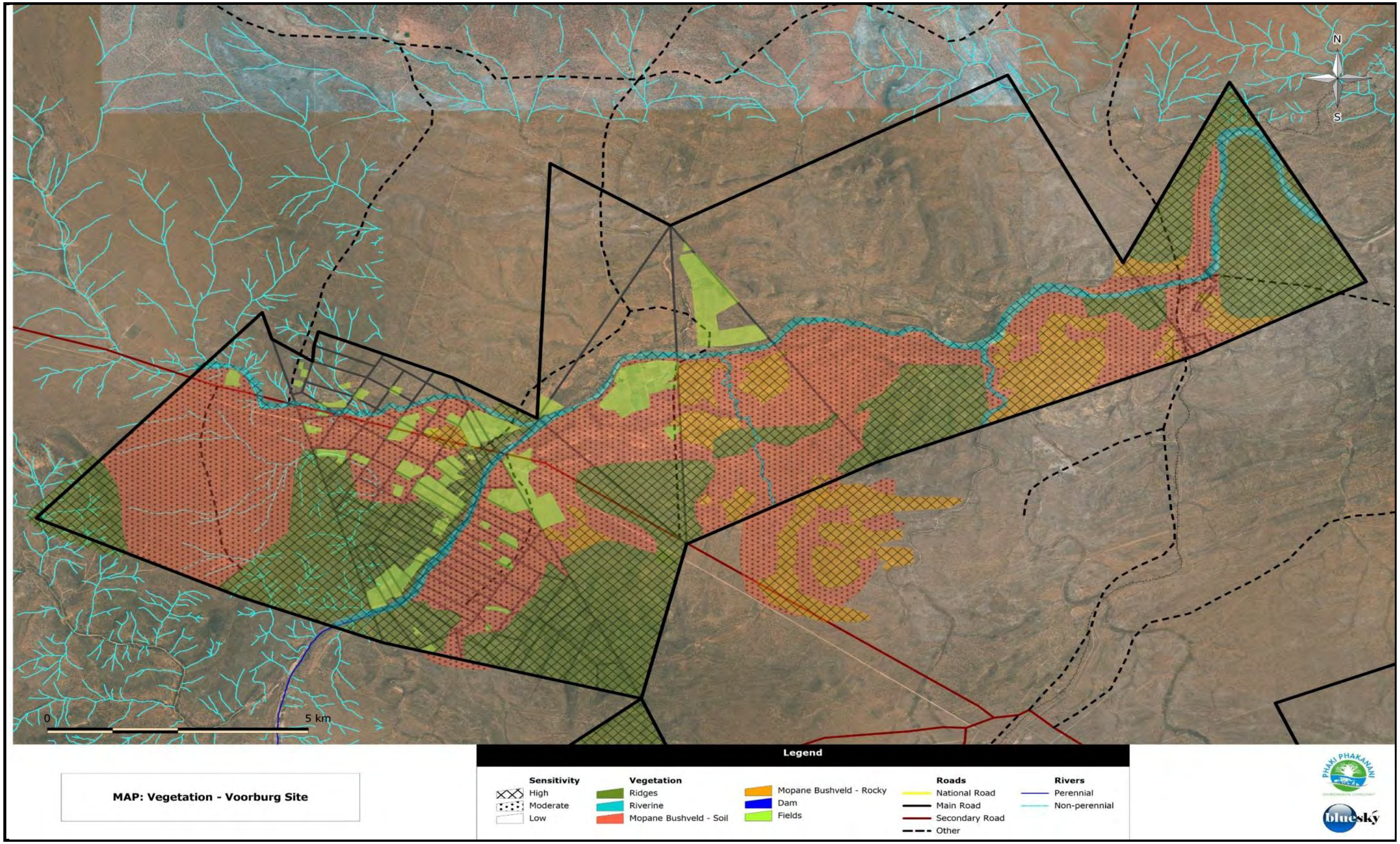


Figure 20: Vegetation communities - Voorburg Section

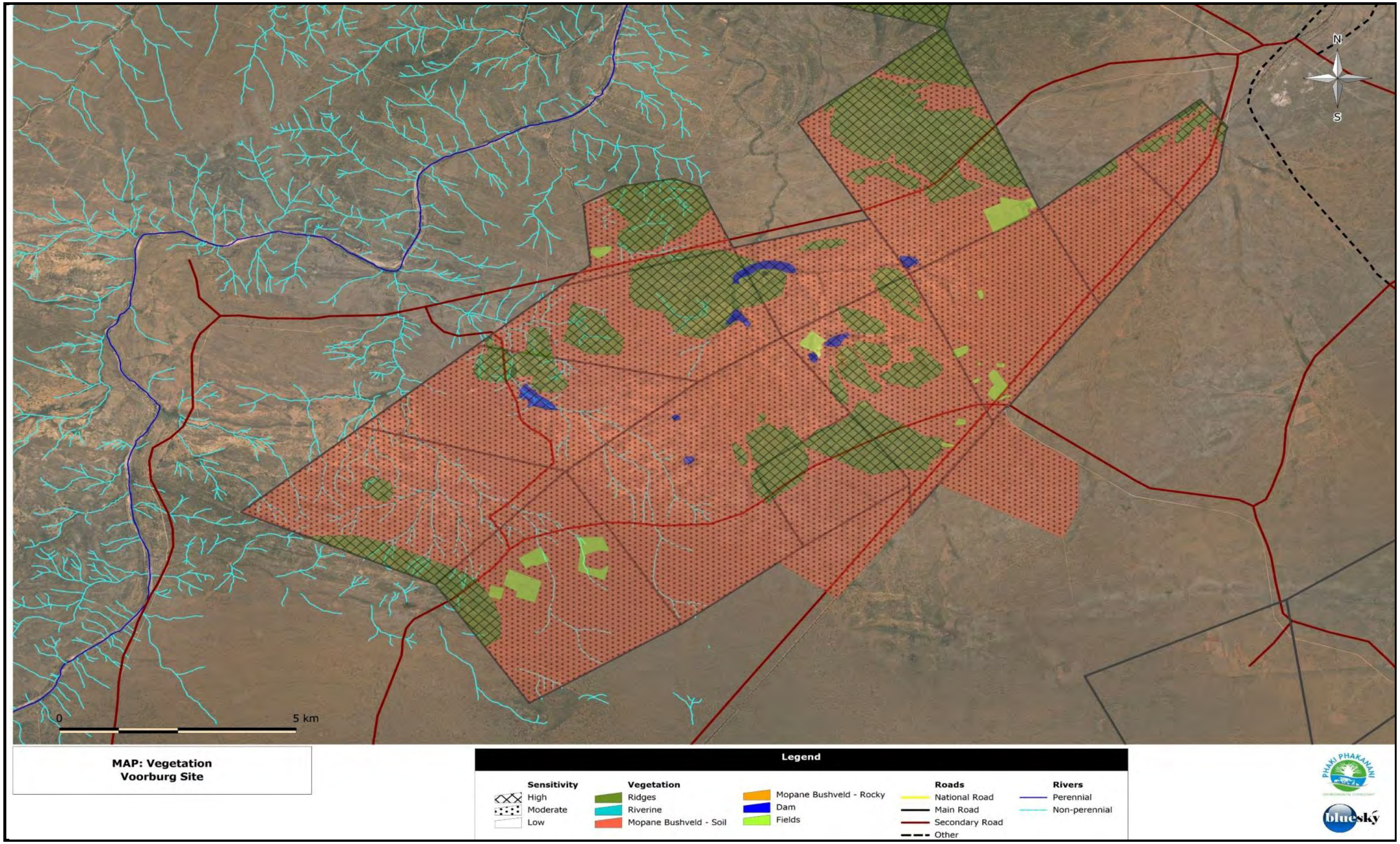


Figure 21: Vegetation communities - Jutland Section

1.2.5.2 Fauna

1.2.5.2.1 Mammals

The Soutpansberg has a remarkable diversity of mammals that make up 60% of the total number of species that occur in South Africa. More mammal species have been recorded in the Soutpansberg than in the Cape Floristic Kingdom, which was previously recorded at 127. The Kruger National Park only contains two more species of mammals than the Soutpansberg, which is particularly rich in bats, carnivores and larger hoofed animals.

Of the 104 mammal species (listed in Appendix 2 of ANNEX-4) known to occur within the Mopane bushveld area, there are 2 species which are critically endangered:

- Black Rhinoceros (*Diceros bicornis michaeli*)
- Short eared Trident Bat (*Cloeotis percivali*)

There are 2 endangered species:

- Tsessebe (*Damaliscus lunatus lunatus*)
- African wild dog (*Lycaonpictus*)

10 Near threatened species:

- South African Hedge-hog (*Atelerix frontalis*)
- Serval (*Leptailurus serval*)
- Spotted Hyaena (*Crocuta crocuta*)
- Brown Hyaena (*Hyaena brunnea*)
- Honey Badger (*Mellivora capensis*)
- Leopard (*Panthera pardus*)
- Goeffroy's Horseshoe Bat (*Rhinolophusclivosus*)
- Darling's Horseshoe Bat (*Rhinolophus darlingi*)
- Hildebrandt's Horseshoe Bat *(RhinolophusHildebrandtii*)
- Schreiber's Long-fingered Bat(*Mimiopterus schriebersii)*

And 6 vulnerable species include:

- Roan antelope (*Hippotragus equinus*)
- Sable antelope (*Hippotragus nigerniger*)
- Cheetah (*Acinonyx jubatus*)
- Lion (*Panthera leo*)
- Ground pangolin(*Manis temminckii*)
- Giant rat (*Cricetomys gambianus*)

1.2.5.2.2 Avifauna

According to the Soutpansberg Birding Route Organization, the Soutpansberg Mountains and Limpopo River Valley hosts over 540 bird species. This is 56% of the South African avifauna and 76%

of the South African terrestrial and fresh water avifauna, excluding vagrants and oceanic avifauna. The Soutpansberg Mountain Range itself hosts between 380 and 400 species. The western Soutpansberg covers an area of 900 km^2 and has 298 species of avifauna (Stuart, Stuart, Gaigher & Gaigher, 2001). The quarter degree Grid Square 2230AA (an area of about 700km^2) has 338 native species and the quarter degree Grid square which includes The Greater Kuduland Conservancy 2130DA (700 km^2 with 412 species) and the Greater Kuduland Conservancy itself (150 km^2 with 304 species). A complete list of potential bird species is provided in Appendix 2 of ANNEX-4.

There are 38 birds of prey species which includes Species of Special Concern (SSC) of the Soutpansberg:

- Cape vulture(*Gyps coprotheres*)
- Crowned eagle (*Stephanoaetus coronatus*)
- Forest Buzzard (*Buteotrizonatus*)
- Bat Hawk (*Macheiramphus alcinus*)
- Crested Guineafowl (*Guttera pucherani*)
- Blue spotted wood dove (*Turtur afer*)
- Knysna Turaco (Tauraco corythais)
- Pel's fishing Owl (*Scotopeliapeli*)
- Mottled spinetail *(Telecanthura ussheri*)
- Narina Trogon (*Apaloderma narina*)
- African Broadbill (*Smithornis capensis*)
- Grey Cuckoo-shrike (*Coracina caesia*)
- African golden Oriole (*Oriolus auratus*)
- Eastern bearded Robin (*Erythropygia quadrivirgata*)
- Gorgeous Bush Shrike (*Telephorusquadricolo*r)
- Black Fronted bush-shrike (*T. Nigrifrons*)
- Golden Backed Pytilia (*Pytilia afra*)
- Green Twinspot (*Mandingoa nitidula*)
- Pink Throated-Twinspot (*Hypargos margaritatus*)

The Blouberg Nature Reserve is situated approximately 60 km from the study area. The mountain in this reserve houses the largest breeding colony of Cape Vulture (endangered) in the world. These birds have extensive home ranges and the study area falls well within the birds feeding ground.

At least 5 Red Data species that are listed as vulnerable occur in the area:

- White-Backed Night heron (*Gorsachius leuconotus*)
- Cape Vulture, Martial Eagle (*Polemaetus bellicosus*)
- African fin-foot (*Podica senegalensis*)
- Grass Owl (*Tyto capensis*)
- Pel's Fishing Owl

11 near threatened species:

- The Black Stork (*Ciconia nigra*),
- Bat Hawk (*Macheiramphus alcinus*)
- Ayres' Eagle (*Hieraetus ayresii*)

- Crowned Eagle
- Peregrine Falcon (*Falco peregrines minor*)
- Lanner Falcon (*Falco biarmicus*)
- Half collared King-fisher (*Alcedo semitorquata*)
- African Broadbill
- Orabge Thrush (*Zoothera gurneyi*)
- Wattled-eyed Flycatcher (*Platysteira peltata)*
- Pink -Throated Twinspot

Birds are attracted to the Mopane veld for food and nesting grounds. Weavers make use of many trees for nest building and breeding, with some species making use of only one species of tree, and others a variety tree species. Weavers are attracted to Mopane veld as many tree species therein have thin branch tips to bind nests to and thorns, to provide protection against predatory nest raiders. The buffalo weaver (*Dinemellia dinemelli)* limits its breeding to the Baobab (*Adansonia digitata*).

Bee- eaters (*Merops* spp) use steep river banks to dig tunnel nests which offer an advantage. Rollers, such as the Lilac breasted Roller (*Coraciascaudatus),* make use of cavities in trees for nesting, many Mopane trees naturally develop cavities in their trunks when they become old.

Birds of Prey (Raptors) are site specific in terms of breeding. The Mopane veld offers a wide variety of habitats that is utilized as nesting habitats for Raptors. For example, African Fish Eagles (*Haliaeetus vocifer*) build large nests in forked branches of a large trees near water courses, while Crowned Eagles make use of similar trees situated in heavily forested areas. Martial Eagles and Black Eagles (*Ictinaetus malayensis*) nest on large cliff faces, while Spotted Eagle Owls (*Bubo africana*) use small cliff edges or edges on river banks to breed. Raptors are attracted to the Mopane veld due to habitat and an abundance of prey, which includes; rodents and birds for the small Raptors and small mammals for larger Raptors. The number of large Raptors that were surveyed for the purpose of the proposed mine was limited, due to the fact that they have large home ranges. For example the Martial Eagle has a home range of up to 100 km^2, and therefore the resident pair of Martial Eagles will keep out any of its own species within the radius of 100 km.

*1.2.5.2.3 **Reptiles***

There are over 400 reptile species in southern Africa, with a possible occurrence of 120 species in the Mopane bushveld. Reptiles are important as they aid in the control of rodents and provide food for many animals (secretary birds, raptors and carnivorous mammals). They occupy every habitat within the Mopane veld, and certain species occupy restricted habitats (niches). Any form of destruction/development will have extremely negative effects on these reptiles. A complete list of reptiles is provided in Appendix 2 of ANNEX-4.

There are 4 species that could occur in the Mopane bushveld with a near threatened status:

- Distant's ground agama(*Agama aculeate distant)*
- Southern African Python(*Python natalensis*) Soutpansberg
- Flat Lizard(*Platysaurus relictus*)
- Soutpansberg Rock Lizard(*Australolacerta rupicola*)

There are 4 species that hold a vulnerable status and could occur within the Mopane bushveld:

- South African Python(*Python natalensis*)
- Muller's velvet gecko (*Homopholis mulleri*)
- Cryptic Dwarf Gecko (*Lygodactylus nigropunctatus incognitus)*
- Soutpansberg Dwarf Gecko (*Lygodactylus ocellatus soutpansbergensis*)

There is one exotic species, the Tropical house gecko (*Hemidactylus mabouia),* along with the presence of the Nile crocodile which was recorded in the SandRiver. The presence of the crocodile is a result of recent flooding of the Limpopo River where the crocodiles escaped from a crocodile farm.

Table 15: Reptile Species of Special Concern (SSC) that have been identified

SCIENTIFIC NAME	COMMON NAME	HABITAT	POTENTIAL IMPACT
Homopholos mulleri	Muller's Velvet Gecko	Likely to occur within the mature trees of the Mopane Bushveld.	Destruction of trees during bush clearing will result in a loss of habitat
Lygodactylus nigropunctatus incognitus	Cryptic dwarf gecko	Restricted to outcrops of the Soutpansberg, with isolated populations within the Musina plain.	Direct destruction of outcrops during mining operations.
Lygodactylus Occendentalis soutpansbergensis	Soutpansberg Dwarf Gecko,	Restricted to the mountain outcrops of the Soutpansberg, with isolated outcrops within the Musina Plain.	Destruction of outcrops during mining operations.
Typhlosaurus lineatus subtaeneatus	Striped-bellied Blind legless skink	Restricted to sandy soils within the Musina Plain.	Habitat destruction during mining operations.
Australolacerta rupicola	Soutpansberg rock lizard	Restricted to the Soutpansberg mountain tops.One record, however, confirmed that it can occur within outcrops north of the Soutpansberg.	Destruction of outcrops leading to the destruction of habitat.
Python natalensis	Southern Rock Python	Found throughout the habitat.	Destruction of habitat resulting in conflict with humans.
Amblyodipsas microphthalma nigra	Soutpansberg Purple glossed snake	Restricted to Aeolian soils within the Musina Plain.	Destruction of habitat during mining operations
Xenocalamus tranvaalensis	Speckled Quill-snouted snake	Restricted to Aeolian soils of the Musina Plain.	Destruction of the habitat during mining operations.
Platysaurus relictus	Soutpansberg Flat Lizard	Restricted to the Soutpansberg	Destruction of outcrops leading to habitat destruction.

1.2.5.2.4 __Amphibians__

Amphibians are difficult to survey as many of them are nocturnal and many are restricted to permanent water bodies. The correct time to survey frogs is during times of high rainfall or whilst it is raining. One can identify frogs by the calls (vocalization) of the males during breeding season.

As the surveys were conducted in July (which is out of frog season), there is a lack of species recorded. There is a possibility of 26 amphibian species that could occur within the Mopane veld,of which 1 species is considered endangered, the Northern Forest Rain Frog (*Breviceps silvestris*). There are 2 species which are protected under the National Environmental Management: Biodiversity Act 2007, under the Threatened and Protected Species Rating; the Giant African Bull Frog (*Pyxicephalus adspersus*) and the African Bull Frog (*Pyxicephalus edulis*). A complete species list is provided in Appendix 2 of ANNEX-4.

1.2.5.2.5 Invertebrates

An elimination process was undertaken when investigating invertebrate (insects). Firstly, insects were categorized and analysed according to the insects' occurrence within the Limpopo Province and its distribution in terms of the study area (the northern area of the Limpopo Province). They were then cross referenced for specific occurrence in the Mopane bushveld through important factors, such as; dietary requirements, flora and micro habitat. Other important factors include; cultural, pest, ecological factors and conservation status.

For example, the *Pontia helice* (Meadow White Butterfly) occurs within the Limpopo Province as well as throughout South Africa. It was therefore excluded from this report as it will not be affected by the mining activities. However, the *Sagra bicolor* (Swollen-legged Leaf beetle) only occurs in the Limpopo Province, the northern parts of the North West Province and Mpumalanga, it has limited distributed throughout South Africa and has therefore been included.

Invertebrate communities consist of decomposers, herbivores, parasites and predators (carnivores), and all occur within the Mopane veld. However, even though a particular species is dependent on the Mopane veld, they have been documented to survive on other vegetation habitats.

Termites

There are seven species of termites that occur in the northern region of the Limpopo Province (Picker, Griffiths & Weaving, 2004), with three important species occurring within the study area: *Amitermes hastats* (Black Mound Termite), *Odontotermes badius* (Common Fungus-growing Termite) and *Macrotermes natalensis* (Large Fungus-growing Termite).

Termites play a major role in the Mopane veld ecology:

- They aid in moribund tree decomposition (collapsed old dead trees) thus bringing them to the soil surface to decay.
- They provide a means of burying plant matter underground, which in turn increasing the nutrient value of the soil.
- An abandoned moribund termite mounds serve as a refuge for reptiles, such as snakes and geckos.
- They also act as a food source for animals such as birds, small mammals and larger mammals, such as the aardvark.

Thus said, Termites are a major contributor to the ecological functioning of the Mopane veld. The ecological balance between termites and the woodland will be disrupted as a result of unsound human development practices. For example, termites might consume too many trees and affect development by devouring fence poles, wooden structures and buildings. Termites have more mobility as they spread to new areas via flying ants. Therefore, Termites are highly important as they build their nests around and against trees, and then convert the tree into soil (when the tree dies) to provide nutrients for new plants and trees to grow.

Butterflies and moths

Many butterfly species are habitat specific and can be regarded as bio-indicator of rare ecosystems (Terblanche, 2012). According to Woodhall (2005) it is preferable to survey butterflies at specific times of the year, mainly springtime and early summer, or late summer to autumn. Since the rainy season had no yet commenced during the site-visit, many plant species were still dormant and thus, a full butterfly survey was unable to be completed.

There are 9 Red Data Butterfly species which could occur within the study area. According to Henning, Terblanche & Ball (2009) threatened butterfly species of the Limpopo Province are:

- *Alaena margaritace* (Wolkberg Zulu): critically endangered
- *Aloeides stevensoni* (Steven's POrt): Vulnerable
- *Anthene crawshayi juanitae* (Juanita's Ciliated Blue/Hairtail): Vulnerable
- *Dingana jerinae* (Jerine's Widow): vulnerable
- *Erikssonia edgei* (Edge's Acraea Copper) :critically endangered
- *Lepidochry sops lotana* (Lotana Blue critically): endangered
- *Pseudonympha swanepoeli* (Swanepoel's Brown): critically endangered
- *Telchinia induna salmontana* (Soutpansberg Acraea): vulnerable.
- *Anthene liodes* (Liodes Ciliated Blue/Hairtail) is not threatened but is of special conservation concern due to its very restricted range in South Africa

The greater Soutpansberg area can support over 250 butterfly species (Woodhall, 2005). The *Acraea machequena* and *Acraea lygus* are both rare species with limited distributions in South Africa and could occur within the Mopane veld.

Over 50 species of butterflies occur within the Mopane bushveld. Out of the habitats investigated, it was found that the butterfly species were most abundant within the riparian zones. The most important species identified are as follows and are listed in terms of their distribution and association to the Mopane Veld:

- White-cloaked Skipper (*Leucochitonea levubu*)
- Friar (*Amauris niavius*)
- African Monarch (*Danaus chrysippus*)
- Guinea Fowl (*Hamanumida daedalus*)
- Green-veined Charaxes (*Charaxes candiope*)
- Foxy Charaxes (*Charaxes jasius*)
- Club-tailed Charaxes (*Charaxes zoolina*)
- Straight-line Sapphire (*Lolaussilas*)
- Swanepoel's Copper (*Aloeides swanepoeli*)

Ant Lions

There are 14 species of Ant lion that occur within the Mopane bushveld area (Picker, Griffiths & Weaving, 2004). Ant lions control the ant population in South Africa, and they are all predators.

The larval stage of the Ant lions life-span is terrestrial, later they become flying insects that resemble dragonflies. Ant lions burrow funnel traps into loose sand whilst submerging themselves in the centre of the burrow to wait for prey to fall into the trap. They are not sand specific and can be found in many different types of soil; the main factor for their occurrence is loose dry soils.

Although certain species occur throughout South Africa, some species are limited to the Mopane veld. The most important species are:

- Gregarious antlion (*Hagenomyia tristis)* whose larvae lives off soft vegetation under trees.
- Large grassland antlion (*Creoleon Diana*) which lives in the Acacia grassland.
- Grassland Ant lions (*Distoleon pulverulentus*) whose larvae live in shallow loose sand.
- *Neuroleon* whose larvae lives in fine sand under over hanging rock.
- Dotted veld ant lion (*Palpares sobrinus*), the larvae travels freely in loose sand and lie just below the surface to ambush and drag prey under.
- Mottled veld ant lion (*Palpares caffer*) whose larvae travel freely in loose soil just beneath the surface to ambush prey and drag them under the sand.
- Hook tailed ant lion (*Palparidius concinnus*), the larvae live and feed in deep sand.
- Blotched long-horned antlion (*Tmesibasis lacerate*), with this species, the larvae live under stones.

Lady Birds (Family: Coccinellidae)

Lady birds are important invertebrates as they are a form of biological pest control for citrus farming. The larvae are commonly black with conspicuous yellow or white markings. Adults and larvae are usually carnivorous (feeding on various homopteran bugs, small insects and mites), except for the subfamily *Epilachninae* which are herbivorous. 5 carnivorous species occur within the Mopane veld, (Picker, Griffiths & Weaving, 2004)namely:

- Black Two-spot Ladybird (*Chilocorus distigma*) which feeds on Aloe white scale.
- Humbug Ladybird (*Micraspis striata*),which feeds on small insects (such as thrips).
- Spotted Amber Ladybird (*Hippodamia variegate*), a specialized feeder of aphids.
- Lunate Ladybird (*Cheilomenes lunata*), specialist feeder of aphids (including wheat aphids).
- Black Mealy Bug Predator (*Exochomus flavipes*), which feeds on aphids, mealy bugs, soft scales and cochineal insects.

There are two species of lady birds which are herbivorous and are known pests, namely:

- Nightshade Ladybug (*Epilachna paykulli*) which is a pest for feeding on the leaves of potato leaves, solenaceous plants, and tomatoes.
- Potato Ladybird (*Epilachna dregei*); which feeds on leaves of potatoes and tomatoes.

Mygalomorph Spiders (with reference to Baboon Spiders)

Mygalomorph spiders are a primitive group of spiders and mainly consist of tarantulas, baboon spiders and trap door spiders. It is important to note that all baboon spiders are protected by the National Environmental Management: Biodiversity Act (NEMA) 2007, Threatened or Protected Species (TOPS). Baboon spiders (*Arachnida Theraphosidae*) with a high conservation status in the Limpopo Province are:

- *Ceratogyrys bechuanicus,* they are not threatened but all *Ceratogyrus* species are protected by TOPS.
- *Ceratogyrys brachycephalus*, all *Ceratogyrus* species are protected by TOPS.
- *Pterinochilus*, all *Pterinochilus* species are protected by TOPS.

Baboon spiders belonging to the *Ceratogyrus* family (Horned baboon spiders) are mainly found in the Limpopo Province. It is of importance to the pet trade and is on the TOPS list with other baboon spider genera *Harpactira* and *Pterinochilus*.

Ceratogyrus bechuanicus and *Ceratogyrus brachycephalus* are usually only found in small colonies, whereas Baboon spiders, such as *Pterinochilus* are usually in much larger colonies. The distribution of *Ceratogyrus bechuanicus* ranges from Botswana, Central Namibia, Zimbabwe and Mozambique to the northern parts of South Africa (Dippenaar-Schoeman, 2002). *Ceratogyrus bechuanicus* has also been recorded in the western Soutpansberg (Foord, Dippenaar-Schoeman & Van der Merwer, 2002).

In contrast to *Ceratogyrus bechuanicus*, *Ceratogyrus brachycephalus* has a more restricted distribution. They are confined to localities in central Botswana, southern Zimbabwe and the extreme north of Limpopo (De wet & Dippenaar-Schoeman, 1991: Dippenaar-Schoeman, 2002). *Ceratogyrus* bechuanicus is well represented in the Kruger National Park (De wet & Schoonbee, 1991). *Ceratogyrusbrachycephalus* has only been found in the Messina Provincial Nature Reserve, while its historical distribution includes the Langjan Nature Reserve (De wet & Schoonbee 1991). *Ceratogyrusbrachycephalus* with a much smaller distribution has a higher conservation priority than *Ceratogyrus bechuanicus*.

There appears to be no threatened baboon spider species on the site, although care must be taken to provide for natural no-go areas to provide habitat if there should be on the site. The diversity of micro habitats supports the statement that baboon spiders are present on the site.

There is an abundance of orb web spiders within the Mopane Veld which encourages the female wasp of *Batozonellus fuliginosus* into the bushveld as it specializes in preying on orb web spiders.

Scorpions

Hadogenes troglodytes, a non-threatened rock scorpion, is habitat sensitive and therefore protected by TOPS. *Hadogenes troglodytes* is sensitive to habitat destruction owing to its small brood size and slow rate of reproduction (Leeming, 2003). *Hadogenes troglodytes* is restricted to rocky outcrops and mountain ranges in the northern parts of South Africa (Leeming, 2003) and is the longest scorpion in the world. *Opistophthalmus wahlbergi* is known from the area and is protected by TOPS.

Wasps

Wasps are known as insect predators. Wasps either occur throughout the entire South Africa or have widespread distributions within South Africa; none of which are exclusively dependant on or are have exclusive distribution within the Mopane veld .The cricket hunter wasp (*Chlorion maxillosum*) preys on the giant burrowing cricket (*Brachytrupes membranaceus*), which is restricted to the Mopane veld.

Dung Beetles

Dung beetles perform an important ecological function in the bushveld. Dung beetles convert animal dung into humus and deliver manure under the ground, thus aiding in nutrient delivery to plant roots.There are over 700 dung beetle species throughout South Africa. The conservation important dung beetles within the area are:

- *Scarabaeus schulzeae*
- *Metacatharsius sp*
- *Proagoderus lanista*
- *Onitis obenbergeri*

Other important dung beetles which do not have a listed conservation status are:

- Green dung beetle (*Garreta nitens*)
- Grooved dung beetle (*Heteronitis castelnaui*)
- Trident dung beetle(*Heliocopris neptunus)*
- Plum dung beetle (*Anachalcos convexus)*
- Bi-coloured dung beetle (*Proagoderus tersidorsis*)
- Large Copper dung beetle (*Kheper nigroaeneus)*
- Fork nosed dung beetle (*Coptorhina klugi*)

These dung beetle species were identified as important due to their exclusive distribution within the Mopane veld and limited distribution throughout South Africa etc.

Mopane Moth (Imbrasia Belina)

The larvae of the Mopane Moth feed on a large variety of plants including; Mopane (*Colophospermum Mopane*), *Ficus, Terminalia, Trema* and *Rhus*. They form an important constituent (after evisceration and drying) of the local diet. Outbreaks of this species defoliate shrubs which deprives game of available food. After the moths appear, the Mopane trees recover. This species is in competition with the Speckled Emperor moth (*Gynanisa maja*) and can compete for Mopane trees during the larvae stage, especially when outbreaks occur by both species simultaneously. The Mopane moth is opportunistic and their larvae may feed on citrus trees therefore they may become a pest for the citrus farmers in the surrounding areas.

Other invertebrates of importance are listed in Table 16.

Table 16: Table of Invertebrate Species having Ecological Importance

INSECT SPECIES	ECOLOGICAL IMPORTANCE/COMMENT
Dung beetles	Converts dung into humus which provides nutrients to the soil. 17 difference species occur within the Mopane bushveld.
Armoured darkling beetle	The beetle larvae live in the soil and feeds on roots and plant detritus, converting the matter into soil nutrients. Its presence was confirmed in the Sand River, 4 were found in the pit traps on one occasion.
Corn cricket	This insect feeds on acacia leaves and forms a major food source for bat eared foxes, birds and jackals. There are citrus farms in proximity to the proposed mining area, where

INSECT SPECIES	ECOLOGICAL IMPORTANCE/COMMENT
	the insect has been known to become pests.
Giant burrowing cricket (*Brachytrupes membranaceus*)	Occur mainly within Mopane Veld, and is hunted by the cricket hunter wasp (*Chlorion maxillosum*). The Giant burrowing cricket is the largest and loudest cricket in the world.
Bush hoppers (family *Euschmidtiidae*)	Mainly occurs within the Limpopo Province.
Brachytypus rotundifrons (no common name)	Distribution is restricted to the Limpopo Province.
Pantoleistes princeps	Occurs within the Mopane Veld and is associated with termite mounds.
Homoeocerus auriculatus	Occurs within Mopane veld, and feeds on both indigenous and alien acacia species (*Acacia mearnsii*).
Leptoglossus membranaceus	This insect is a pest to citrus farmers, as the fruit which they feed on will drop from the tree. There are many Citrus farms in the area.
Dieuches	A ground dwelling insect that feeds on dassie (*Hyrax*) dung.
Edible stinkbug (*Encosternum delegorguei*)	A diurnal insect that feeds on Acacia and other shrubs and trees. The bug (harugwa), a local delicacy, is killed in hot water and squeezed to remove the almost nauseating secretion then roasted or dried. Also eaten in South Africa raw or cooked.
Red Scale (*Aonidiella aurantii*)	This is a pest of citrus trees as its toxic saliva cause yellow spots. Most citrus trees in the area are infested with thus bug.
Aloe white scale (*Duplachionaspis exalbida*)	This is a pest to aloes and sever infestations can cause leaf tips to wither. Populations are generally kept under control by wasps and ladybird beetles.
Marsh ground beetle (*Bradybaenus opulentus*)	Predator of small insects and occurs mainly within Mopane veld
Butterflies	50 species occur within the Mopane bushveld. The most important species are: White-cloaked Skipper (*Leucochitonealevubu*), Friar (*Amaurisniavius*), African Monarch (*Danauschrysippus*), Guinea Fowl (*Hamanumidadaedalus*), Green-veined Charaxes (*Charaxescandiope*), Foxy Charaxes (*Charaxesjasius*), Club-tailed Charaxes (*Charaxeszoolina*), Straight-line Sapphire (*Lolaussilas*) and Swanepoel's Copper (*Aloeideswanepoeli*).
Bees	Bees form a major role in pollination of the plants and trees in Mopane Veld. There are several species of bees throughout the Limpopo Province, the most important being the Honey bee (*Apis mellifera*). The CapeHoney bee invades and supplants colonies of the less aggressive African Honey bee. Although they are very important as crop pollinators, honey bees may deprive more specialized and efficient indigenous bees of pollen and nectar, effectively reducing pollination of wild flowers. Honey bees are also important for honey production for humans. Bee populations are on the decline due to a disease called American Foul Disease (AFD).) This disease affects the immune system of the bee, thus allowing pathogens to enter and destroy the bee, and subsequently the entire colony.
Mopane bee (*Meliponula* sp.)	This small bee is stingless and is known for trying to collect moisture from eyes and mouths of humans, although not dangerous, it is an irritant in the Mopane bushveld.

1.2.5.2.6 Faunal sensitive areas

Areas sensitive from a faunal perspective are related to the habitat present. Sensitive areas include the river systems and drainage lines as well as areas having exposed rocky outcrops usually having notable populations of reptiles.

1.2.5.3 Biodiversity and Ecosystem Processes

1.2.5.3.1 __National Biodiversity Assessment (NBA, 2011)__

No NBA 2011 Endangered or Critically Endangered Ecosystems are affected by the proposed development.

1.2.5.3.2 __Biodiversity Proxy__

The Biodiversity Proxy was created by combining a layer created through the interpolation of species grid information compiled by the Vhembe Biosphere Reserve (VBR) scientific group with the Conservation Status of the SANBI vegetation. Values were then subtracted using the land cover to reflect transformation and impacts.

In general the Biodiversity Proxy for the affected area is low to moderate in some patches (Figure 22).

1.2.5.4 Ecosystem Services

Using the Ecosystem Services (ESS) Classification developed for the Department of Environmental Affairs (DEA) by Transboundary Consulting Africa (2012), the ESS Index for the Mopane Project and surrounding areas was compiled by combining the values of the Provisioning (Food, Fresh Water and Mineral Value), Regulating (Carbon Sequestration, Groundwater Regulation and Water Purification), Supporting (Biomass Production, Threatened Ecosystems and Conservation Status) and Cultural (Scenic Value, Preservation Value, Heritage Value and Human Impacts) Service.

Ecosystem Services are low for most of the affected area, becoming moderate around rivers, drainage lines and ridges (Figure 23).

Broad ecosystem delineation is limited to the terrestrial mopane and mixed veld areas, sandstone ridges and plateaus, rocky ridges and outcrops and the Sand River with associated riverine forest, floodplains and large drainage lines.

The Sand River riverine forest and floodplains are important dry season refuge areas for many fauna species in their natural state. It is also a centre of floral diversity. Some of these areas are however degraded and overgrazed. The Sand River does provide a source of water, while the deeper alluvial soils may provide better forage than areas inland of the riparian zone. Any impacts on the sensitive aquatic ecosystems, regardless of the source, need to be avoided. Impacts on this system include erosion, deforestation through flooding, habitat loss and degradation and the associated impacts on faunal and floral diversity, dewatering, water abstraction as well as increased sedimentation. Continued impacts on the riverine ecosystems may also ultimately reduce the capacity of this system to absorb dramatic flooding events.

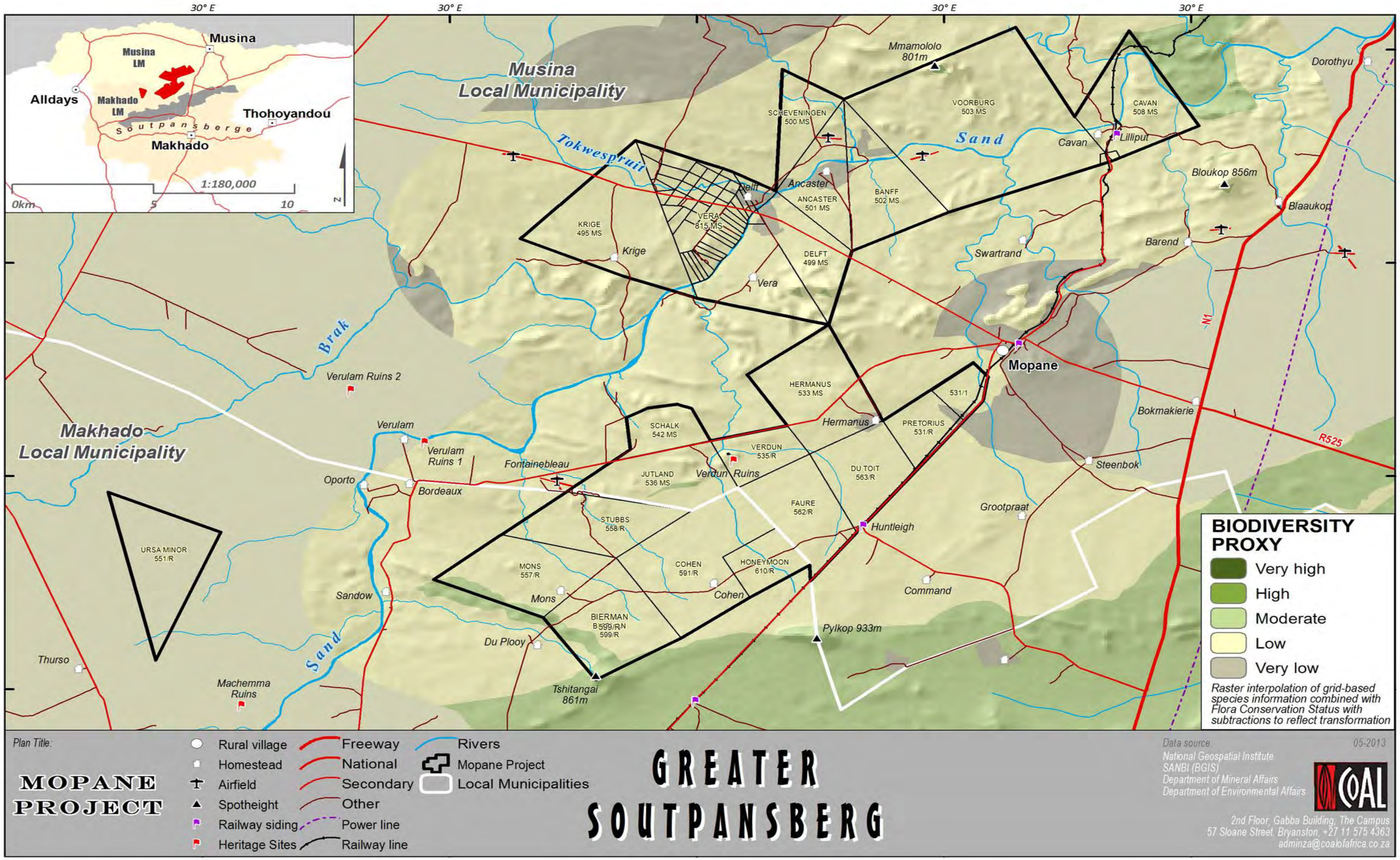


Figure 22: Biodiversity Proxy of the Mopane Project area and surrounds

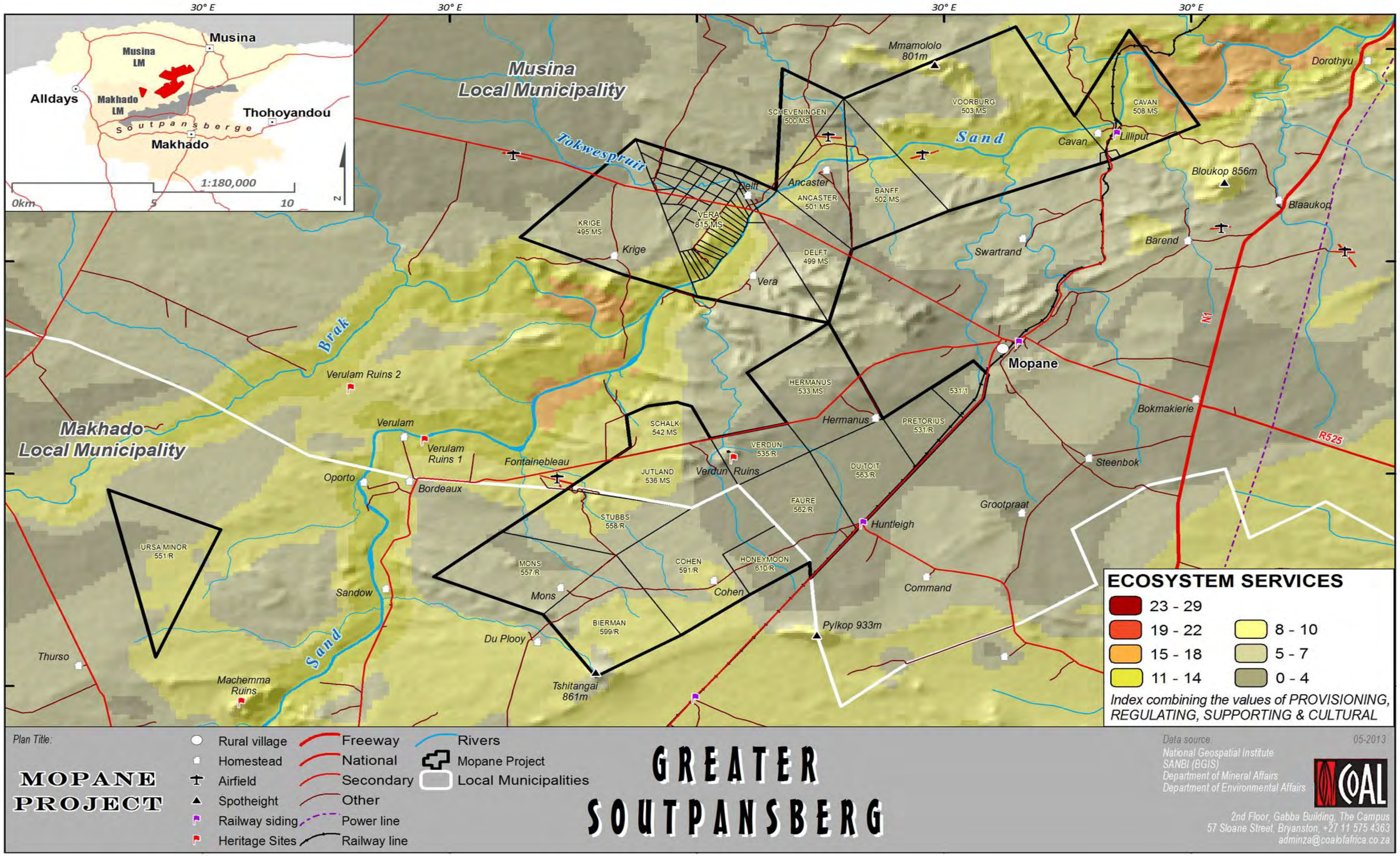


Figure 23: Ecosystem Services of the Mopane Project area and surrounds

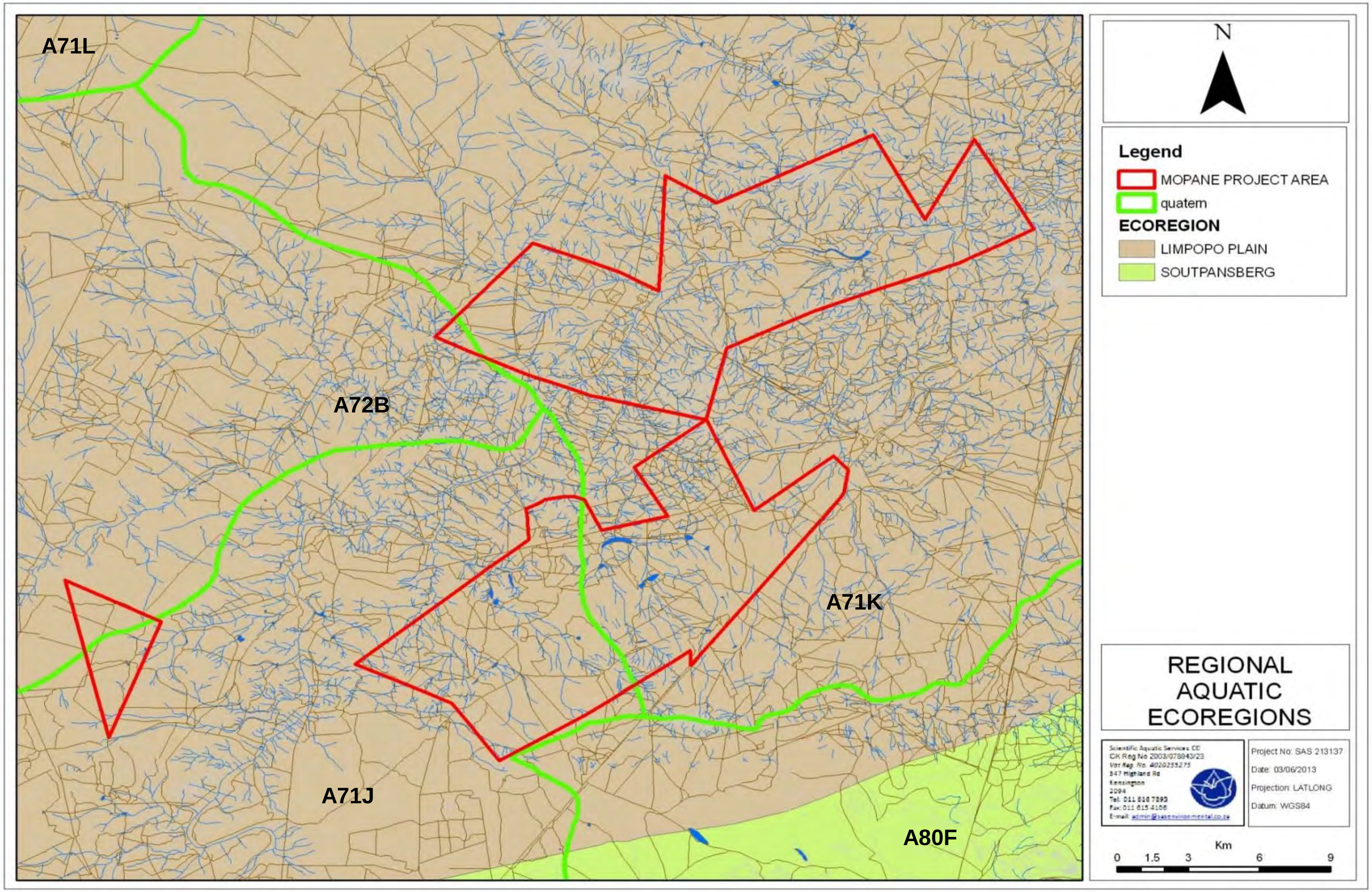


Figure 24: Ecoregions associated with the Mopane Project area (Mucina and Rutherford, 2006)

1.2.6 AQUATIC ENVIRONMENT

1.2.6.1 Ecoregions

When assessing the ecology of any area (aquatic or terrestrial), it is important to know which ecoregion the area is located within. This knowledge allows for improved interpretation of data to be made, since reference information and representative species lists are often available on this level of assessment, which aids in guiding the assessment.

The Mopane Project falls within the Limpopo Plain Ecoregion and is located within the A71J, A71K and A72B quaternary catchments. Figure 24 indicates the aquatic ecoregions and quaternary catchments of the Mopane Project.

1.2.6.2 Ecostatus

Water resources are generally classified according to the degree of modification or level of impairment. The classes, used by the South African River Health Program (RHP), are presented in the table below and will be used as the basis of classification of the systems in future field studies.

Table 17: Classification of river health assessment classes in line with the RHP

Class	Description
A	Unmodified, natural
B	Largely natural, with few modifications
C	Moderately modified
D	Largely modified
E	Extensively modified
F	Critically modified

Studies undertaken by the Institute for Water Quality Studies assessed all quaternary catchments as part of the Resource Directed Measures for Protection of Water Resources. In these assessments, the Ecological Importance and Sensitivity (EIS), Present Ecological Management Class (PEMC) and Desired Ecological Management Class (DEMC) were defined and serve as a useful guideline in determining the importance and sensitivity of aquatic ecosystems, prior to assessment or as part of a desktop assessment.

This database was searched for the catchment of concern in order to define the EIS, PEMC and DEMC. The results of the assessment are summarised in the table below.

Table 18: Summary of the ecological status of quaternary catchments A71J, A71K and A72B based on Kleynhans (1999)

Catchment	Resource	EIS	PESC	DEMC
A71J	Sand River	Low/Marginal	Class B	D: Resilient system
A71K	Sand River	Moderate	Class B	C: Moderately sensitive system
A72B	Brak River	Low/ Marginal	Class B	D: Resilient system

A71J

According to the ecological importance classification for the quaternary catchment, the system can be classified as a ***Resilient*** system which, in its present state, can be considered a Class B (largely natural) stream.

The points below summarise the impacts on the aquatic resources in the A71J quaternary catchment (Kleynhans 1999):

- The aquatic resources within this quaternary catchment have been moderately affected by bed modification as a result of erosion, grazing and sedimentation within the catchment.
- Flow modification within the catchment is considered very low.
- Marginal impacts from inundation of the system occur as a result of weirs within the catchment.
- Riparian zones and stream bank conditions are considered to be moderately impacted by erosion, grazing and sedimentation.
- A very low impact occurs as a result of the introduction of in-stream biota.
- Impacts on water quality in the system are considered very low.

In terms of ecological functions, importance and sensitivity, the following points summarise the conditions in this catchment:

- The riverine systems in this catchment have a marginal diversity of habitat types.
- The site has a very low importance in terms of conservation.
- The riverine resources in this system have no intolerance to flow and flow related water quality changes.
- The aquatic resources in the area have a marginal importance in terms of migration of species.
- The system is considered to be of no importance in terms of rare and endemic species conservation.
- The aquatic resources in this catchment are marginally important in terms of the provision of refuge areas.
- The riverine resources in this system have a low sensitivity to changes in water quality and flow.

- The aquatic resources in this area are of moderate importance in terms of Species/Taxon richness with up to 10 different species present.
- The system is of no importance with regards to unique or endemic species.

A71K

According to the ecological importance classification for the quaternary catchment, the system can be classified as a ***Moderately Sensitive*** system which, in its present state, can be considered a Class B (largely natural) stream.

The points below summarise the impacts on the aquatic resources in the A71K quaternary catchment (Kleynhans 1999):

- The aquatic resources within this quaternary catchment have been marginally affected by bed modification as a result of sedimentation within the system.
- Flow modification due to the presence of weirs within the system is considered marginal.
- Marginal impacts from inundation of the system occur as a result of weirs on the Voorburg Dam.
- Riparian zones and stream bank conditions are considered to be marginally impacted by farming activities.
- A marginal impact occurs as a result of the introduction of in-stream biota with special mention of *Cyprinus carpio* (Common Carp).
- Impacts on water quality in the system are considered low.

In terms of ecological functions, importance and sensitivity, the following points summarise the conditions in this catchment:

- The riverine systems in this catchment have a moderate diversity of habitat types including sandy beds, rapids and riparian vegetation.
- The site has a moderate importance in terms of conservation with special mention of the Messina Nature Reserve.
- The riverine resources in this system have a high intolerance to flow and flow related water quality changes with special mention of *Labeo* species, *Chiloglanis paratus* (Sawfin Suckermouth) and *Labeobarbus marequensis* (Largescale Yellowfish).
- The aquatic resources in the area have a moderate importance in terms of migration of species with special mention of bird species.
- The system is considered to be of moderate importance in terms of rare and endemic species conservation with special mention of crocodile species.
- The aquatic resources in this catchment are moderately important in terms of the provision of refuge areas for birds and fish.
- The riverine resources in this system have a low sensitivity to changes in water quality and flow.
- The aquatic resources in this area are of moderate importance in terms of Species/Taxon richness with up to 8 of fish different species present.
- The system is of no importance with regards to unique or endemic species.

A72B

According to the ecological importance classification for the quaternary catchment, the system can be classified as a ***Resilient*** system which, in its present state, can be considered a Class B (largely natural) stream.

The points below summarise the impacts on the aquatic resources in the A72B quaternary catchment (Kleynhans 1999):

- The aquatic resources within this quaternary catchment have been marginally affected by bed modification.
- Flow modification within the catchment is considered very low.
- Marginal impacts from inundation of the system occur.
- Riparian zones and stream bank conditions are considered to be marginally impacted.
- A low impact occurs as a result of the introduction of instream biota.
- Impacts on water quality in the system are considered low.

In terms of ecological functions, importance and sensitivity, the following points summarise the conditions in this catchment:

- The riverine systems in this catchment have a moderate diversity of habitat types.
- The site has a moderate importance in terms of conservation with special mention of the Langjan Nature Reserve.
- The riverine resources in this system have a moderate intolerance to flow and flow related water quality changes with special mention of CGAR.
- The aquatic resources in the area have a moderate importance in terms of migration of species.
- The system is considered to be of no importance in terms of rare and endemic species conservation.
- The aquatic resources in this catchment are moderately important in terms of the provision of refuge areas.
- The riverine resources in this system have a low sensitivity to changes in water quality and flow.
- The aquatic resources in this area are of marginal importance in terms of Species/Taxon richness with up to 5 different species of fish present.
- The system is of no importance with regards to unique or endemic species.

1.2.6.3 Ecological Importance

The SANBI Wetland Inventory (2006) and NFEPA (2011) databases were consulted to define the ecology of the wetland or river systems within the Mopane Project Area that may be of ecological importance. Key findings are listed below:

- The sub-Water Management Area is not regarded important in terms of fish sanctuaries, rehabilitation or corridors, translocation and relocation zones for fish;
- The Sand River is a perennial system classified as a Class B (largely natural) river and is not indicated as a free flowing or flagship river. However, the northern portion of the Sand River is indicated as a Freshwater Ecosystem Priority Area (FEPA) river and the southern portion of the Sand River is indicated as an Upstream Management Area;
- River FEPAs achieve biodiversity targets for river ecosystems and threatened fish species, and were identified in rivers that are currently in a good condition (A or B ecological category). Their FEPA status indicates that they should remain in a good condition in order to contribute to national biodiversity goals and support sustainable use of water resources. Although FEPA status applies to the actual river reach within such a sub-quaternary catchment. The shading of the whole sub-quaternary catchment indicates that the surrounding land and smaller stream network need to be managed in a way that maintains the good condition (A or B ecological category) of the river reach;
- Upstream Management Areas are sub-quaternary catchments in which human activities need to be managed to prevent degradation of downstream river FEPAs and Fish Support Areas.

1.2.6.4 Wetland Assessment

Sites selected with the use of desktop methods, were investigated during the field survey undertaken in July 2013 (SAS, 2013 – ANNEX-5). For the purposes of this investigation, use was made of distinguishing factors as either defined by DWA (2005) for 'wetland habitat' or defined in the National Water Act (NWA; Act No 36 of 1998) for 'riparian habitat'. Due to the ephemeral nature of many features within the study area they could not be considered true wetland or riparian habitat and was consequently not assessed.

Wetland and riparian features within the study area were categorised with the use of the Classification System for Wetlands and other Aquatic Ecosystems in South Africa (Ollis, 2013). After the field assessment it can be concluded that three main feature groups are present within the study area, namely depressions (pans and wetland depressions), rivers (Sand River, Tokwespruit, Banff Stream and Voorburg Stream) and smaller drainage lines.

These groups were then assessed to determine importance in terms of function and service provision as well as Present Ecological State (PES.) The bullets below summarise the key findings – refer to ANNEX-5 (Aquatic Specialist Study, SAS 2013) for detail description:

- The results obtained indicate that the Sand River can be considered the most important in terms of function and service provision, with the highest scores calculated for water supply, biodiversity and tourism and recreation. The next highest average scores calculated was for the Voorburg Stream, Banff Stream and wetland depressions;

- Wet-Health was used to determine the PES of smaller drainage lines including wetland depressions and pans. Pans calculated average scores for vegetation, hydrology and geohydrology that fall within a very high PES (unmodified, natural), mainly as a result of their remoteness. Smaller drainage lines calculated the same impact score for vegetation, however hydrology and geohydrology impact scores are lower as a result of impact from earth works due to the construction of the impoundments (wetland depressions) as well as abstraction of water;
- Riparian Vegetation Response Assessment Index (VEGRAI) was used to assess the response of riparian vegetation to impacts within rivers as well as smaller drainage lines. The mean average scores calculated for the Sand River and Tokwespruit both fall within Class C (moderately modified) and mean average scores calculated for the smaller drainage lines, Banff and Voorburg Streams fall within Class B (largely natural); and
- The Index of Habitat integrity (IHI) was used to assess the vegetation, hydrology and geomorphology of the different river systems and drainage lines. All three aspects were used to determine the average PES category for each feature assessed. The smaller drainage lines calculated the highest PES score falling within a Class A (unmodified), followed by the Banff Stream, Voorburg Stream and the Tokwespruit all calculating scores falling between Class A and B (largely natural). The Sand River calculated the lowest score falling between Class B and Class C (moderately modified).

The following general conclusions were drawn upon completion of the aquatic assessment – refer to ANNEX-5 (Aquatic Specialist study, SAS 2013) for a detail description of the assessment methodologies and results obtained during the site visit:

- Increased concentrations of dissolved salts were observed in a downstream direction, resulting from low flow conditions compounded by water abstraction from the system for agricultural purposes);
- pH values also increased in a downstream direction;
- The most significant impacts (in-stream habitat) are from water abstraction, flow modification and water quality modifications;
- In the riparian zone the system has been affected by vegetation removal, alien encroachment and bank erosion;
- Habitat conditions seem to deteriorate in a downstream direction with impacts from farming and construction evident;
- Conditions (macro-invertebrate community) in the Sand River have deteriorated in a downstream direction according to both the Dallas (2007) and the Dickens & Graham (2001) classification systems;
- In comparison the downstream sites vary between class C (moderately impaired) and class E (severely impaired) conditions according to the Dickens & Graham (2001) classification system. With the Dallas (2007) classification system conditions vary between class D and class and in a class E/F for the downstream sites;
- The MIRAI results in terms of (ecological category classification) follow the same trends as that obtained using the SASS class classifications;
- The (ecostatus) EC classification obtained are in congruence with previous studies performed in the same system.

1.2.6.5 Present Ecological State and Recommended Ecological Class

The PES of the wetland systems at the Voorburg and Jutland Sections are illustrated in Figure 25 and Figure 26 respectively.

According to the resource directed measures for protection of water resources a wetland or river may receive the same class for the PES, as the Recommended Ecological Class (REC), if the habitat is deemed in good condition, and therefore must stay in good condition. Otherwise, an appropriate REC should be assigned in order to prevent any further degradation as well as to enhance the PES of the feature. The results obtained from the assessments indicate a relatively low presence of transformation on all levels of ecology and functionality except for the Sand River which can be considered to be a largely modified system. It is therefore recommended that the features be assigned the same REC as the PES Class calculated.

Table 19: Assigned REC Classes

Feature	PES Class	REC Class
Sand River	D (combined assessment of wetlands and aquatic ecostatus)	D
Tokwespruit	A/B (IHI)	A/B
Banff Stream	A/B (IHI)	A/B
Voorburg Stream	A/B (IHI)	A/B
Smaller drainage lines	A/B (Wet-Health)	A/B
Wetland depressions	A/B (Wet-Health)	A/B
Pans	A (Wet-Health)	A

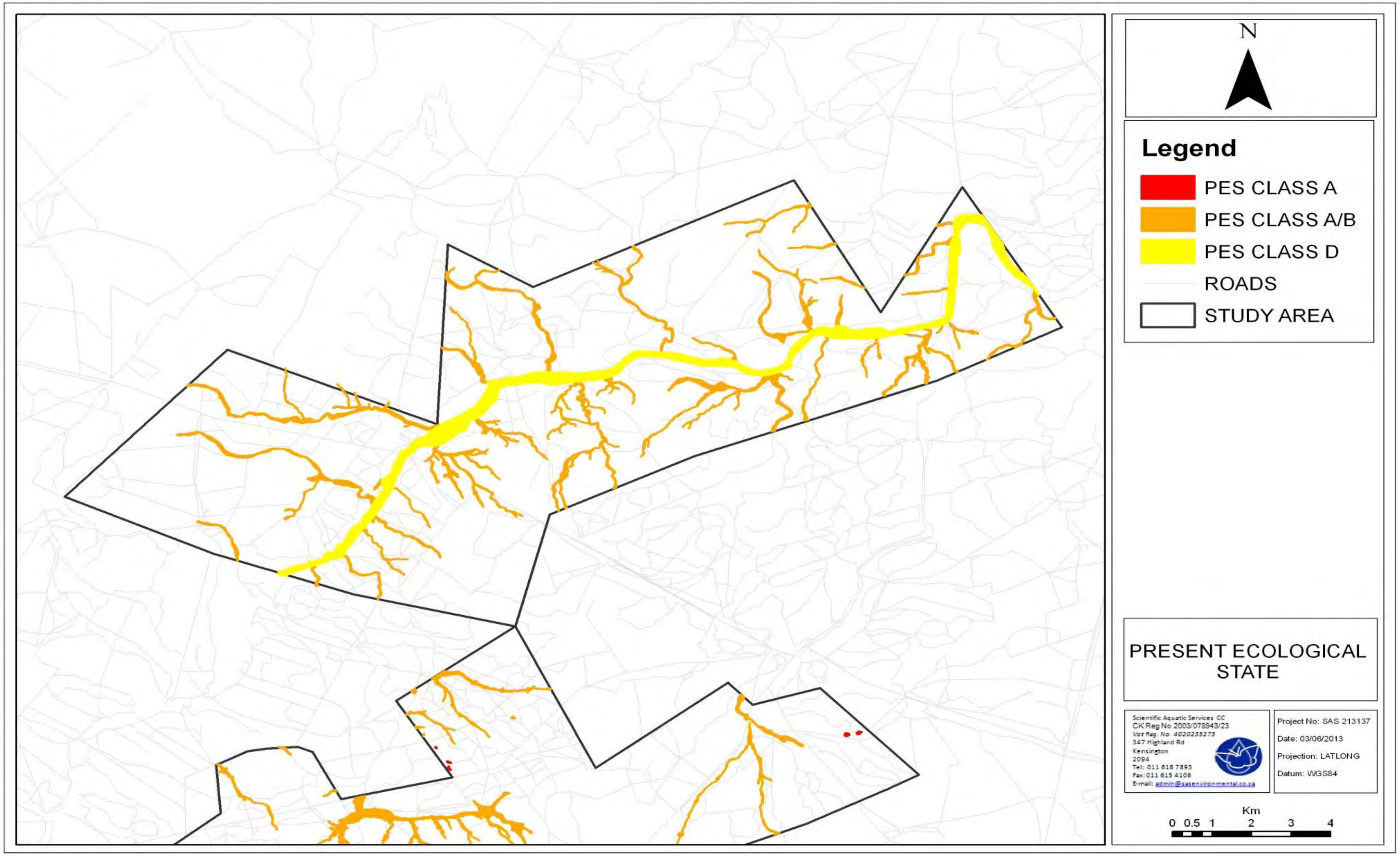


Figure 25: Present Ecological State of the wetland systems at Voorburg Section

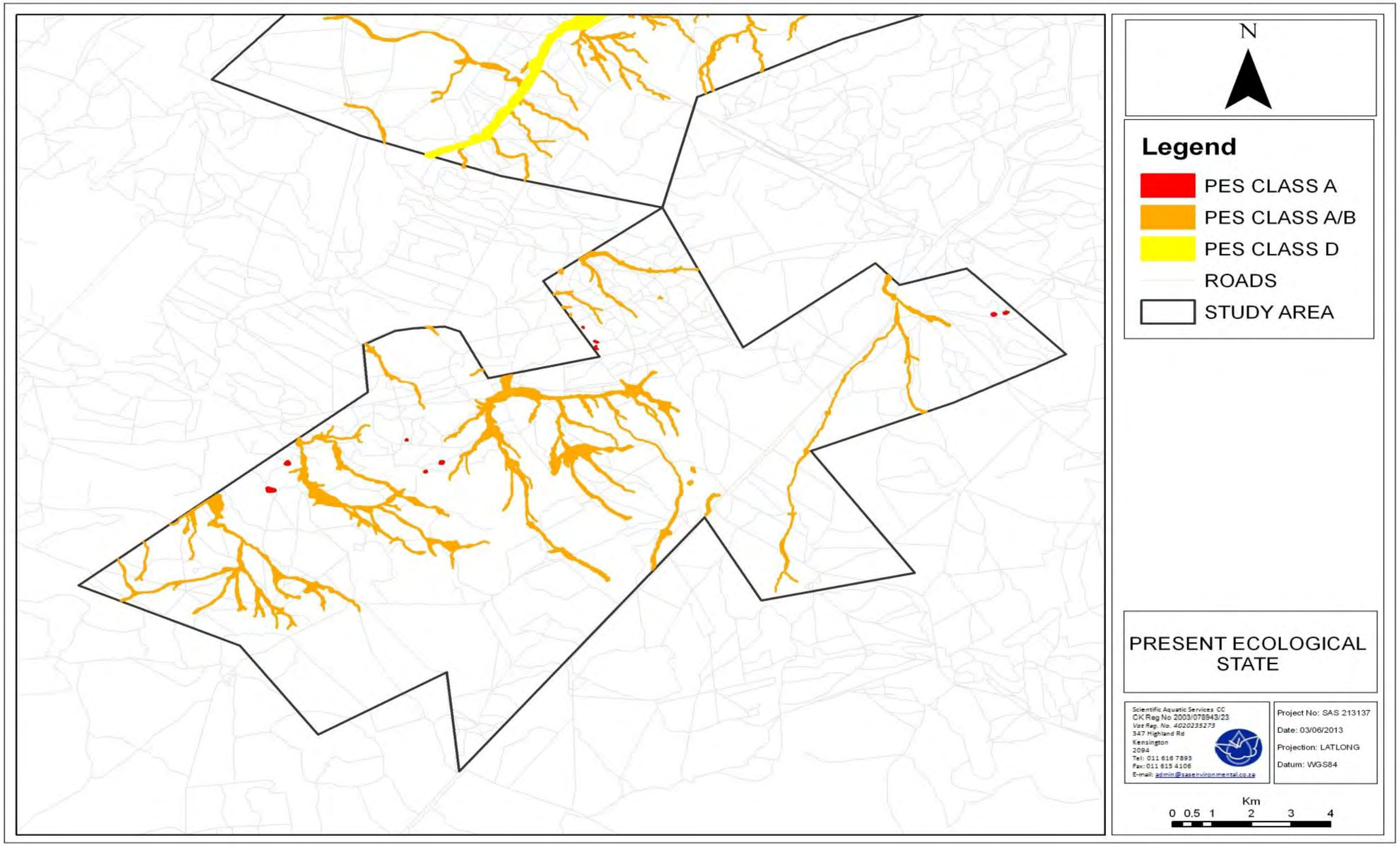


Figure 26: Present Ecological State of the wetland systems at Jutland Section

1.2.7 SURFACE WATER

1.2.7.1 Locality and Background Information

Figure 27 below shows the Jutland and Voorburg Sections in relation to the lower quaternary catchments areas of the Sand River. The Sand River Basin is regarded as by far the driest of the river basins in the Limpopo River Water Management Area (WMA) (ISP, Limpopo WMA, DWA 2004). The surface water resources are thus regarded as very limited and there is no scope for construction of dams.

The existing major dams in the catchment are located upstream, namely the Seshego Dam in the Blood River (Polokwane Local Municipality), Hout River Dam (supply to rural villages), Turfloop Dam in the south-eastern part of the Basin, Spies Dam in the Dorps River about 20 km west of Louis Trichardt and Brak River Dam, west of the Voorburg area.

There is no government developed irrigation scheme but extensive private and commercial irrigation schemes have been developed. The bulk of the water requirements are met almost by the ample groundwater resources. In the upper region of the Basin, Polokwane and other larger towns rely on transfers of water from other WMAs.

The proposed Mopane Project is located in the downstream portion of the Basin, about 50 km (measured along the river) from its confluence with the Limpopo River. The Voorburg Section is almost wholly inside Quaternary Catchment A71K, while the Jutland Section is about halfway within each of Catchments A71K and A71J. Hydrological data of the quaternary catchments are given in the following sections.

The flow in the lower Sand River, its tributaries and minor streams is highly ephemeral. Run-off occurs after rainfall events, with flow in the main stem of longer duration after major, wide-spread rainfall in its catchment area.

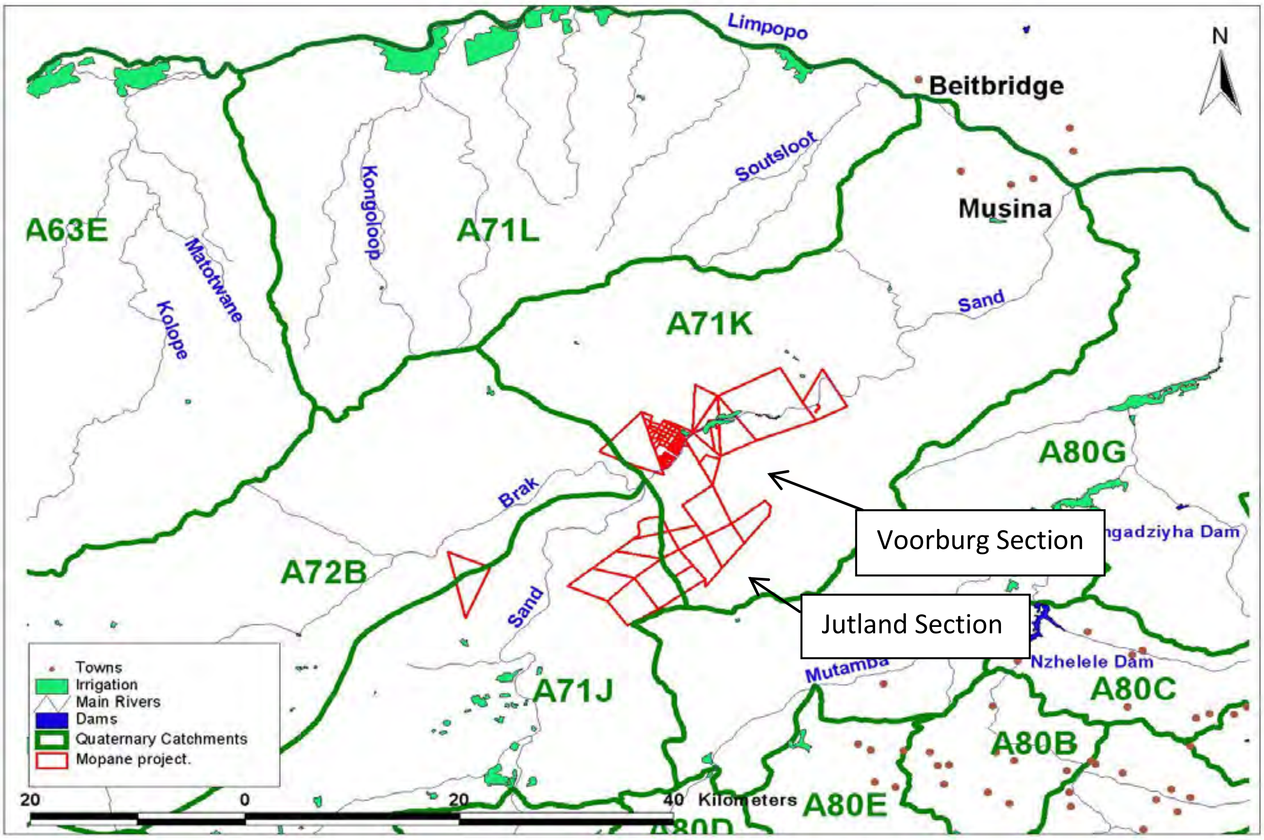


Figure 27: Mopane Project in relation to the lower quaternary catchments areas of the Sand River

1.2.7.2 Surface Water Quality

According to the Water Resource Situation Assessment, the upper and central Sand River receives "large quantities" of industrial and domestic effluent from large towns and high density rural towns along its banks. The mineralogical water quality of the whole of the catchment was thus classified as "marginal" (DWA, 2002).

In contrast to this assessment, the ISP study (DWA, 2004) states that apart from problems with groundwater quality in the Vivo and Dendron areas there are no major water quality problems in the Sand River Key Area (the Key area includes the Sand River Basin and other smaller rivers draining to the Limpopo River).

A Baseline Study of the water chemistry of the Limpopo Basin (Univ. of Zimbabwe, 2009) found that in the Vhembe District, which includes the Sand River, nitrate levels increased with groundwater flow towards the Sand River and high levels of nitrate were recorded in both the river and alluvial groundwater during the raining season. It was suggested that the nitrate is from dry land cropping, overgrazed pastures and, in some areas, pit latrines. High fluoride was noted in the area north of the Soutpansberg and has been attributed to high evaporation.

DWA has river water quality monitoring stations at Waterpoort(22°54'37' S and 29°26'41' E) which is 64 km upstream of the site and at Dorothy (22°54'37' S and 29°26'41' E) which is 17 km downstream of the site.

Table 20: Water quality measured at Dorothy (Station A7H009)

Macro-elements														
Element	Unit	DWA Gauge "Dorothy" : STATION A7H009 in Quaternary Catchment A71K								Aquatic Ecosystem WQT	Drinking Water WQT	Agriculture WQT (irrigation)	Agriculture WQT (livestock)
DATE		12/1997	3/1998	5/2000	11/2000	04/2001	07/2001	11/2001	12/2001				
pH		8.46	8.55	8.49	8.62	8.07	8.6	7.9	8.6		6.0 - 9.0	6.5-8.4	
E.C	mS/m	55.8	75.3	210	319	317	377	32.6	258		150	40	
TDS	mg/l										1000		1000
NO_3	mg/l	0.02	0.02	0.056	0.02	0.02	0.055	0.020	0.055	0.5	6	5	100
F	mg/l	0.27	0.4	0.326	0.347	0.368	0.51	0.27	0.44	0.75	1	2	2
SO_4	mg/l	2	21	155	293	273	321	17	209		400		1000
Cl	mg/l	46	95	343	742	730	866	24	507		200	100	1500
Ca	mg/l	34	32	91	85	94	103	17	73		150		1000
Mg	mg/l	21	25	74	124	112	149	10	87		100		500
Na	mg/l	47	91	193	406	401	453	28	290		200	70	2000
TAL	mg/l	219	247	285	207	248	297	107	227				
HCO3	mg/l												
CO3	mg/l												
P	mg/l												
NOTE: VALUES IN GREEN SHOW CONSTITUENTS WHERE RANGE TESTED NOT FINE ENOUGH TO COMPARE TO TARGET WATER QUALITY RANGE													

The data above includes eight most complete set of results of the eleven sets available for "Dorothy" but spans the whole of the sampling period. It shows elevated levels of pH, Electrical conductivity, chloride, magnesium and sodium when compared to the drinking water Irrigation Target Water Quality (TWQ) Guidelines. This may be attributed to the upstream irrigation activities.

Table 21: Water quality measured at Waterpoort (Station A7H001)

Macro-elements												
Element	Unit	DWA Gauge "Waterpoort" : STATION A7H001 in Quaternary Catchment A71J							Aquatic Ecosystem WQT	Drinking Water WQT	Agriculture WQT (irrigation)	Agriculture WQT (livestock)
DATE		4/2000	12/2001	10/2002	01/2003	04/2004	08/2005	02/2006				
pH		8.2	8.5	8.2	7.9	7.8	7.8	7.7		6.0 - 9.0	6.5-8.4	
E.C	mS/m	70	253	20	36	19	10	10		150	40	
TDS	mg/l									1000		1000
NO_3	mg/l	0.8	0.02	0.07	0.12	0.06	0.04	0.04	0.5	6	5	100
F	mg/l	0.21	0.41	0.13	0.23	0.1	0.05	0.11	0.75	1	2	2
SO_4	mg/l	34	207	6	16	7	2	5		400		1000
Cl	mg/l	105	565	12	41	13	8	6		200	100	1500
Ca	mg/l	34	77	14	23	14	8.5	5		150		1000
Mg	mg/l	22	92	8	8	7	3	3		100		500
Na	mg/l	64	287	7	28	10	4	6		200	70	2000
TAL	mg/l	34	207	6	16	7	2	5				
HCO3	mg/l											
CO3	mg/l											
P	mg/l											
NOTE: VALUES IN GREEN SHOW CONSTITUENTS WHERE RANGE TESTED NOT FINE ENOUGH TO COMPARE TO TARGET WATER QUALITY RANGE												

The table above shows water results of DWA for the most recent seven years. This station has a long record of monthly sampling but these values were selected to give an indication of more recent water quality, albeit upstream of the site and of the irrigation areas. Elevated levels of pH, EC, chloride and sodium occurred after the extreme flood of 2000 and also in the following year. Instead of a dilution effect, this data may indicate the effect of higher wash-off from contaminated areas.

Table 22: **Water samples collected by WSM Leshika in 2013**

Macro-elements												
Element	Unit	**Mopane project samples taken by WSM Leshika: 27 June 2013**							Aquatic Ecosystem WQT	Drinking Water WQT	Agriculture WQT (irrigation)	Agriculture WQT (livestock)
NAME		27	28	29								
pH		8.53	8.18	7.47						6.0 - 9.0	6.5-8.4	
E.C	mS/m	254	208	13.7						150	40	
TDS	mg/l	1697	1269	67						1000		1000
NO_3	mg/l	0.478	-0.017	-0.017					0.5	6	5	100
F	mg/l	0.692	0.286	0.105					0.75	1	2	2
SO_4	mg/l	238	176	-0.04						400		1000
Cl	mg/l	572	522	9.15						200	100	1500
Ca	mg/l	84	94.9	12						150		1000
Mg	mg/l	133	97.2	5.52						100		500
Na	mg/l	387	257	5.97						200	70	2000
TAL	mg/l	451	183	52.5								
HCO3	mg/l											
CO3	mg/l											
P	mg/l											

Figure 28 shows the localities of the proposed long term surface water monitoring points. Only three samples (shown as blue balloons in Figure 28) could be collected in the site visit undertaken in June 2013 due to the dry river or to inaccessibility. Note that sample S28 was collected slightly downstream of the proposed site WAT2 and sample S29 was taken close to site WAT8 at Waterpoort.

The samples taken at Sites 27 and 28 were from slow moving water in shallow ponds and the high EC and TDS values (as reflected in the elevated values for chloride, magnesium and calcium) probably indicate the effect of evaporation.

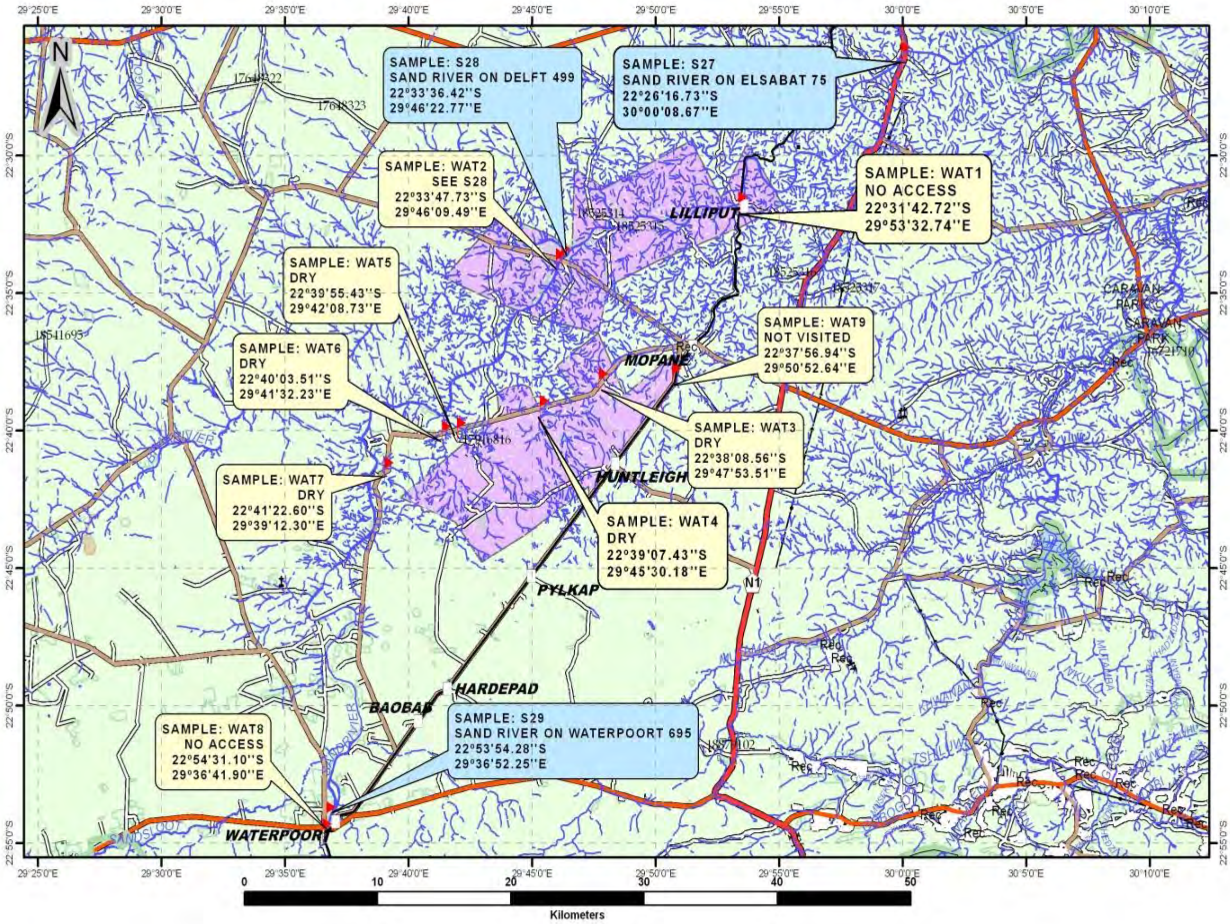


Figure 28: Water quality monitoring points

1.2.7.3 Current Land Use

The Sand River area north of the Soutpansberg is sparsely populated and apart from Musina close to the Limpopo River there are no other towns within the catchment area.

The farm land is used for cattle and game farming, as well as irrigation from the Sand River alluvial deposits (classified as groundwater use) and from boreholes in fractured aquifers. Not all of the cleared land identified on satellite imagery is currently under irrigation. The extent of irrigation depends, amongst other factors, on the availability of water in the alluvial sand deposits of the Sand River and thus varies from year to year.

Of importance, however, is the possible downstream impact of the mining activity on surface water use. The downstream use is limited to irrigation from the river for a small present development, stock and game drinking water as well as the requirements of riverine vegetation. It must be noted that groundwater sources are also utilized for drinking water by households, cattle and game because of the ephemeral nature of river and stream flows.

Apart from the main stem of the river, the mining development would also impact on the local drainage systems which are described in the following Section.

1.2.7.4 Drainainage System and Main Stem Hydrology

Figure 29 shows the major rivers and the general flow direction of the minor drainage system. Since the NWA identifies a stream as a feature where water flows, albeit intermittently, all identifiable drainage lines are shown in Figure 30 (Voorburg Section) and Figure 31 (Jutland Section). The 1:100-year flood-line for the Sand River and two tributaries has been determined and is included in Figure 30.

From the figures it is clear that even though the site is situated in a dry region, surface water flows occur in a defined network. Flow deviations will be required upstream of the mine to ensure that the water quality is maintained. The drainage density is somewhat less in the Jutland Section which is located further away from the Sand River.

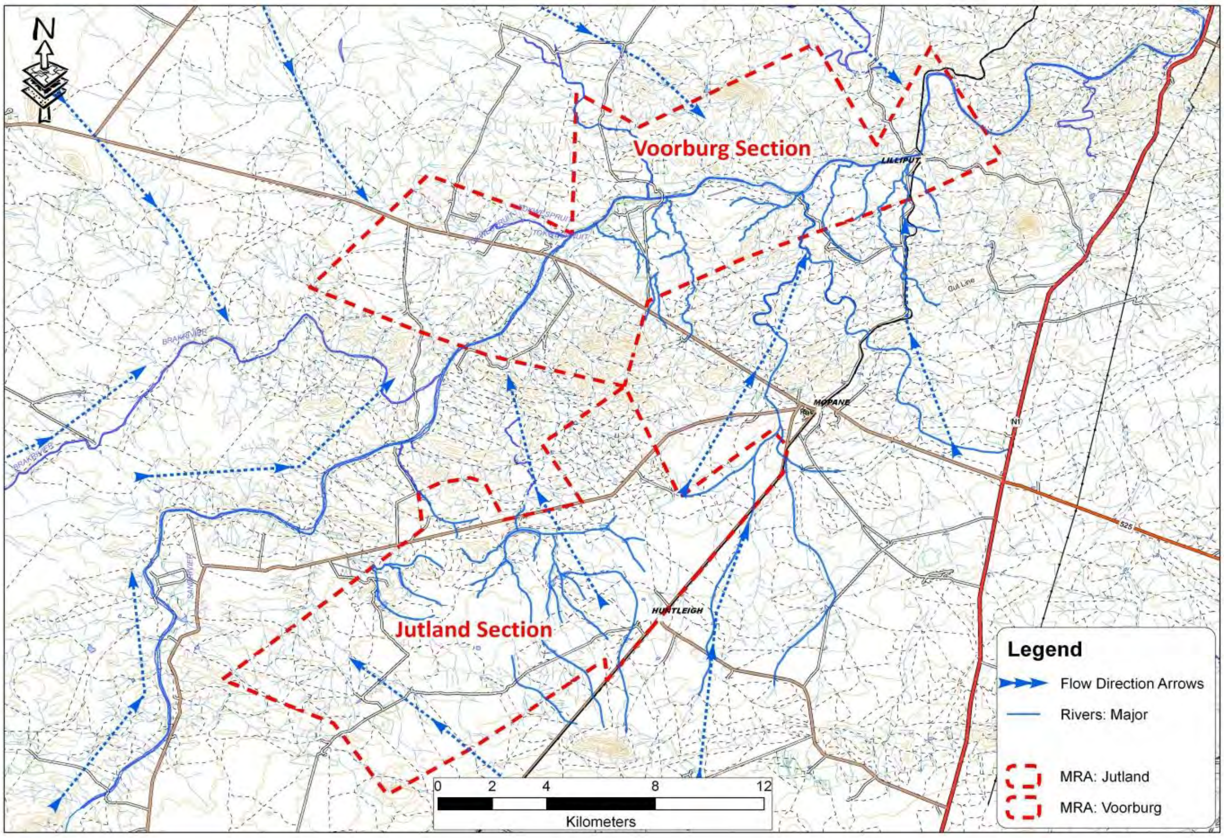


Figure 29: Major rivers and general drainage direction in Mopane Project area

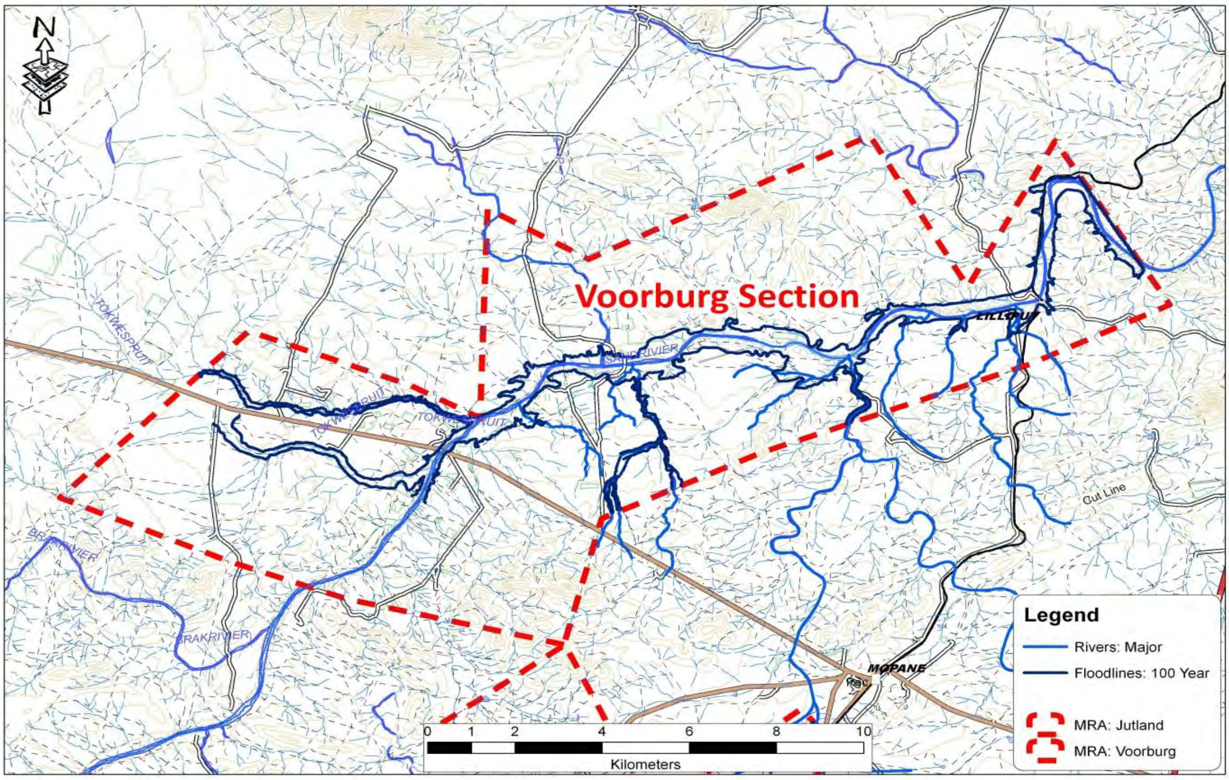


Figure 30: Voorburg Section drainage lines and major flood-lines

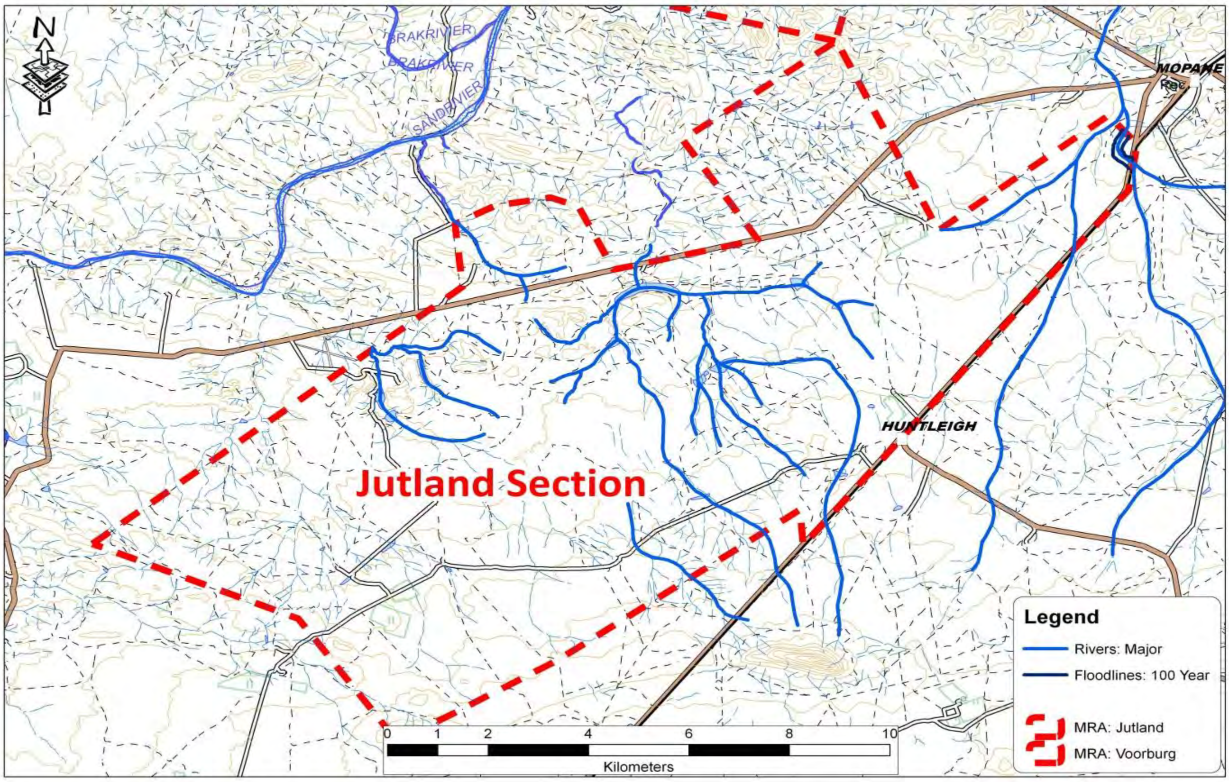


Figure 31: Jutland Section drainage lines

1.2.7.5 Flood Peak Calculations

The flood peak assessment of the Sand River has been done, as described below:

A number of methods can be used to determine flood peaks, as described in the Drainage Manual (Kruger, 2006). These are generally categorised as deterministic, statistical or empirical methods:

- ***Deterministic methods*** include those methods where the flood magnitude (the effect) is derived from an estimate of the catchment characteristics, including rainfall (the cause), for the required annual exceedance probability. Note that these methods have been calibrated according to selected regions and flood events and its application is usually limited to the size of catchment on which they can be applied. Included in this category are the Rational, Unit Hydrograph and Standard Design Flood methods.
- ***Statistical methods*** use actual annual series flood peak data, to which a statistical Probability Distribution Function (PDF) is applied. The validity of the result depends on the record length, the quality of the data and the aptness of the applied PDF. A graphical presentation of the data and the fitted curve should be made to select the best PDF, which include the Log-normal, Log-Pearson Type 3 and General Extreme Value functions.
- ***Empirical methods*** are calibrated equations that may be partially based on a deterministic relationship, such as the Midgley-Pitman method. Also included in this category is the Regional Maximum Flood method developed by Kovaćs.

Note that the flood analyses were based on the gross catchment area to include for the possibility that the endoreic catchments may contribute to storm water run-off in large flood events.

1.2.7.5.1 Statistical analysis

There is a long term river flow gauge (A7H001, started year 1958) on the Sand River in the Waterpoort (where the river crosses the Soutpansberg). Although not constructed to measure high flows, the DWA has determined the high flood peaks at this site by other calculations. For example, the 2000 flood peak has been determined as 5 100 m^3/s and published by Alexander (2001). It is, however, not a very reliable gauge in that only 28 years of complete records exist in the 54 years of its existence. An analysis has been carried out (refer to Table 23) and the results of the Log-Pearson Type 3 and Log-Normal were selected as reflecting the most probable range of results in Southern African conditions. Their results were transposed to the downstream site at the Voorburg Section by applying the square root of the catchment area ratio and the results are given in Table 24.

Table 23: Results of statistical analysis of flood data at Waterpoort (Gauge A7H001) (peak flow rate in m^3/s)

PDF	RECURRENCE INTERVAL (years)				
	1:10	1:20	1:50	1:100	1:200
Log-Normal	631	992	1 660	2 361	3 233
Log-Pearson Type 3	679	1 325	3 023	5 482	9 753
Log-Gumbel	650	1 317	3 284	6 510	12 876
GEV	1 232	1 783	2 642	3 417	4 320

Table 24: Adjustment of statistical results at Waterpoort to the site

Recurrence Interval (years)	At Waterpoort (A=7 703 km^2)		At Voorburg (A=13 155 km^2)	
	Log-Normal PDF	Log Pearson Type 3 PDF	Log-Normal PDF	Log Pearson Type 3 PDF
2	126	103	165	135
10	631	679	825	887
20	992	1 325	1 296	1 732
50	1 660	3 023	2 169	3 951
100	2 361	5 482	3 085	7 164
200	3 233	9 753	4 225	12 745

1.2.7.5.2 Deterministic methods

The flood peaks were also determined by applying deterministic analyses even though not all are fully applicable over such a large catchment area. The Standard Design Flood and the Alternative Rational Methods as described in the SANRAL Drainage Manual (Kruger 2006), using software developed by Sinotech cc (Utility Programs for Drainage, version 1.0.2), were used. The results were also compared to the flood peak estimates based on the Regional Maximum Flood as proposed by Kovaćs (1988).

Note that the impact of cyclones (or tropical weather systems) that occur occasionally in the north eastern parts of the country has been allowed for. The flood peak estimations are partially based on the statistical analyses of site specific rainfall data which includes the high rainfall events.

The flood peaks have been calculated at the point where the river exits the area. The river's catchment data are shown in Table 25. The Mean Annual Precipitation (MAP) of 442 mm used (in some of the methods) is the weighted average precipitation over the catchment area, determined by application of the Thiessen polygon method. In order to apply the Alternative Rational Method to the total catchment, the weighted 1:2-year 24-hour rainfall (M2) has also been estimated by this method as 51 mm.

Table 25: Sand River catchment characteristics at the site

DESCRIPTION	VALUE
Gross Catchment area (km^2)	13 155
Mean Annual Precipitation (mm)	442
Mean M2 rainfall value (mm)	51
Length of watercourse to boundary (km)	296.54
Average stream slope (m/m)	0.003
Rational Method Run-off factor	0.248
Veld Type (Unit Hydrograph procedure)	n.a.
SDF Method Drainage Basin No	3
RMF Method K-value	5

The results are summarised in Table 26.

Table 26: Estimated peak flows for the Sand River

METHOD USED	Flood peaks per recurrence period (m^3/s)		
	1:50	1:100	1:200
Rational Method with rainfall intensity from Alexander method	1 985	2 789	3 216
Standard Design Flood	4 385	5 834	7 503
Kovaćs RMF method (RMF = 2 450 m^3/s)	6 097	7 168	-

1.2.7.5.3 Selected floods for the Sand River

The final flood peak selection was based on a graphical presentation (Figure 33) of the information shown in Table 26. In selecting the flood peaks less weight was given the Kovaćs Method and the results of the Standard Design Flood since both are based on conservative upper envelope curves of observed storm events and tend to always give upper limits in flood peak calculations. On the other hand the Rational Method applied on large catchments tends to under-estimate the larger events. The selected values, as indicated by the green line on the graph, are shown in Table 27.

Table 27: Selected flood peaks for the Sand River at Voorburg

FLOOD PEAKS IN m^3/s (for recurrence interval in years)				
1:10	**1:20**	**1:50**	**1:100**	**1:200**
975	1 750	3 000	4 400	9 000

The values above were used to determine the 1:100-year flood-line for the Voorburg Section, using the HecRas software.

Note that the flood peaks and associated flood-lines for affected tributaries and streams will be determined in the next stage of the process when the mining layout is available.

1.2.7.5.4 Flood peak determination of major tributaries

The flood peaks for the major tributaries of the Sand River were determined by applying the deterministic Alternative Rational Method as described in the SANRAL Drainage Manual (Kruger 2006), using software developed by Sinotech cc (Utility Programs for Drainage, version 1.0.2).

Two major streams, stream V2 and V3 were identified that could be impacted by the mining activities. The two catchment areas were then further divided into sub-catchments to find the peak discharges at points of confluence. Please note that the streams do not have names and was thus labeled e.g. V2R1 etc.

The catchment areas of the site streams are shown in Figure 32.

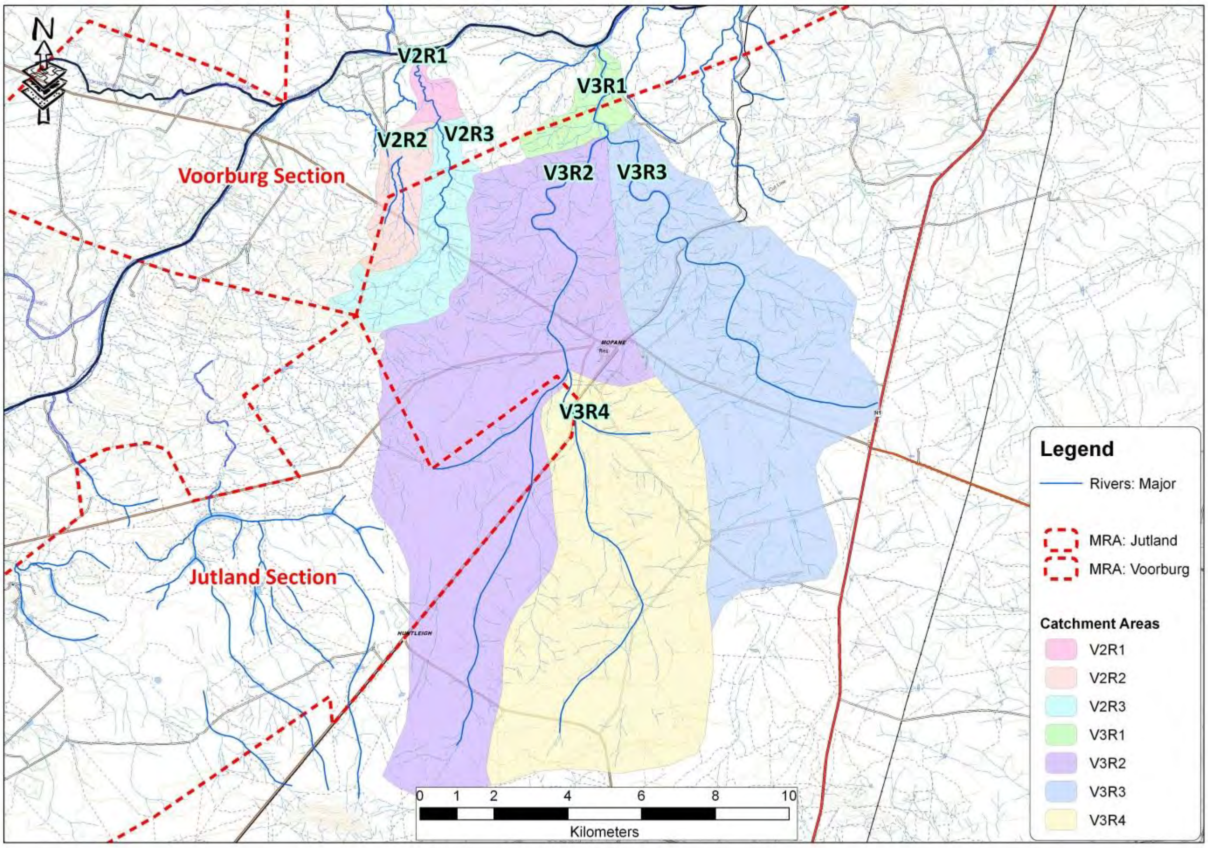


Figure 32: Catchment areas

Applying the catchment data given in Table 28 below, the flood peak estimates were obtained and are also shown in Table 28.

Table 28: Catchment data and calculated flood peaks for the selected streams

DESCRIPTION	V2R1	V2R2	V2R3	V3R1	V3R2	V3R3	V3R4
Catchment area (km^2)	14.86	4.61	8.76	160.95	110.26	47.05	67.53
Length of watercourse to boundary (km)	10.29	5.46	7.50	23.02	19.82	14.16	11.18
Average stream slope (m/m)	0.00700	0.01001	0.00658	0.00736	0.00816	0.00659	0.00775
Runoff factor	0.267	0.268	0.284	0.292	0.285	0.295	0.279
50 Year Flood Peak (m^3/s)	35.5	17.9	26.4	238.5	202.1	97.6	155.8
100 Year Flood Peak (m^3/s)	49.3	24.8	36.7	331.1	280.6	135.5	216.3

Figure 34 below shows the 1:100 year flood-lines of the major streams in relation to the mining areas.

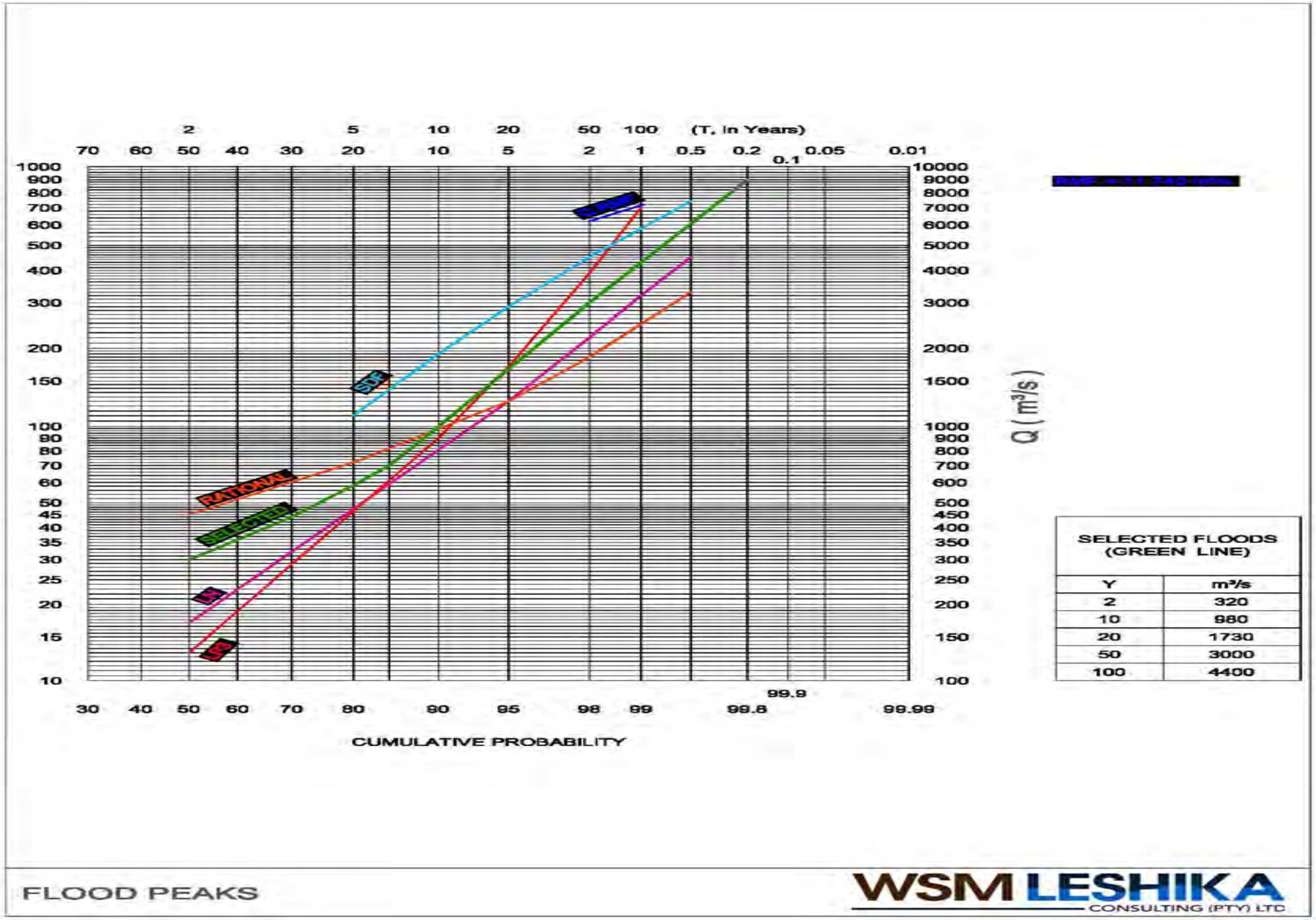


Figure 33: Presentation of flood peak results

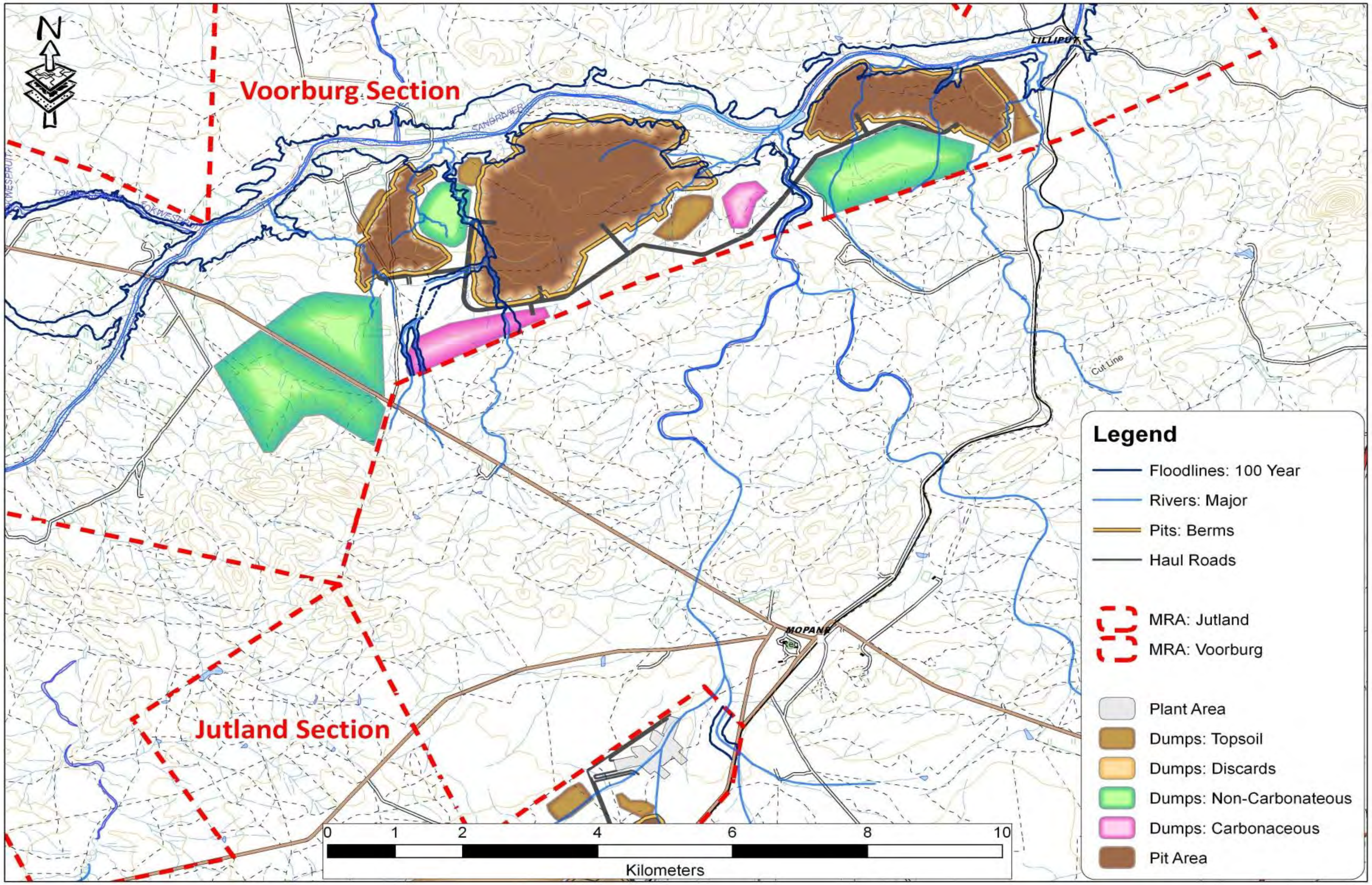


Figure 34: 1:100 year flood-lines of the major streams in relation to the mining areas

1.2.8 GROUNDWATER

1.2.8.1 Hydrocensus

A borehole census was conducted on the mining right application area and adjacent farms. The farms include; Ancaster, Banff, Delft, Voorburg, Zwartrand, Ryswyk, Erasmus, Du Toit, Erasmus, Faure, Verdun, Hermanus, Goosen, Pretorius, Vera, Jutland, Sonskyn, Cohen, Honeymoon, Valharden and Vrienden. Where possible water levels were measured and abstraction information obtained. Water samples were taken for macro and micro chemical analysis. The borehole and spring localities are indicated on Figure 35. The hydrocensus borehole data are summarized in Table 6 of the Groundwater Specialist Report (ANNEX-3).

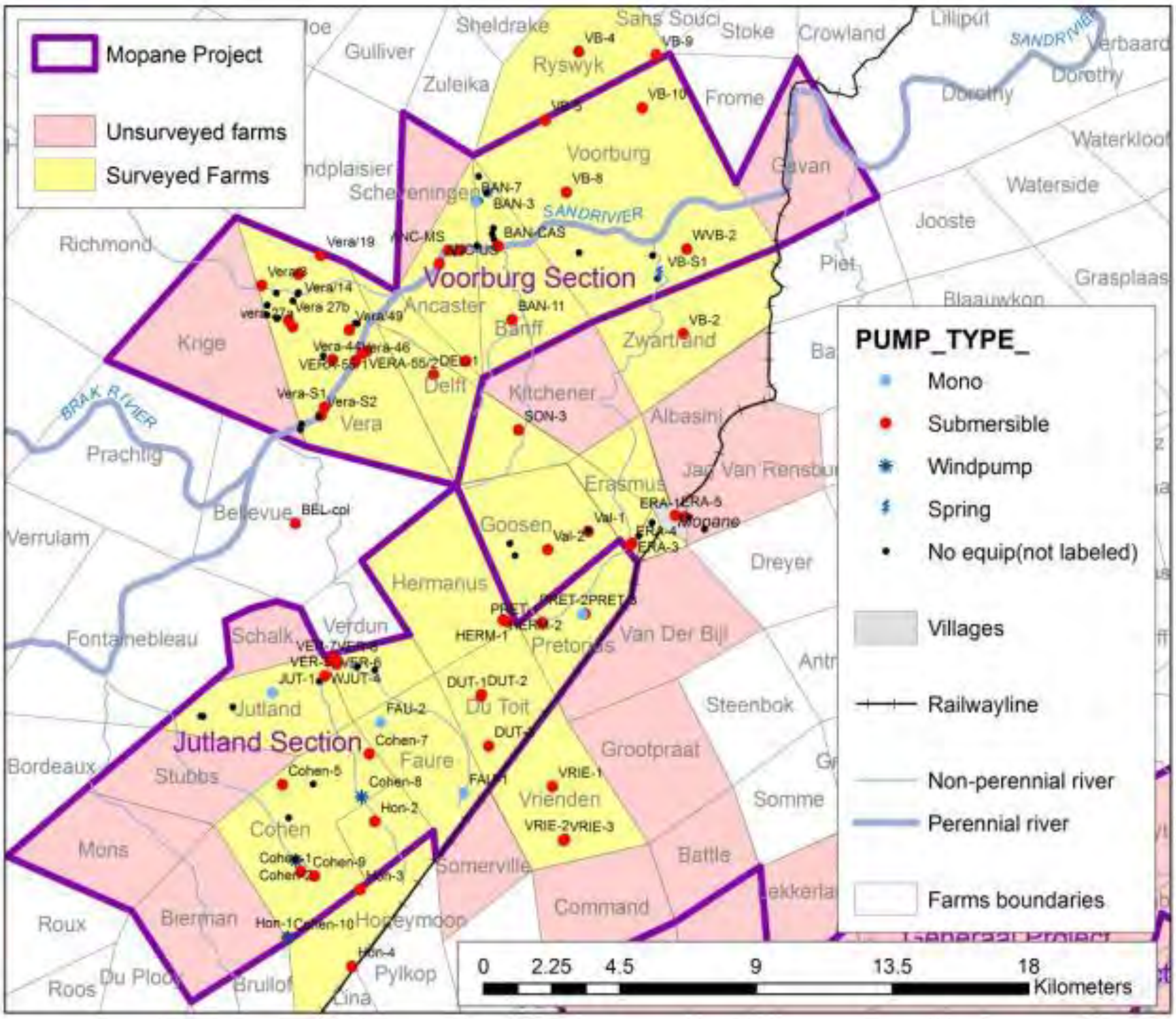


Figure 35: Mopane Project hydrocensus borehole locations

1.2.8.2 Piezometry and Groundwater Flow

If the water table is undisturbed, the groundwater surface tends to mimic a subdued form of the topography. Water levels measured during the hydrocensus revealed water levels ranging from 0-40 mbgl. The water level data was color-coded according to set of piezometric height ranges from which a piezometric contour map was drawn (Figure 36).

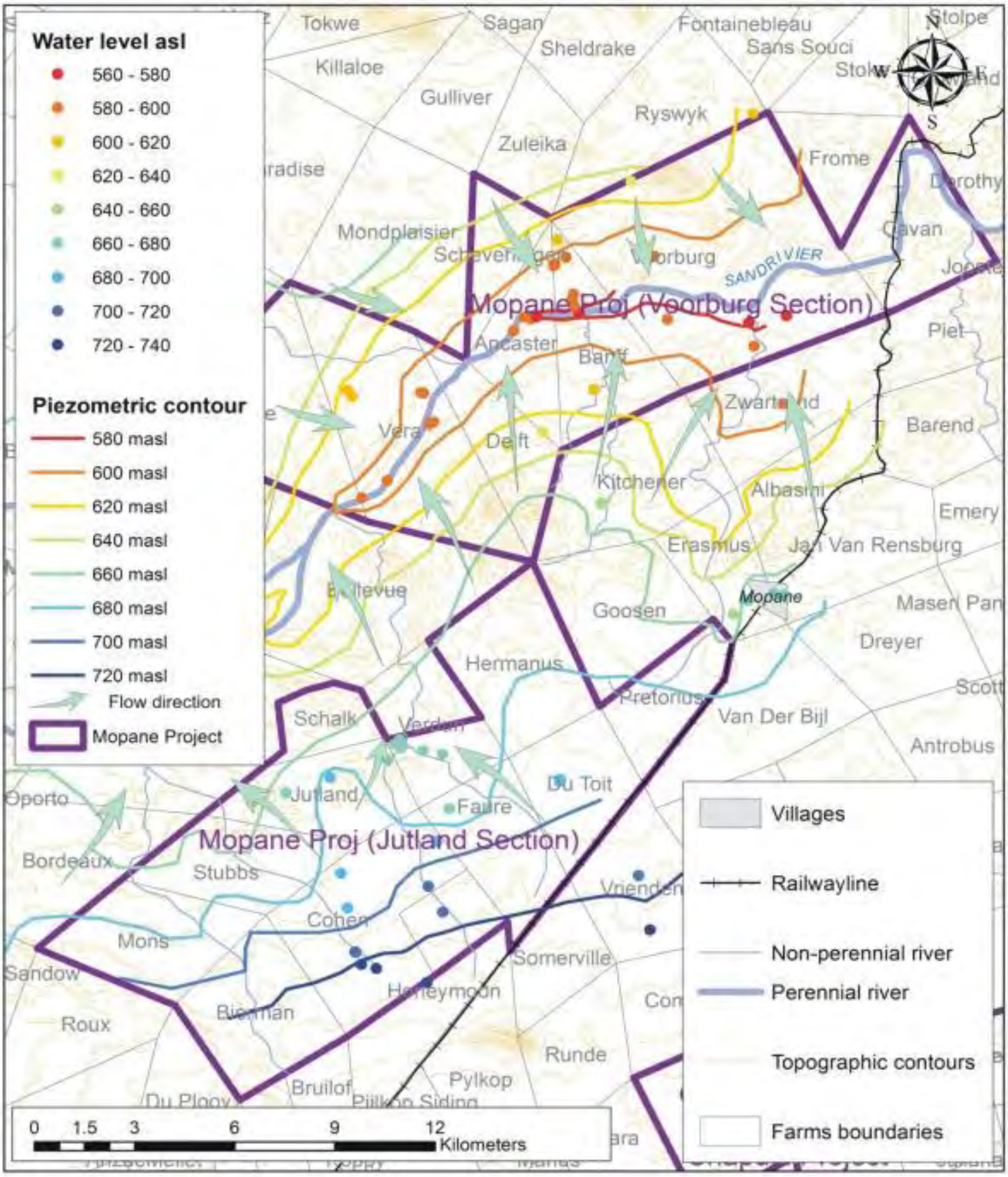


Figure 36: Piezometric contour map showing general groundwater flow direction

Water levels are shallowest in the Sand River bed and tributaries with water tables lying just below the sand after the recent good rains. Ancaster and Banff have well developed sand deposits (7m thick) and substantial abstraction for irrigation occurs from this section of the river. Water levels in the sands are lowered by 2-3m into the dry period but generally recover annually by the summer wet season.

The water table as observed from water level data appears to be in an equilibrium state, under the current levels of abstraction. This is to be expected as the bulk of the abstraction is taken from the alluvial aquifer which is replenished each year by surface run off. The fractured aquifer is utilized mostly as a supplementary source of water for irrigation or for game and domestic supply requirements

Springs occur where the water table intersects the surface, usually along some structure. There is one known spring on Voorburg (Figure 35) with a yield of about 1 l/s.

1.2.8.3 Impact of regional geology on the hydrogeology of the project area

Refer to Section 2.1 that describes the regional geology in detail.

1.2.8.3.1 The Jutland Section

The complete package of Karoo sequence strata from the basalts to the basal tillite is preserved in this half graben. Clarens sandstone forms prominent hills, surrounded by flat plains consisting of basalt to the north and mudstone to the south. The general dip is 10º - 12º to the north, terminating against a regional rift fault (Jutland or Bosbokpoort Fault) along the northern margin.

1.2.8.3.2 The Voorburg Section.

The complete Karoo sedimentary package (no basalt) is preserved in this half graben basin. The Fripp Formation forms a small flat topped ridge into which the Lilliput Shaft was excavated (Figure 59).

The sediments are again truncated along its' northern margin by a WSW trending rift fault (Voorburg fault) with a down-throw of approximately 1,000m to the south. The strata on average dip at 5°N. Of all the exploration holes drilled in the past to present, only one hole intersected dolerite.

Groundwater flowfor most of the study area is in a northward direction to the Sand River which abuts against the Voorburg fault and then flows eastwards. Groundwater is on average high in salt content indicating the arid climate and which may increase when in contact with upper Karoo strata. The study area can be regarded as having a low groundwater potential for the following reasons:

- Low rainfall and therefore poor recharge.
- Shallow weathering of the LMB gneisses. The LMB is exposed on the up-thrown block of a horst/graben set resulting in the removal of unconsolidated or weathered material from the elevated block.
- Relatively undisturbed/un-fractured Karoo strata away from the major faults.

Higher yielding boreholes are found along the faults and in the alluvial deposits. The Primary Alluvial Aquifer is utilized on a commercial basis by irrigation farmers along the Sand River where the alluvium is deep enough to store abstractable quantities. Good alluvial deposits often coincide with Karoo strata where the terrain is flatter and more conducive to alluvial deposition. The Karoo shale also produces a loamy to clayey soil more suitable for crops.

1.2.8.4 Groundwater Quality

Groundwater quality is dependent on the concentrations of soluble salts and the residence time of water within the host rock. Most of the water derived from secondary aquifers reflects the aridity of the study area with elevated salt content.

The data is presented with reference to the Water Quality Threshold (WQT) according to the Department of Water Affairs Water Quality Guidelines for Rivers and Streams as summarized in the table below, for the following water uses:

- Drinking water
- Agriculture-irrigation
- Agriculture-livestock

1.2.8.4.1 __Macro-chemistry__

Table 29: DWA WQT classification – Macro-chemistry

Species	pH	E.C	TDS	NO_3	F	SO4	Cl	Ca	Mg	Na
Unit		mS/m	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Drinking	6.0 - 9.0	150	1000	6	1	400	200	150	100	200
Agriculture (irrigation)	6.5 - 8.4	40		5	2		100			70
Agriculture (livestock)			1000	100	2	1000	1500	1000	500	2000

A total of 43 hydro-census samples were analysed for pH and major and micro elements. The chemistry results are listed in the table below. Concentrations exceeding the WQT for any of the above uses are marked in red.

Table 30: Macro chemistry results

BH No	Date	pH	E.C	TDS	NO_3	F	SO4	Cl	Ca	Mg	Na
ANC-US	29/05/13	7.4	183	1188	<1.4	0.2	153	331	97	64	181
ANC-DC	29/05/13	7.4	192	1249	2.9	0.3	160	365	119	75	167
ANC-MS	29/05/13	7.2	412	2678	31.2	0.2	362	895	267	167	342
BAN-1	28/05/13	7.1	809	5259	<1.4	0.2	444	2309	153	348	949
BAN-7	28/05/13	7.0	254	1651	12.5	1.4	134	356	92	137	256
BAN-CAS	11/12/12	7.6	944	6722	0.4	0.4	1516	2333	294	344	1270
BAN-CASX5	28/05/13	7.4	275	1788	3.6	0.3	325	534	79	89	387
BANF-11	19/11/12	7.1	683	4694	0.2	1.9	712	2048	395	48	1096
BANF-3	11/12/12	8	287	1816	18.0	1.2	173	480	84	132	337
BAN-MG	28/05/13	7.3	325	2113	<1.4	0.2	389	679	132	114	407
BAN-N	28/05/13	7.2	711	4622	<1.4	1.9	649	2017	468	47	1009
Cohen - 1	19/07/13	7.8	123	796	2.0	1.6	19	71	63	65	128
Cohen-8	19/07/13	7.1	359	2336	7.8	1.3	196	728	119	202	334
DOT-3	30/05/13	6.8	268	1742	6.2	0.8	174	456	128	115	244
DUT-2	30/05/13	6.8	234	1521	1.6	1.7	325	277	76	89	248
ERA-1	29/05/13	7.1	218	1417	33.9	0.5	109	192	101	148	133
ERA-2	29/05/13	6.9	445	2893	44.1	0.9	380	875	227	280	275
FAU-1	19/11/12	8.1	95	650	4.7	2.4	20	43	43	40	116
FAU-1	29/05/13	7.5	103	668	4.0	2.1	20	38	47	49	128
Herm-1	16/07/13	7.3	358	2324	4.0	1.1	482	644	156	178	349
Herm-2	15/07/13	7.2	367	2383	5.1	1.3	462	668	154	181	373
Hon-3	18/07/13	7.2	299	1941	3.6	2.0	127	388	65	119	443
Hon-4	18/07/13	7.0	171	1114	8.8	0.5	57	237	85	80	156
PRET-1	29/05/13	7.1	293	1905	32.4	2.2	134	376	74	181	287
PRET-2	29/05/13	6.8	297	1931	24.2	1.3	152	397	105	130	333
SON-3	30/05/13	7.0	119	770	23.8	0.4	26	58	78	80	68
Val-1	16/07/13	7.7	138	897	49.7	0.7	58	122	85	67	91
VB-1	3/04/12	7.7	402	2530	62.0	1.2	261	753	132	201	374
VB-2	3/04/12	7.5	298	1760	0.9	2.6	345	624	165	21	328
VB-5	11/09/13	8.5	166	1076					64	113	133
VB-7	18/11/11	7.24	1694	10223	3.7	0.7	742	3175	314	751	1451
VB-9	11/09/13	7.2	188	1221					103	83	196
VB-10	11/09/13	7.0	277	1803					124	176	233
WVB-2	3/04/12	7.5	389	2534	0.9	2.4	399	806	349	15	403
Vera - 44	17/07/13	7.7	326	2116	4.3	0.3	233	770	173	151	259
Vera - Singh	17/07/13	7.3	358	2327	4.0	1.2	504	634	161	183	359
Vera 35b	17/07/13	7.9	473	3076	<1.4	0.2	465	1136	43	297	533
Vera 51	16/07/13	7.0	75	485	<1.4	0.2	4	82	19	14	120
Vera-27a	16/07/13	7.6	378	2459	10.2	1.5	337	916	144	136	419
Vera-27b	17/07/13	7.6	332	2155	2.5	1.6	325	828	146	72	412
Vera-46	16/07/13	7.4	634	4121	2.4	0.6	377	1719	254	305	595
VER-5	28/05/13	7.8	116	755	3.0	1.4	58	99	21	44	168
VER-8	28/05/13	7.5	124	808	2.0	2.2	52	83	40	46	188
VERA-1	28/05/13	6.8	486	3159	36.0	0.9	547	915	177	335	331

The study area is characterized by predominantly poor groundwater quality typical of arid environments. Salt is also an inherent component of the Karoo strata with associated elevated TDS concentrations. A histogram showing the frequency distribution of TDS content for the three main geological units is provided below.

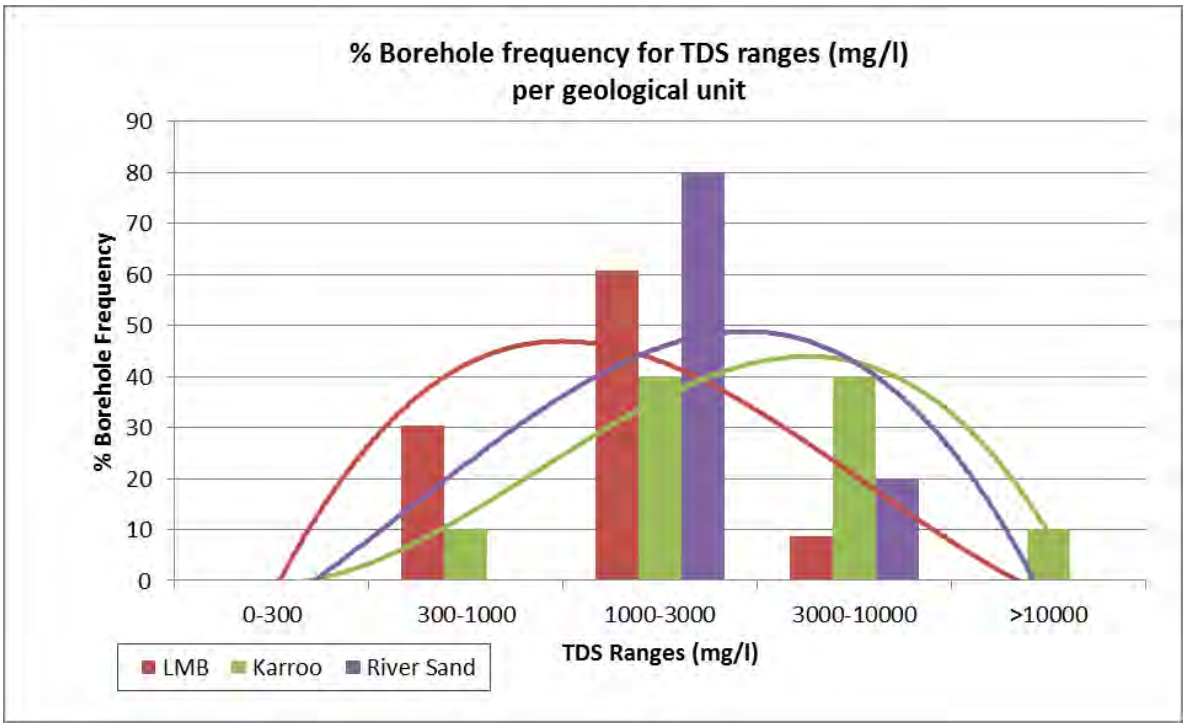


Figure 37: % frequency distribution of TDS for the 3 major rock types

Groundwater in the LMB gneisses have TDS concentrations that range between 300 to 3000 mg/l with a median of 1534 mg/l for the samples analysed. The Karoo strata exhibits higher TDS concentrations from 1000 to 10 000mg/l with a median of 2805 mg/l. Water quality in the river sand appears to mimic the Karoo water quality with a median TDS of 2185 mg/l. This supports the idea that groundwater and/or irrigation return water is recharging the river system. All the sand points and irrigated land in the data set is underlain by Karoo strata and is reflected in the river water chemistry. The TDS in the river sand varies according to the season with salt build up into the winter season and dilution from surface water after a flow event in summer. The samples taken at BAN-CAS exhibits this trend i.e. alluvial water taken from a caisson in the Sand River in 2012 with a TDS of 6722 mg/l showing a marked reduction in salinity levels (BAN-CASx5 at 1788 mg/l) since the recent floods in January 2013. Despite the recent floods the TDS content is still over a 1000 mg/l and is not ideal irrigation quality.

In an attempt to classify the groundwater of the study area the ratios of the macro elements were plotted on a Durov Diagram (Figure 38).

The diagram indicates that most of the water sampled falls within the lower stagnant water or chloride-type block. The data was classified in terms of the expanded Durov diagram and plotted on the geology map.

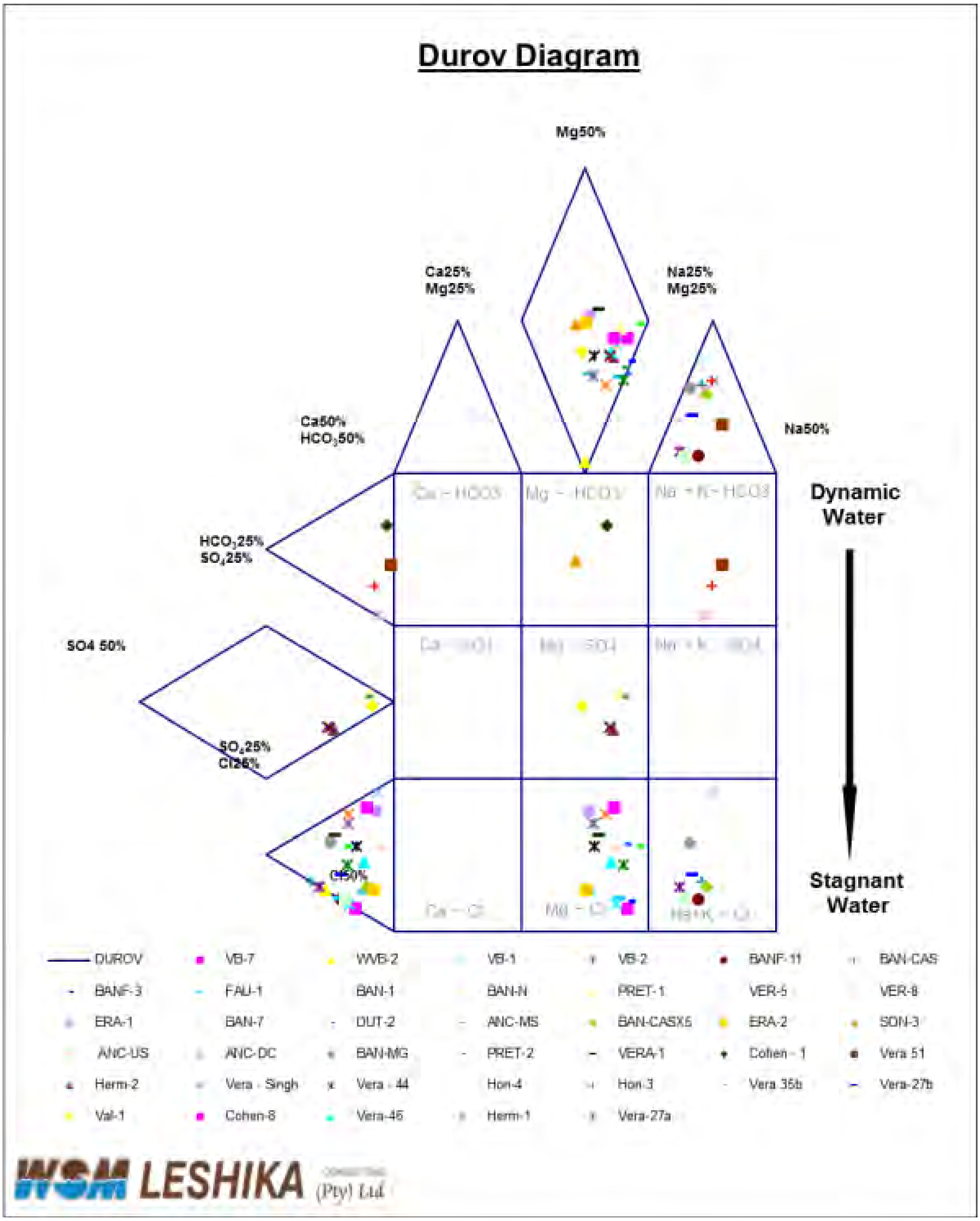


Figure 38: Durov classification of water

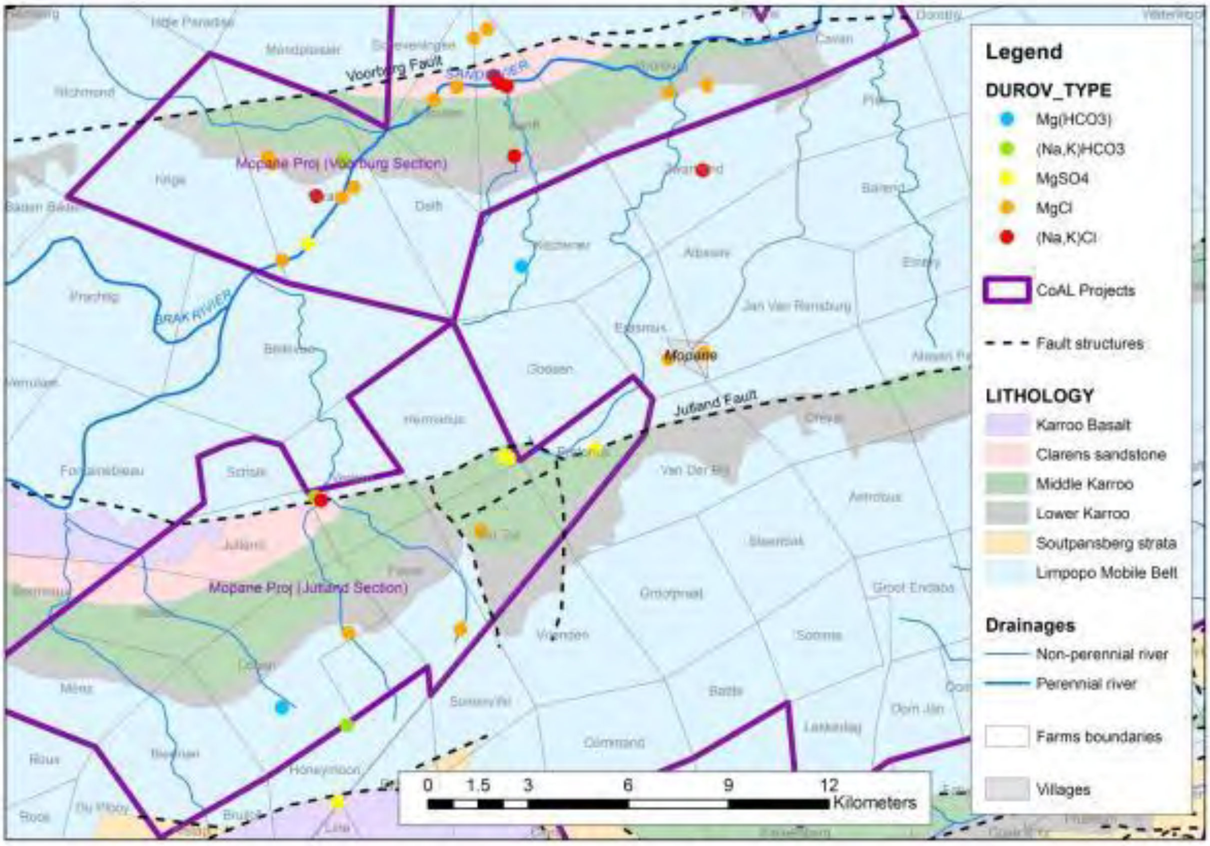


Figure 39: Durov water types plotted on the geology

Although no direct correlation is apparent between the water types and the rocks, some observations can be made:

- The water type in the alluvium is the same as that of the groundwater indicating that groundwater feeds the river system.
- HCO_3 and SO_4 type water is found along the major faults indicating higher flow rates and a more recent recharge component to the water.
- Away from the major structures the water is pervasively of the chloride type except for isolated pockets of bicarbonate water usually near the top of a sub-catchment or on catchment divides.

1.2.8.4.2 __Micro-chemistry__

Table 31: Micro-chemistry with DWA-WQT Classification

Specie	Al	As	B	Cd	Co	Cr	Cu	Hg	Mn	Mo	Ni	Pb	Se	V	Zn
Unit	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Drinking	0.5	0.05		0.005		0.05	1,3	0.001	0.4			0.01	0.05	0.1	5
Agriculture (irrigation)	5	0.1	0.5	0.01	0.05	0.1	0.2		0.02	0.01	0.2	0.2	0.02	0.1	1
Agriculture (livestock)	5	1	5	0.01	1	1	0.5	0.001	10	0.01	1	0.1	0.05	1	20

Concentrations exceeding the WQT for any of the above uses are marked in red. It must be noted that concentrations exceeding the WQT are often below the detection limit for some elements.

Table 32: Micro-chemistry with DWA-WQT Classification

Specie	Al	As	B	Cd	Co	Cr	Cu	Hg	Mn	Mo	Ni	Pb	Se	V	Zn
Unit	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
ANC-DC	0.01	<0.03	0.14	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.09	<0.02	0.01	0.03
ANC-MS	<0.01	<0.03	0.16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.09	0.02	0.01	<0.01
ANC-US	<0.01	<0.03	0.18	<0.01	<0.01	<0.01	<0.01	<0.01	0.45	<0.05	<0.01	<0.09	<0.02	0.01	0.01
BAN-1	<0.01	<0.03	0.62	<0.01	<0.01	<0.01	<0.01	<0.01	0.37	<0.05	<0.01	<0.09	<0.01	<0.01	0.03
BAN-7	<0.01	<0.03	0.70	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	0.01	<0.09	<0.02	0.07	2.89
BAN-CAS	0.19	<0.010	0.93	0.20	<0.025	<0.025	<0.025	-	1.36	<0.025	<0.025	<0.020	0.04	<0.025	0.03
BAN-CASX5	<0.01	<0.03	0.44	<0.01	<0.01	<0.01	<0.01	<0.01	0.44	<0.05	<0.01	<0.09	0.03	0.01	0.01
BANF-11	0.16	<0.010	0.83	<0.005	<0.025	<0.025	<0.025	-	0.31	<0.025	<0.025	<0.020	<0.020	<0.025	0.14
BANF-3	0.13	<0.010	0.92	<0.005	<0.025	<0.025	0.04	-	<0.025	<0.025	<0.025	<0.020	0.02	0.05	<0.025
BANF-MC	<0.01	<0.03	0.33	<0.01	<0.01	<0.01	<0.01	<0.01	0.25	<0.05	<0.01	<0.09	<0.02	0.02	0.01
BANF-N	<0.01	<0.03	0.67	<0.01	<0.01	<0.01	0.06	<0.01	0.34	<0.05	<0.01	<0.09	<0.02	<0.01	0.21
Cohen - 1	<0.01	<0.03	0.24	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.09	<0.02	0.02	0.01
Cohen-8	<0.01	<0.03	0.64	<0.01	<0.01	<0.01	<0.01	<0.01	0.03	<0.05	<0.01	<0.09	0.02	<0.01	0.08
DUT-2	<0.01	<0.03	0.55	<0.01	<0.01	<0.01	<0.01	<0.01	0.03	<0.05	0.01	<0.09	0.02	<0.01	0.01
ERA-1	<0.01	<0.03	0.50	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.05	<0.01	<0.09	<0.02	0.04	0.02
ERA-2	0.01	<0.03	0.82	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.09	0.02	0.06	2.95
FAU-1	<0.01	<0.03	0.22	<0.01	<0.01	<0.01	0.03	<0.01	<0.01	<0.05	<0.01	<0.09	<0.02	0.05	0.03
Herm-1	<0.01	<0.03	0.79	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.09	0.04	0.01	0.06
Herm-2	<0.01	<0.03	0.91	<0.01	<0.01	<0.01	0.10	<0.01	0.01	<0.05	0.02	<0.09	0.03	0.01	0.44
Hon-3	<0.01	<0.03	1.08	<0.01	<0.01	<0.01	0.03	<0.01	<0.01	<0.05	<0.01	<0.09	<0.02	0.03	0.04
Hon-4	<0.01	<0.03	0.33	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.09	0.03	0.07	0.01
PRET-1	<0.01	<0.03	0.91	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.09	<0.02	0.08	<0.01
PRET-2	0.01	<0.03	0.75	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.05	<0.01	<0.09	<0.02	0.01	<0.01
SON-3	0.01	<0.03	0.15	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.05	<0.01	<0.09	<0.02	0.04	<0.01
Val-1	<0.01	<0.03	0.18	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.09	0.02	0.05	0.01
VB-1	0.41	0.05	1.18	<0.005	<0.025	<0.025	<0.025	-	0.16	<0.025	<0.025	NA	0.03	<0.025	0.48
VB-2	0.49	0.05	0.68	<0.005	<0.025	<0.025	<0.025	-	0.14	<0.025	<0.025	NA	0.02	<0.025	1.36
VB-5	<0.01	<0.03	0.22	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.05	<0.01	<0.09	<0.02		
VB-9	<0.01	<0.03	0.32	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.05	<0.01	<0.09	<0.02		
VB-10	<0.01	<0.03	0.72	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.09	<0.02		
WVB-2	0.21	0.05	0.71	<0.005	<0.025	<0.025	<0.025	-	0.26	<0.025	<0.025	NA	0.02	<0.025	0.36
VER-5	<0.01	<0.03	0.30	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.05	<0.01	<0.09	<0.02	0.09	0.05
VER-8	<0.01	<0.03	0.47	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.05	<0.01	<0.09	<0.02	0.11	<0.01
Vera - 44	<0.01	<0.03	0.21	<0.01	<0.01	<0.01	<0.01	<0.01	0.30	<0.05	<0.01	<0.09	<0.02	0.02	0.01
Vera - Singh	0.02	<0.03	0.79	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.09	<0.02	0.01	0.07
Vera 35b	<0.01	<0.03	0.84	<0.01	<0.01	<0.01	<0.01	<0.01	0.25	<0.05	<0.01	<0.09	<0.02	<0.01	<0.01
Vera 51	<0.01	<0.03	0.15	<0.01	<0.01	<0.01	<0.01	<0.01	0.72	<0.05	<0.01	<0.09	0.02	<0.01	<0.01
VERA-1	<0.01	<0.03	1.04	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.09	0.02	0.08	<0.01
Vera-27a	<0.01	<0.03	0.67	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.09	<0.02	0.03	0.01
Vera-27b	<0.01	<0.03	0.69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.09	<0.02	0.01	0.01
Vera-46	0.01	<0.03	0.43	<0.01	<0.01	<0.01	<0.01	<0.01	0.08	<0.05	<0.01	<0.09	0.02	0.01	0.06

The microchemistry shows elevated boron in most samples analysed with significantly higher manganese associated with the alluvial water. High zinc concentrations occur in some boreholes located in the gneisses of the LMB.

1.2.8.5 Groundwater Use

In the Mopane Mining Right Application area, irrigation is prevalent mostly along the Sand River where well developed alluvial sand deposits occur. The regional secondary aquifer is utilised mainly for household, stock and game watering.

For irrigation estimates where numbers were not provided by the farmers, the following assumptions were made:

- the irrigation requirement for cash crops in the area was taken as 7 880 m^3/ha/annum.
- irrigation occurs throughout the year.
- that not all of the cleared land is under irrigation. The area of lands under irrigation is dependent on crop rotation and water availability and many lands lie fallow.

Abstraction quantities are regarded as conservative (i.e. an overestimation).

1.2.8.5.1 <u>Voorburg Section</u>

The groundwater abstraction within the Voorburg Section is summarized in the table below.

Table 33: Voorburg Section: Groundwater use per farm

Project Section	Farm	Cleared land	Ha under irrigation	Water Use Kl/day	Water Use (Ml/ annum)	WARMS (Ml/ annum)	Assessment Method
Voorburg	Ancaster	84	35	755	276	276	sensus
	Banff	90	36	777	283	297	sensus
	Delft	77	40	863	315	99	sensus
	Vera	160	30	647	236	892	sensus
	Voorburg	-	-	76	28	80	sensus
	Krige	-	-	10	4	92	Inferred
	Cavan	-	-	5	2	-	Inferred
	Scheveningen	5	-	10	4	-	Inferred
	TOTAL	**416**	**141**	**3143**	**1147**	**1736**	

The total existing abstraction for the Voorburg Section is thus estimated at a maximum of 1 147 Ml per annum most of which is abstracted from the alluvial deposits in the Sand River (1 110 Ml per annum).

1.2.8.5.2 Jutland Section

The groundwater abstraction within the Jutland Section Mine Application Area is summarized in the table below.

Table 34: Jutland Section: Summary of groundwater use per farm

Project Section	Farm	Cleared land	Ha under irrigation	Water Use Kl/day	Water Use (Ml/ annum)	WARMS (Ml/ annum)	Assessment Method
Jutland	Bellevue	-	-	5	2	-	sensus
	Cohen	-	-	18	7	-	sensus
	Du Toit	-	-	42	15	-	sensus
	Erasmus	-	-	72	26	-	sensus
	Faure	-	-	2	1	-	sensus
	Hermanus	40	2	60	22	-	sensus
	Honeymoon	-	-	9	3	-	sensus
	Jutland	-	-	20	7		sensus
	Pretorius	-	-	45	16	-	sensus
	Verdun	6	6	178	65	4	sensus
	Vrienden	-	-	3	1	-	sensus
	Schalk	-	-	10	4	-	inferred
	Stubbs	-	-	10	4	-	inferred
	Mons	-	-	10	4	-	inferred
	Bierman	-	-	10	4	-	inferred
	TOTAL	**46**	**8**	**494**	**180**	**4**	

The total existing abstraction for the Jutland area is thus estimated at 180 Ml per annum abstracted from the secondary hard rock aquifers.

1.2.8.6 Regional Groundwater Flow

To determine the orientation of groundwater flow on a regional scale, water levels were available from 965 boreholes. Historic data from 657 boreholes was obtained from the National Groundwater Database (NGDB), and the remainder was collected by hydrocensus during the study for Makhado mine and the present study. These data were converted to absolute water levels by determining borehole elevation from Google Earth. The MODFLOW model was utilised to generate current water levels as a piezometric map (Figure 40). The Model was also utilised to generate a map of water level under virgin conditions (Figure 41).

Regional groundwater flow is oriented northeast towards the Limpopo River (Figure 17). Flow volumes are extremely low due to the low permeabilities and low recharge, especially in the northern half of the catchment underlain by the Limpopo Mobile Belt and overlain by alluvium.

In the south, where the catchment is underlain by Karoo and Soutpansberg rocks and where mining is proposed, a local northward hydraulic gradient is present due to high recharge in the Soutpansberg Mountains. A significant cone of depression exists around the Sand River directly north of the Soutpansberg Mountains due to the large scale irrigation from groundwater. Quantifying abstraction is problematic, since not all the lands are irrigated every year. Irrigation was estimated from lands identified as being irrigated on the most recent Google Earth images.

Under natural conditions, groundwater drains via localised springs, as base flow to the perennial tributaries flowing from the Soutpansberg, and by evapotranspiration by riverine vegetation along the main river channels.

Groundwater is of good quality in the Soutpansberg rocks, which is the main recharge zone; however, increased salinity occurs northwards as groundwater flows through saline Karoo sediments, accumulating salts. Low recharge rates in the drier terrain north of the Soutpansberg also results in low recharge rates to dilute these salts. The movement of groundwater passing through saline deposits of the Karoo rocks, and subsequent evapotranspiration by riverine vegetation, causes a rapid salt accumulation northward, with a peak salt load along the fringes of the channels lying over Karoo rocks, like the Mutamba, the Brak and Sand Rivers, resulting in poor natural water quality.

The Mufungudi entering Nzhelele dam, the Kandanama River a tributary of the Mutamba River, entering the catchment in the south along the N1 highway, and the upper reaches of the Mutamba emerging from the Soutpansberg are perennial, but lose water to groundwater as they flow out of the Soutpansberg), becoming ephemeral. This water is abstracted by boreholes for irrigation on the farms Windhoek, Eckland and Overwinning along the Kandanama, and by irrigation boreholes along the Sand River on Sterkstroom, Sitapo, Sutherland and Waterpoort, or is utilized by riparian vegetation. Very little surface runoff is believed to recharge the regional aquifers north of the Soutpansberg, since high salinity levels in the Karoo aquifers suggest it is not recharged by fresh water from the river. In comparison, groundwater is of good quality in the Karoo aquifer along the southern tributaries such as the Kandanama River, where river losses take place. Isotope studies conducted during the Makhado investigation confirm this.

Figure 40: Steady state water levels under current conditions (metres above mean sea level)

Figure 41: Steady state water levels under virgin conditions (metres above mean sea level

1.2.9 AIR QUALITY

1.2.9.1 Baseline Air Quality

Based on satellite imagery and a site visit, the following sources of air pollution have been identified in the area. These are important to consider in terms of assessing the cumulative impact potential on air quality in the region:

- Agricultural activities;
- Veld fires;
- Domestic fuel burning; and
- Quarries

A qualitative discussion on each of these source types is provided in the subsections which follow.

1.2.9.1.1 Agricultural activities

Agricultural activity can be considered a significant contributor to particulate emissions, although tilling, harvesting and other activities associated with field preparation are seasonally based. The main focus internationally with respect to emissions generated due to agricultural activity is related to animal husbandry, with special reference to malodours generated as a result of the feeding and cleaning of animals. Emissions assessed include ammonia and hydrogen sulphide (USEPA, 1996). Little information is available with respect to the emissions generated due to the growing of crops. The activities responsible for the release of particulates and gases to atmosphere would however include:

- Particulate emissions generated due to wind erosion from exposed areas;
- Particulate emissions generated due to the mechanical action of equipment used for tilling and harvesting operations;
- Vehicle entrained dust on paved and unpaved road surfaces;
- Gaseous and particulate emissions due to fertilizer treatment; and
- Gaseous emissions due to the application of herbicides and pesticides.

1.2.9.1.2 Veld fires

A veld fire is a large-scale natural combustion process that consumes various ages, sizes, and types of flora growing outdoors in a geographical area. Consequently, veld fires are potential sources of large amounts of air pollutants that should be considered when attempting to relate emissions to air quality. The size and intensity, even the occurrence, of veld fires depend directly on such variables as meteorological conditions, the species of vegetation involved and their moisture content, and the weight of consumable fuel per hectare (available fuel loading). Once a fire begins, the dry combustible material is consumed first. If the energy released is large and of sufficient duration, the drying of green, live material occurs, with subsequent burning of this material as well. Under suitable environmental and fuel conditions, this process may initiate a chain reaction that results in a widespread conflagration. It has been hypothesized, but not proven, that the nature and amounts of air pollutant emissions are directly related to the intensity and direction (relative to the wind) of the veld fire, and are indirectly related to the rate at which the fire spreads. The factors that affect the rate of spread are (1) weather (wind velocity, ambient temperature, relative humidity); (2) fuels (fuel type, fuel bed array, moisture content, fuel size); and (3) topography (slope and profile). However, logistical problems (such as size of the burning area) and difficulties in safely situating personnel and equipment close to the fire have prevented the collection of any reliable emissions data on actual veld fires, so that it is not possible to verify or disprove the hypothesis.

The major pollutants from veld burning are particulate matter, carbon monoxide, and volatile organics. Nitrogen oxides are emitted at rates of from 1 to 4 g/kg burned, depending on combustion temperatures. Emissions of sulphur oxides are negligible (USEPA, 1996). A study of biomass burning in the African savannah estimated that the annual flux of particulate carbon into the atmosphere is estimated to be of the order of 8 Tg C, which rivals particulate carbon emissions from anthropogenic activities in temperate regions (Cachier et al, 1995).

Figure 42 below illustrates the risk potential of veld fires across the country. Limpopo Province has an extremely high risk of veld fires.

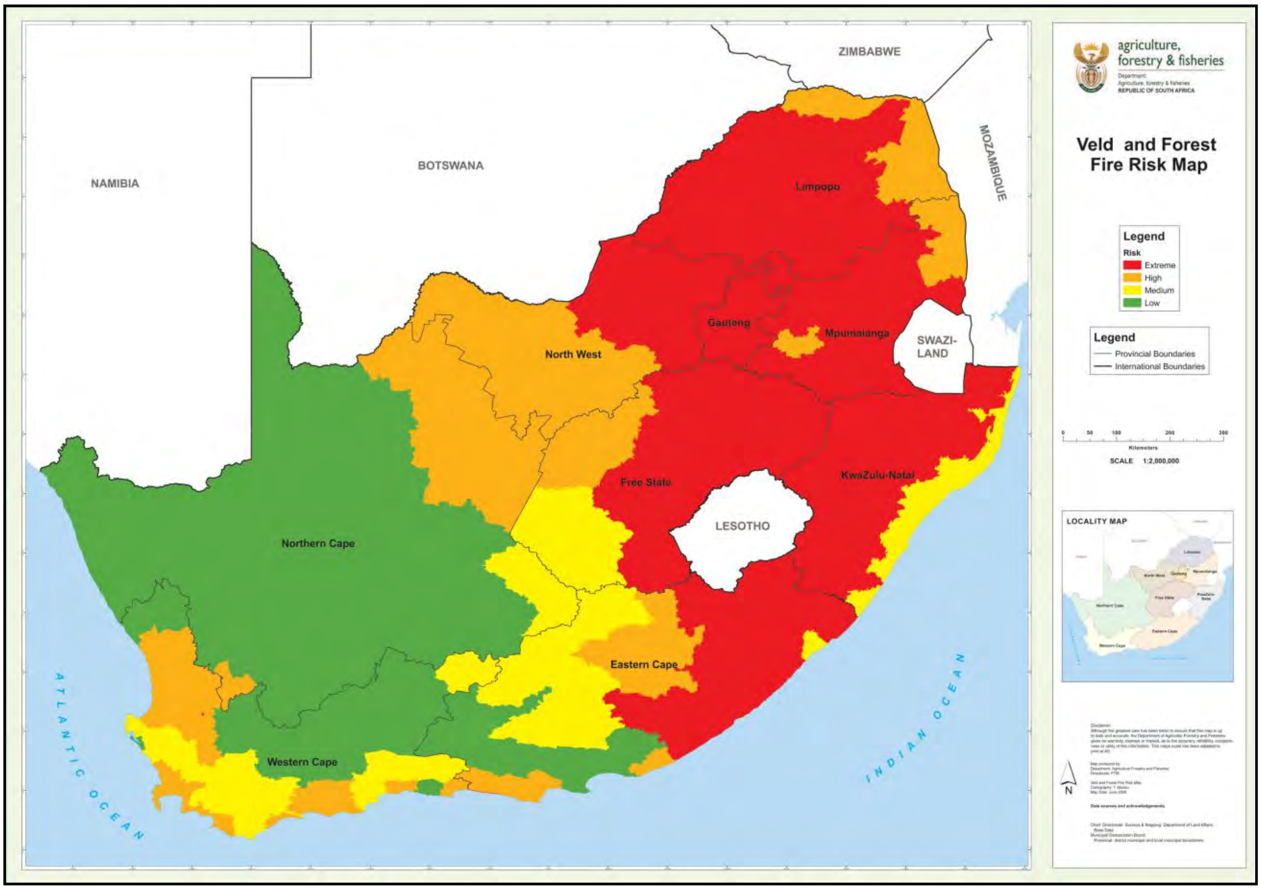


Figure 42: Veld Fire risk map

1.2.9.1.3 Domestic fuel burning

There are numerous farms and game ranches located in close vicinity to the proposed mining area, and are classified as sensitive receptors. The informal settlement of Mudimeli is located south east to the proposed mining area. It is anticipated that low income households in the area are likely to combust domestic fuels for space heating and/ or cooking purposes. Exposure to indoor air pollution from the combustion of solid fuels is an important cause of morbidity and mortality in developing communities. Biomass and coal smoke contain a large number of pollutants and known health hazards, including PM, CO, NO_2, SO_2 (mainly from coal), formaldehyde, and polycyclic organic matter, including carcinogens such as benzo[a]pyrene (Ezzati and Kammen, 2002).

Exposure to indoor air pollution from the combustion of solid fuels has been implicated, with varying degrees of evidence, as a causal agent of several diseases in developing countries, including acute respiratory infections (ARI) and otitis media (middle ear infection), chronic obstructive pulmonary disease (COPD), lung cancer (from coal smoke), asthma, cancer of the nasopharynx and larynx, tuberculosis, perinatal conditions and low birth weight, and diseases of the eye such as cataract and blindness (Ezzati and Kammen, 2002).

Monitoring of pollution and personal exposures in biomass-burning households has shown concentrations are many times higher than those in industrialized countries. The latest International Ambient Air Quality Standards, for instance, required the daily average concentration of PM_{10} to be $< 180\ \mu g/m^3$ (annual average $< 60\ \mu g/m^3$). In contrast, a typical 24-hr average concentration of PM_{10} in homes using bio fuels may range from 200 to 5 000 $\mu g/m^3$ or more throughout the year, depending on the type of fuel, stove, and housing. Concentration levels, of course, depend on where and when monitoring takes place, because significant temporal and spatial variations may occur within a house. Field measurements, for example, recorded peak concentrations of $> 50\ 000\ \mu g/m^3$ in the immediate vicinity of the fire, with concentrations falling significantly with increasing distance from the fire. Overall, it has been estimated that approximately 80% of total global exposure to airborne particulate matter occurs indoors in developing nations. Levels of CO and other pollutants also often exceed international guidelines (Ezzati and Kammen, 2002).

1.2.9.1.4 <u>Quarries</u>

Quarries are a type of open pit mine in which rocks and minerals are extracted. Quarries are generally used for the extraction of building material. There is an operational quarry located within close proximity of the Mopane Village. Typical quarry operations involves not only extraction of materials (rock) but also crushing and screening that makes the material suitable for use in construction. In quarrying operations the major pollutant of concern are related to nuisance dust and particulate matter. The apprehension regarding quarries is that it often results in a loss of habitat and the subsequent depletion of diversity is one of the most worrisome problems associated with the activity. Many municipalities regard quarries as an eyesore and most require abatement methods to counter the impacts of dust, noise and appearance. Once mining in a quarry is complete and it has reached its lifespan, the area can be used as a landfill.

Another factor to consider regarding quarries is fugitive dust emissions and particulate matter by unpaved roads. When mining vehicles travel on the unpaved roads, the force of the wheels on the road surface causes the pulverisation of surface material. Particles are lifted and dropped from the rolling wheels and the road is exposed to stronger air currents in turbulent shear with the surface.

1.2.9.2 Ambient Monitoring

No ambient air quality data exists on the Mopane Project area. However, baseline dust fallout and particular matter is monitored on the Makhado Colliery site. Similar baseline conditions can be expected in the Mopane Project area.

1.2.9.2.1 __Dust fallout monitoring__

The Makhado Project currently carries out dust fallout monitoring at three locations, Fripp, Windhoek and MCC. Figure 43 below illustrates the dust fallout for the monitoring period of August 2010 – April 2013. The industrial limit of 1200 $mg/m^2/day$ was exceeded at MCC monitoring point during August 2012 (1254 $mg/m^2/day$). The domestic standard of 600 $mg/m^2/day$ was exceeded at MCC monitoring point on 7 occasions. The domestic standard of 600 $mg/m^2/day$ was exceeded at the Windhoek monitoring point on 4 occasions. The Fripp monitoring point recorded no exceedences during the monitoring period.

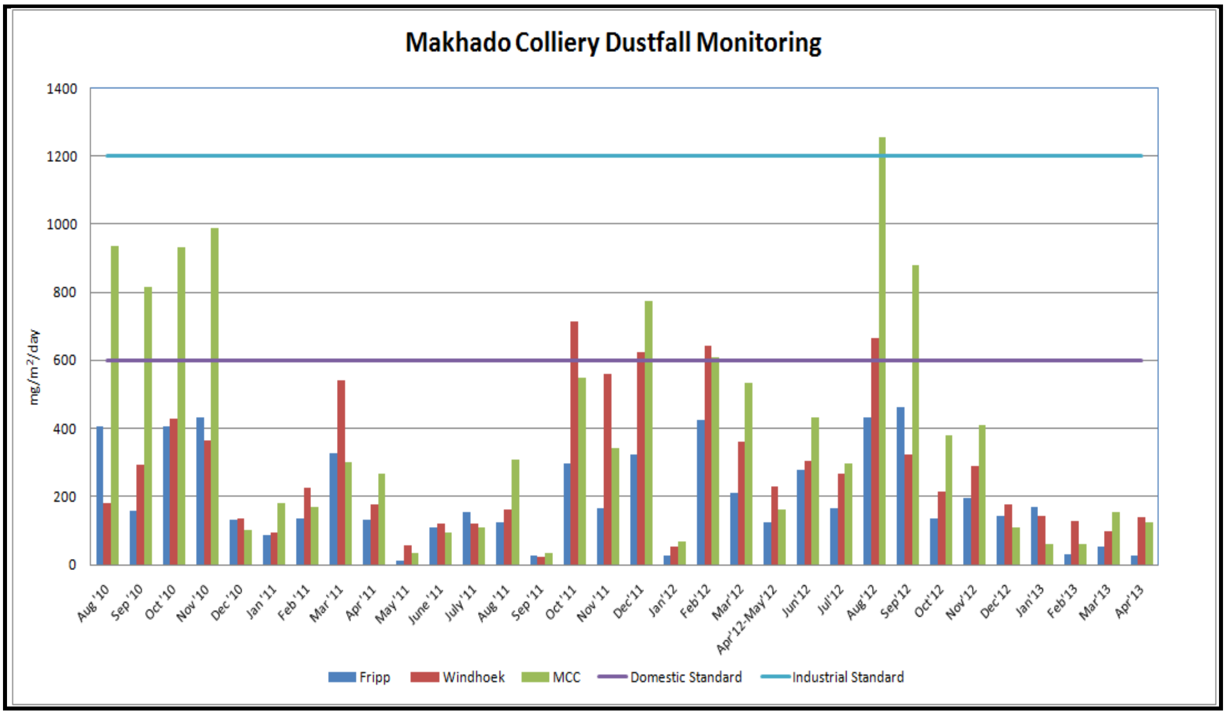


Figure 43: Makhado Colliery dust fallout monitoring Aug 10 – Apr 13

1.2.9.2.2 __Particulate matter__

Ambient monitoring of Particulate matter is carried out within the Mudimeli village using the Grimm and Davis monitoring equipment, which meets the quality standards of SANS (South African National Standards). Figure 44 below illustrates PM_{10} and $PM_{2.5}$ levels for the July 2012 – April 2013 monitoring period. Figure 45 below illustrates the predominant wind direction during the July 2012 – April 2013 monitoring period. Variable levels of PM were experienced. The SANS standard of 120 µg/m^3 were exceeded on 5 occasions. There were no exceedences of the newly gazetted $PM_{2.5}$ standard of 65 µg/m^3.

The predominant wind direction experienced at the Makhado site during the July 2012 – April 2013 monitoring period is mainly from the south eastern region (Figure 45). This compares favourable to the 2008-2012 meteorological wind rose compiled from data from the South African Weather Services (Figure 8).

Based on the dust fallout and particulate matter monitoring data, it is evident that peak concentrations are highest during the winter months (June, July and August). Low concentrations are experienced during the summer months (December, January and February). Dust suppression techniques for example continuous watering should be considered during the dry and windy seasons in order to limit the impacts of dust fallout within the area.

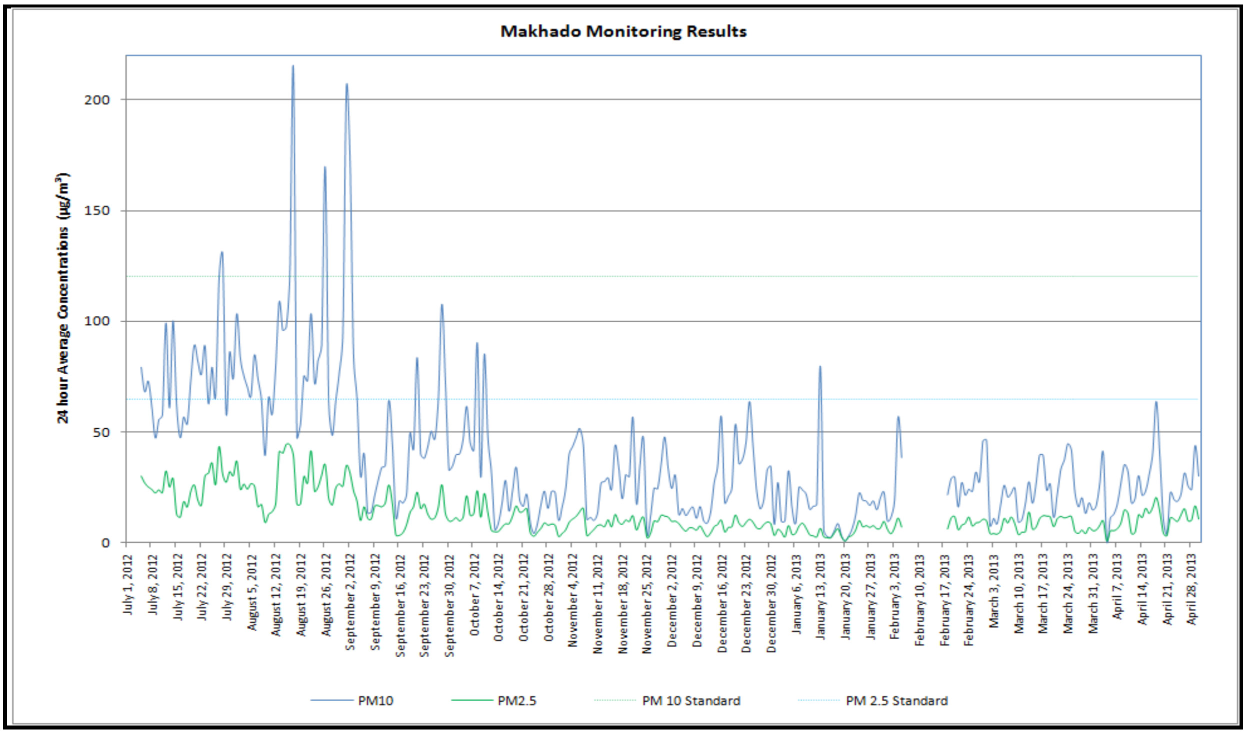


Figure 44: Makhado PM monitoring results July 2012 – April 2013

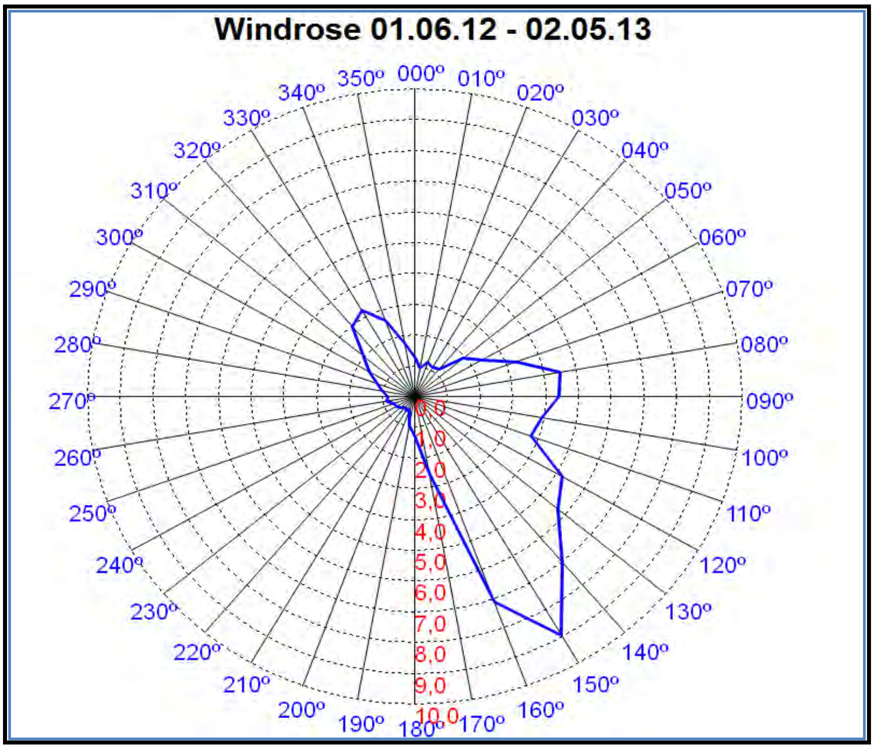


Figure 45: Period wind rose for the Makhado Grimm for the July 2012 – April 2013 monitoring period

1.2.10 AMBIENT NOISE

1.2.10.1 Noise Criteria of Concern

The criteria that will be used to determine the significance of the noise impact during the EIA phase were drawn from the criteria for the description and assessment of environmental impacts from the EIA Regulations, published by the DEA (April 1998) in terms of the NEMA, SANS 10103 as well as guidelines from the World Health Organization.

There are number of criteria that are of concern for the assessment of noise impacts. These can be summarised in the following manner:

- Increase in noise levels: People or communities often react to an increase in the ambient noise level they are used to, which is caused by a new source of noise. With regards to the Noise Control Regulations (promulgated in terms of the ECA), an increase of more than 7 dBA is considered a disturbing noise. This is also the criteria promoted to define the potential on potentially sensitive receptors. Refer to Figure 46.
- Zone Sound Levels: Also referred as the acceptable rating levels, it sets acceptable noise levels for various areas. Refer to Table 35.
- Absolute or total noise levels: Depending on their activities, people generally are tolerant to noise up to a certain absolute level, e.g. 65 dBA. Anything above this level will be considered unacceptable.

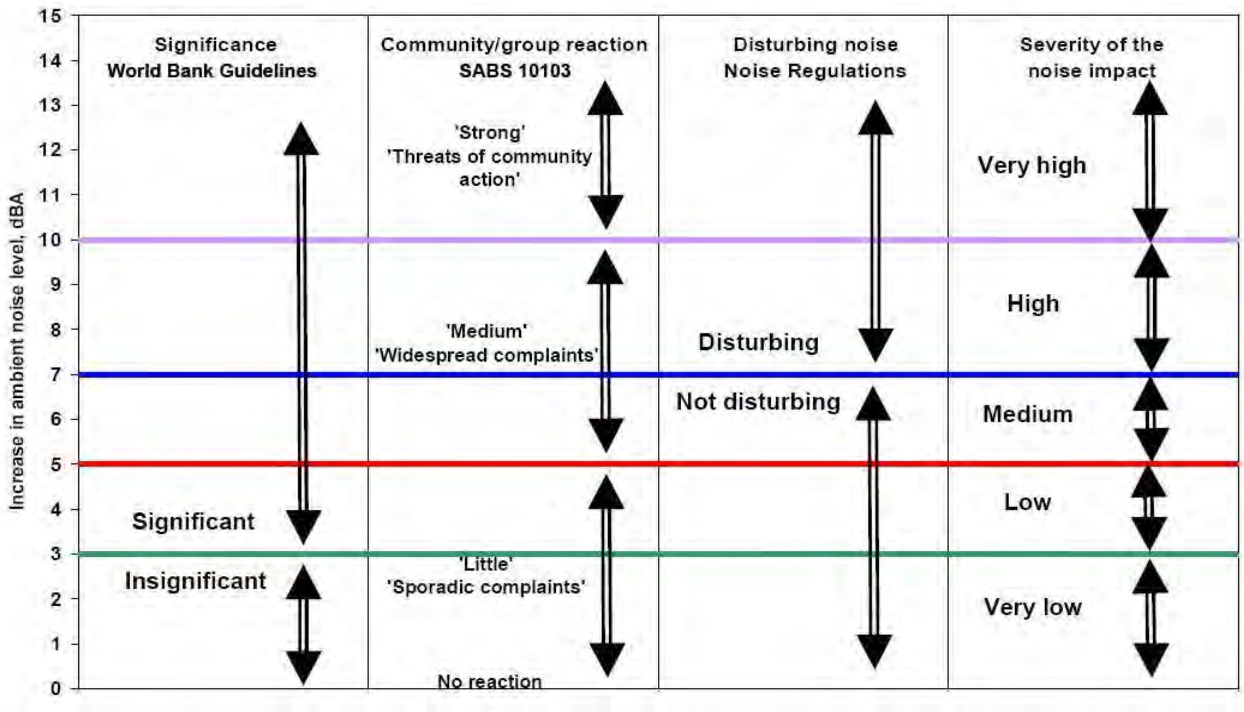


Figure 46: Criteria to assess the significance of impacts stemming from noise

In South Africa the document that addresses the issues concerning environmental noise is SANS 10103 (Edition 6 of 2008 – refer to Table 35). It provides the maximum average background ambient sound levels, $L_{Req,d}$ and $L_{Req,n}$, during the day and night respectively to which different types of developments may be exposed. Based on onsite measurements, considering both the $L_{Aeq,10min}$ and L_{A90} measurements, the ambient sound levels on and around the proposed activity correspond to the rating levels for an rural area. Zone Sound Levels therefore used would be:

- Day (06:00 to 22:00) – $L_{Req,d}$ = 45 dBA.
- Night (22:00 to 06:00) – $L_{Req,n}$ = 35 dBA.

SANS 10103 also provides a guideline for estimating community response to an increase in the general ambient noise level caused by an intruding noise. If Δ is the increase in noise level, the following criteria are of relevance:

- Δ ≤ 3 dBA: An increase of 3 dBA or less will not cause any response from a community. It should be noted that for a person with average hearing acuity, an increase of less than 3 dBA in the general ambient noise level would not be noticeable.
- < Δ ≤ 5 dBA: An increase of between 3 dBA and 5 dBA will elicit 'little' community response with 'sporadic complaints'. People will just be able to notice a change in the sound character in the area.
- < Δ ≤ 15 dBA: An increase of between 5 dBA and 15 dBA will elicit a 'medium' community response with 'widespread complaints'. In addition, an increase of 10 dBA is subjectively perceived as a doubling in the loudness of a noise. For an increase of more than 15 dBA the community reaction will be 'strong' with 'threats of community action'.

Table 35: Acceptable zone sound levels for noise in districts (SANS 10103)

1	2	3	4	5	6	7
Type of district	Equivalent continuous rating level ($L_{Req,T}$) for noise, dBA					
	Outdoors			Indoors, with open windows		
	Day-night $L_{R,dn}$ [a]	Day-time $L_{Req,d}$ [b]	Night-time $L_{Req,n}$ [b]	Day-night $L_{R,dn}$ [a]	Day-time $L_{Req,d}$ [b]	Night-time $L_{Req,n}$ [b]
RESIDENTIAL DISTRICTS						
a) Rural districts	45	45	35	35	35	25
b) Suburban districts with little road traffic	50	50	40	40	40	30
c) Urban districts	55	55	45	45	45	35
NON RESIDENTIAL DISTRICTS						
d) Urban districts with some workshops, with business premises, and with main roads	60	60	50	50	50	40
e) Central business districts	65	65	55	55	55	45
f) Industrial districts	70	70	60	60	60	50

In addition, the number of $L_{A,max}$ events above 60 dBA (60 dBA outside, 45 dBA inside a dwelling assuming 15 dBA attenuation) should be identified and where possible defined, to confirm whether there exist a risk of loud noises that could result in sleep disturbances. Where identified, management measures should be considered to minimize the significance of this impact.

1.2.10.2 Existing Ambient Sound Levels

1.2.10.2.1 __Measurement procedure__

Ambient (background) noise levels were measured at appropriate times in accordance with the South African National Standard SANS 10103:2008 "The measurement and rating of environmental noise with respect to land use, health, annoyance and to speech communication". The standard specifies the acceptable techniques for sound measurements including:

- type of equipment (Class 1);
- minimum duration of measurement;
- microphone positions and height above ground level;
- calibration procedures and instrument checks; and
- supplementary weather measurements and observations.

1.2.10.2.2 __Limitations: Acoustical Measurements and Assessments__

Limitations due to environmental acoustical measurements include the following:

- Ambient sound levels are the cumulative effects of innumerable sounds generated at various instances both far and near. A high measurement may not necessarily mean that noise levels in the area are always high. Similarly, a low sound level measurement will not necessarily mean that the area is always quiet, as sound levels will vary over seasons, time of the day, faunal characteristics, vegetation in the area and meteorological conditions (especially wind). This is excluding the potential effect of sounds from anthropogenic origin. It is impossible to quantify and identify the numerous sources that influenced one 10-minute measurement using the reading result at the end of the measurement;

- Defining ambient sound levels using the result of one 10-minute measurement will be very inaccurate (very low confidence level in the results) for the reasons mentioned above. The more measurements that can be collected at a location the higher the confidence levels in the ambient sound level determined (at that location). The more complex the sound environment, the longer the required measurement (especially when at a community or house);
- Determination of existing road traffic and other noise sources of significance are important (traffic counts etc);
- Measurements over wind speeds of 3 m/s could provide data influenced by wind-induced noises;
- Ambient sound levels recorded near rivers, streams, wetlands, trees and bushy areas can be high due to faunal activity which can dominate the sound levels around the measurement point. This generally is still considered naturally quiet and understood and accepted as features of the natural soundscape, and various cases sought after and pleasing;
- Considering one sound descriptor is not sufficient for and acoustical assessment. Parameters such as L_{AMin}, L_{AIeq}, L_{Aeq}, L_{Ceq}, L_{AMax}, LA10, LA90 and spectral analysis forms part of the many variables to be considered;
- It is technically difficult to correctly measure the spectral distribution of a large equipment in an industrial setting due to the other noise sources active in the area;
- Exact location of a sound level meter in an area in relation to structures, vegetation and external noise sources will impact on the measurements; and
- As a residential area develops the presence of people will result in increased sounds. These are generally a combination of traffic noise, voices, animals and equipment (incl. TV's and Radios). The result is that ambient sound levels will increase as an area matures.

1.2.10.2.3 Ambient sound measurements

The location of the day/night ambient sound measurement locations are presented in Table 36 below and illustrated in Figure 47.

Measurements were conducted from the morning of 2 July to the afternoon of 5 July 2013. Sound level meter settings and measurement methodology conform to specifications listed in SANS 10103:2008.

Measurement locations were numbered as MAS01 to MAS07 in this report. These measurements were conducted over a period of approximately 20 – 24 hours.

Table 36: Day/night-time measurement locations (Datum type: WGS 84)

Point name	Description	Latitude	Longitude
MAS01	Assembly area – Mopane School	-22.616632°	29.855353°
MAS02	Farm Erasmus – Mr Meintjies	-22.608796°	29.852377°
MAS03	Farm Sonskyn – Farmworker's house	-22.608797°	29.838052°
MAS04	Farm Cohen – Osmers dwelling	-22.653268°	29.759507°
MAS05	Farm Vera – Mr Hanekom	-22.561271°	29.741831°
MAS06	Farm Hermanus – Mr vd Merwe	-22.643518°	29.810733°
MAS07	Farm Sonskyn – Foreman's dwelling	-22.592321°	29.813782°

1.2.10.2.4 Results – SANS 10103:2008 Rating Level

- ***MAS01:*** Daytime measured data indicate sound levels typical of an area with a rural district character. Night-time levels however are far higher than expected for a rural area, conforming more to an urban district zone sound level, confirmed by the 54.9 dBA $L_{Aeq,I}$ level measured the following day. Considering the L_{A90} and the developmental character of the area it is the opinion of the author that a rating level typical for a sub-urban area would be acceptable. The constant noise from the limestone plant currently does have a slight noise impact on the location, but, combined with the cumulative effect of single events it raises the noises levels at the location (and surrounding area) from the expected rural to that of an urban area. The measured $L_{Aeq,f}$ levels during the day and night however conforms to the recommendation of 55 and 45 dBA respectively by the World Health Organization, World Bank and International Finance Corporation for residential areas.
- ***MAS02:*** Measured data indicate sound levels typical of an Urban district. Based on the measured levels (statistical) and the development character of the area, a rating level typical for a sub-urban area would probably be acceptable for this location as the average L_{A90} indicates that the ambient noise level could have been lower in the absence of noisy single events. The measured $L_{Aeq,f}$ levels during the day and night conforms to the recommended of 55 daytime sound level but not with the 45 dBA night-time sound levels of the World Health Organization, World Bank and International Finance Corporation for a residential areas.
- ***MAS03:*** Daytime measured data indicate sound levels typical of an area with an urban district noise character. Night-time levels however are very high for a rural area, conforming more to a commercial district zone sound level. Considering the L_{A90} and the developmental character of the area, a rating level typical for a sub-urban area would probably be acceptable. The measured $L_{Aeq,f}$ levels during the day and night however does not conform to the recommendation of 55 and 45 dBA respectively by the World Health Organization, World Bank and International Finance Corporation for residential areas. It should be noted that the increased noise levels are directly related to the animals in the vicinity of the dwelling.

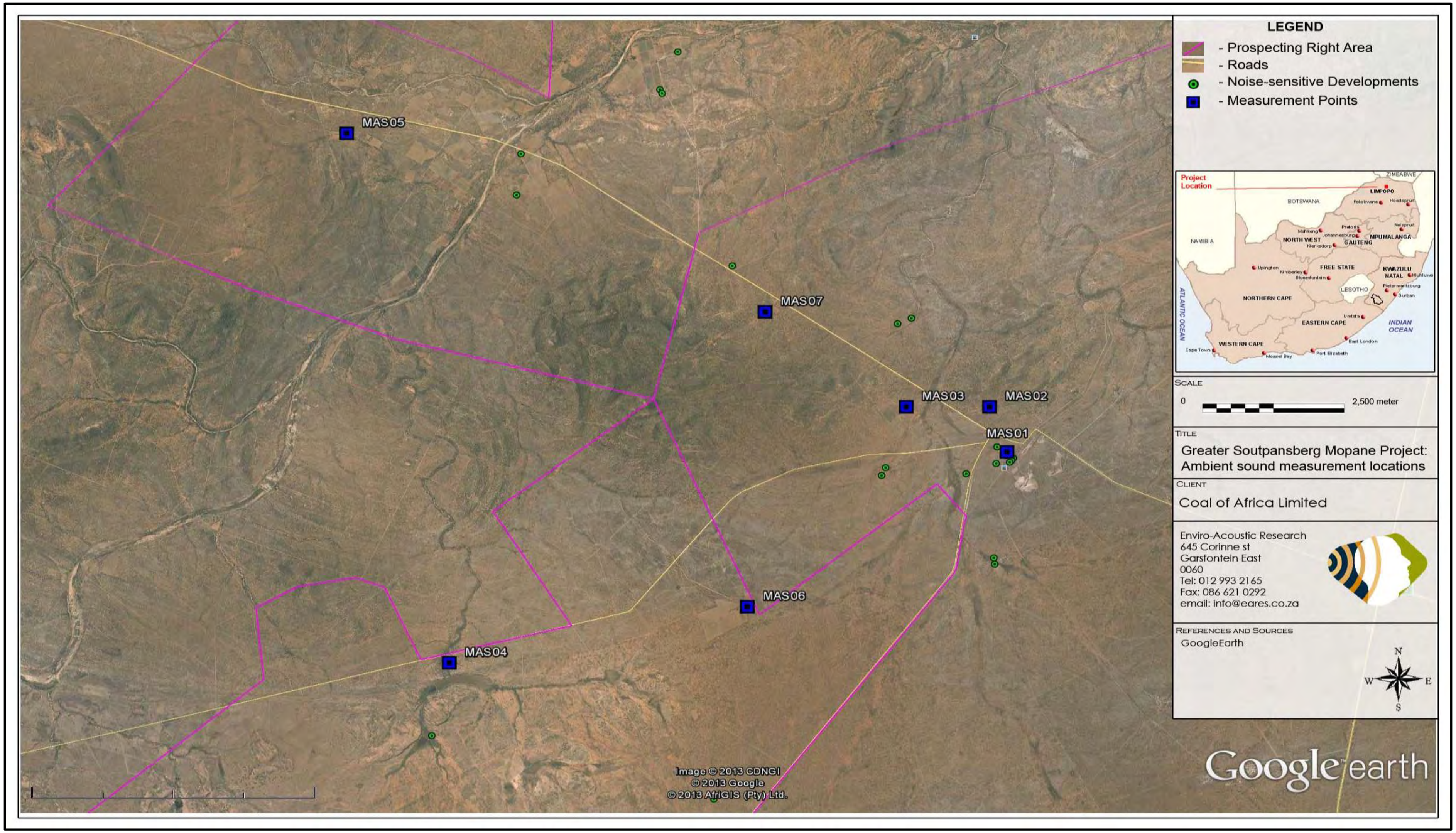


Figure 47: Localities of ambient sound level measurements

- ***MAS04:*** Measured data indicate sound levels typical of an area with a rural district sound character. The measured $L_{Aeq,f}$ levels conforms to the recommended 55 and 45 dBA (day and night respectively) by the World Health Organization, World Bank and International Finance Corporation for residential areas.
- ***MAS05:*** Daytime measured data indicate sound levels typical of an area with an urban district noise character although night-time levels are more typical of a rural area. Considering the L_{A90} and the developmental character of the area, a rating level typical for a sub-urban area would probably be acceptable. The measured $L_{Aeq,f}$ levels during the day and night does conform to the recommendation of 55 and 45 dBA respectively by the World Health Organization, World Bank and International Finance Corporation for residential areas.
- ***MAS06:*** Measured data indicate sound levels typical of a rural district. Based on the measured levels (statistical) and the development character of the area, a rating level typical for a sub-urban area would probably be acceptable for this location. The measured $L_{Aeq,f}$ levels during the day and night conforms to the recommended of 55 and 45 sound level set by the World Health Organization, World Bank and International Finance Corporation for a residential area.
- ***MAS07:*** Measured data indicate sound levels typical of an area with a rural district sound character even the first day recorded an equivalent sound level of 57.6 dBA. The measured $L_{Aeq,f}$ levels conforms to the recommended 55 and 45 dBA (day and night respectively) by the World Health Organization, World Bank and International Finance Corporation for residential areas.

Equivalent sound levels varied significantly from location to location, with all locations experiencing noisy single events at times that impact on the sound levels (both L_{Aeq} and L_{A90}). L_{A90} levels however indicate an area with significant potential to be quiet at times. Equivalent daytime ambient sound levels were measured around between 43 – 64 dBA, ranging between 22 and 75 dBA (10-minute measurements) with equivalent night-time ambient sound levels were measured around between 33 – 64 dBA, ranging between 19 and 75 dBA (10-minute measurements).

The Mopane community and the MAS02 (Mr. Meintjies) currently experience slightly elevated ambient sound levels due to the Limestone Plant in the area. There are however little indication of any significant noise impacts from external sources of anthropogenic origin at other monitoring locations. While the gravel roads in the area does increase noise levels due to single events, the main source of noise appears to be originating from local dwellings. The source in most cases relates to faunal activity around the dwellings. This is specifically clear at measurement location MAS03 where chickens raised the noise levels to those similar of a commercial district.

A summary of the SANS 10103:2008 noise districts are provided in Table 37.

.

Table 37: Summary of noise district rating levels

Point name	Noise district rating based on L_{Aeq} measurement data (Day / Night)	Noise district rating based on all data and character of area	Existing ambient sound levels conforming to international recommended levels?
MAS01	Rural / Urban	Sub-urban	Yes
MAS02	Urban / Urban	Sub-urban	Yes
MAS03	Urban / Commercial	Sub-urban	No
MAS04	Rural / Rural	Rural	Yes
MAS05	Urban / Rural	Sub-urban	Yes
MAS06	Rural / Rural	Sub-urban	Yes
MAS07	Rural / Rural	Rural	Yes

Due to the significant variance in ambient sound measurements it is recommended that the project use the guideline levels for residential use as set by international institutions such as World Health Organization, World Bank and International Finance Corporation for residential areas, as summarised below.

Receptor type	One hour L_{Aeq} (dBA)	
	Daytime 07:00 - 22:00	Night-time 22:00 – 07:00
Residential; institutional; educational	55	45
Industrial; commercial	70	70

1.2.11 VISUAL ASSESSMENT

1.2.11.1 Aesthetics

The topography of the Mopane Project area is essentially flat and lies at an average elevation of about 600 mamsl. Various streams drain the project area. The topography of the area is described in the Limpopo State of the Environment Report (SoER) as rolling and irregular plains with ridges and hills. The ridges and hills depicted in Figure 48 below are confined to the western boundary and the northern areas of the Jutland Section as well as the eastern boundary of the Voorburg Section.

The proposed Mopane Project is located within the Savannah biome, characterized by a grassy ground layer and a distinct upper layer of woody plants (trees and shrubs). Where this upper layer is near the ground (low growing) the vegetation may be referred to as Shrubveld, where it is tall and dense, as Woodland, and the intermediate stages are locally known as Bushveld (BGIS, 2011).

The shrub-tree layer may vary from 1 to 20 m in height, but in the Mopane Project area typically varies from 3 to 7 m. The shrub-tree element may come to dominate the vegetation in areas which are being overgrazed. The shrub-tree layer can provide some visual absorption for the infrastructure depending on the height of the infrastructure and the location of the observer.

1.2.11.2 Visual Character of the Area

The area is characterized by large areas of shrubs (thicket) and woodland with intermitted small patches of dry-land cultivation of land. Land use in the area include game / livestock farming with associated infrastructure, lodges providing accommodation for hunters and eco-tourists as well as dry-land and irrigation crop production.

The man-made landscape types that occur within the study area include cultivated fields, built-up farmstead areas, infrastructure such as roads, a railway line and existing power lines.

A railway line forms the south eastern boundary of the Jutland Section and traverse the farm Cavan 508 MS, the eastern most farm portion of the Voorburg Section. Only local gravel roads with low traffic volumes traverse the immediate area. The N1 is located approximately 5 km east of the Voorburg Section and approximately 8 km to the east of the Jutland Section.

The sense of place of the area can be described as a peaceful rural area with limited visual intrusion. The tourism and hunting sector relies heavily on the rural peaceful character of the area to market their establishments.

The gravel roads contribute to the dust pollution in the area.

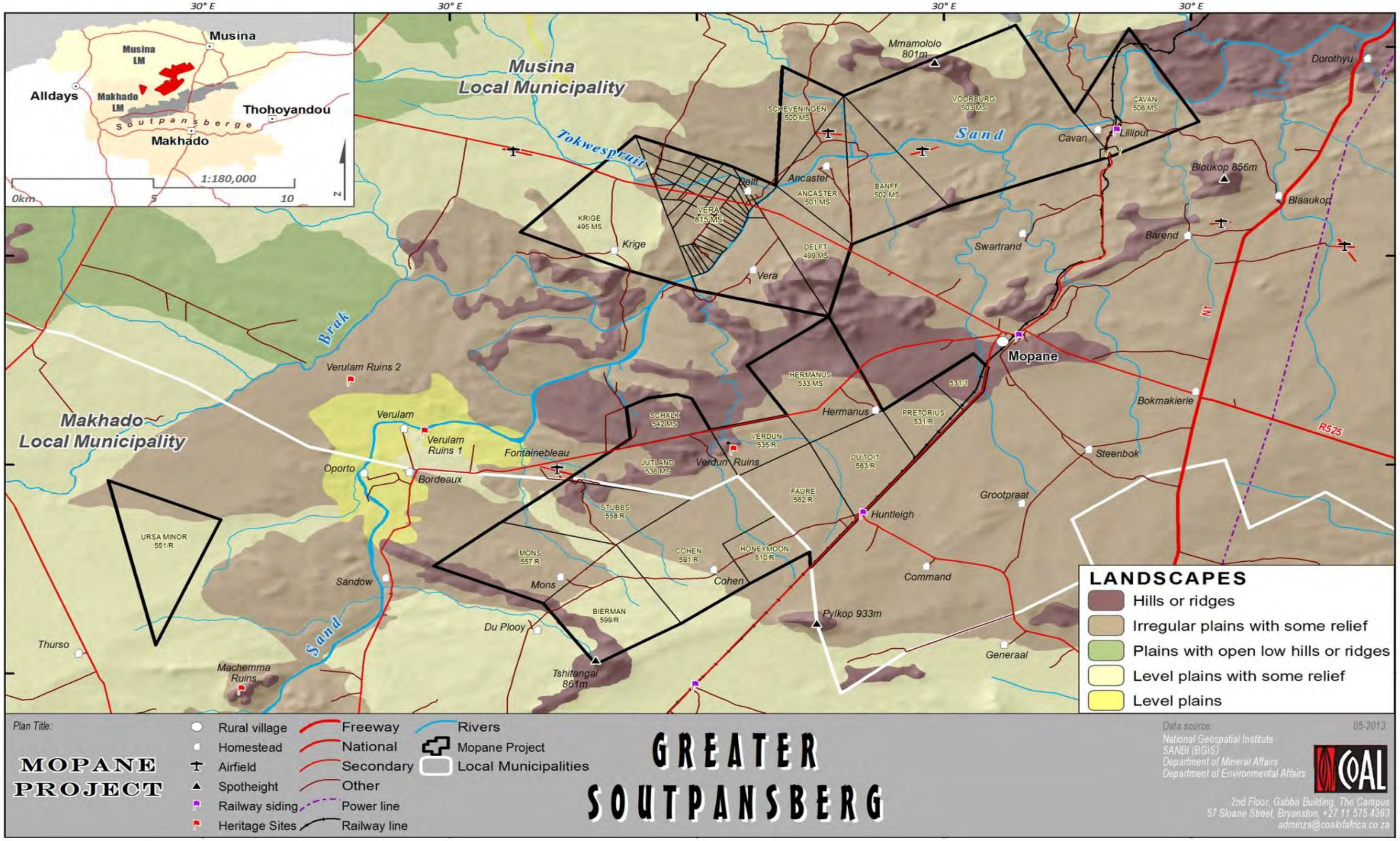


Figure 48: Topography map indicating location of hills and ridges

1.3 ENVIRONMENTAL ASPECTS THAT MAY REQUIRE PROTECTION OR REMEDIATION

1.3.1 SENSITIVE LANDSCAPES

1.3.1.1 River systems

River systems are always considered to be ecologically sensitive, and are thus given a very high (No-Go) sensitivity. This is due to the unique habitats they provide and support for several flora and fauna species. The river systems provide migration corridors for many species. River systems are particularly important due to the water transport and associated biological, economic, health and cultural values. The provision of clean and healthy water to people, agriculture and natural biological systems is of utmost importance in this arid region.

The following is recommended:

- No mining development can be supported within the 1:100 year flood-line on both sides of the rivers. A further buffer zone will be needed to protect the rivers from effects of mining, especially from pollution and erosion;
- Care should be taken that no erosion takes place along the river banks;
- The rivers and river bank areas should be included in an open space plan, where the indigenous vegetation is protected and no development allowed; and
- All alien woody species on the river banks should be removed and controlled.

1.3.1.2 Wetlands

Legislative requirements were used to determine the extent of buffer zone required for each group depending on whether a group is considered wetland/riparian habitat or not:

- The Sand River, Tokwespruit, Banff Stream and Voorburg Stream as well as smaller drainage lines with riparian zones are defined as watercourses. If any activities are to take place within 100 meters or the 1:100 year flood lines exemption terms of Regulation General Notice (GN) 704 of the NWA, 1998 needs to be obtained. Section 21 of the NWA as well as GN No. 1199 of 2009 as it relates to the NWA will also apply and therefore a Water Use Licence (WUL) will be required;
- Smaller drainage lines without riparian zones are not considered wetlands but are still defined as watercourses. If any activities are to take place with the 1:100 year flood line exemption terms of Regulation GN 704 of the NWA, 1998 needs to be obtained, however Section 21 of the NWA as well as GN No. 1199 of 2009 as it relates to the NWA does not apply and therefore no WUL will be required;
- Wetland depressions form part of smaller drainage lines with riparian zones and as a result are already included within the legislative requirements defined for the smaller drainage lines above; and
- Pans are considered wetland habitat, therefore a WUL in terms of section 21 c and i of the NWA will be required, and the 500 m zone of applicability of GN No. 1199 of 2009 as it relates to the NWA will also apply.

According to GN 704 no mining activities may take place within 100m from a water course or within the 1:100 year flood-line, whichever is the greatest. Given the fact that the 1:100 year flood-line is much wider than the 100m (in most cases), the determining factor will for the project has been defined as the 1:100 year flood-line (for the Sand River). Based on the findings of this aquatic assessment, it is recommended that a 100m buffer zone from the edge of the riparian zone (wetlands) be maintained.

Based on the findings of the specialist studies it is therefore recommended that the project should be designed and operated on the basis that no mining activities should take place within 100m from the edge of the 1:100 year flood-line.

1.3.2 FORMAL CONSERVATION INITIATIVES IN THE REGION

1.3.2.1 Vhembe Biosphere Reserve

Biosphere reserves are protected environments which are important for conservation and sustainable utilization of natural resources. They are building blocks for bio-regional planning and economic development. Biosphere reserves are community driven initiatives assisted by government departments or agencies. Biosphere reserves are important ecosystems designated as protected areas by the United Nations Education, Science and Cultural Organization (UNESCO).

The objectives of a Biosphere Reserve are to (LEDET, 2008):

- Preserve special bio-diverse environments for future generations;
- Create and encourage a balance between conservation and economic development;
- Place a priority on encouraging local communities to become involved and to become direct beneficiaries of the benefits flowing from a Biosphere; and
- Establish a social contract between all stakeholders and create an integrated ownership and management structure.

Worldwide Biospheres all have three distinct zones:

- A legally constituted ***Core area*** or areas devoted to long-term protection, according to the conservation objectives of the Biosphere Reserve;
- A ***Buffer zone*** or zones clearly identified and surrounding or contiguous to the core areas, where only activities compatible with the conservation objectives can take place; and
- An outer ***Transition area*** where sustainable resource management practices are promoted and developed.

Limpopo Province has three Biosphere Reserves namely the Waterberg Biosphere Reserve (WBR), the Kruger to Canyon Biosphere (K2C) and Vhembe Biosphere Reserve (VBR).

Figure 49 shows the VBR with its core areas and buffer zones. Although the Mopane Project falls within the boundary of the VBR, it is not within or adjacent to any of the core areas and buffer zones.

1.3.2.2 Protected areas

Figure 49 shows both the formal and informal protected areas within the VBR boundary (SANBI BGIS, 2013). According to this database, no existing protected areas will be directly affected by the proposed Mopane Project.

Protected areas in the close vicinity of the site include:

- Musina Nature Reserve to the North-East
- Nzhelele Nature Reserve to the South-East
- Honnet Nature Reserve to the East
- Greater Kuduland Nature Reserve to the East
- Nwanedi Nature Reserve to the East
- Studholme Nature Reserve to the South
- Hangklip State Forest to the South
- Happy Rest Nature Reserve to the South
- Roodewal State Forest to the South
- Entabeni State Forest to the South
- Bergtop Nature Reserve to the South-West
- Goro Game reserve to the South-West
- Langjan Nature reserve to the West.

The LEDET has recently advertised an intention to declare a number of farms within and adjacent to the Voorburg Section as the Baobab Nature Reserve, including Sheldrake 239 MS, Zwartrand 506 MS, Rykswyk 240 MS, Lucerne 198 MS, Fontainebleau 212 MS and Voorburg 503 MS (City Press, 14/10/2012). In addition, the farm Fontainebleau 212 MS was declared a private nature in 1969 (Government Gazette No.512 of 21 May 1969). The legal status of these farms could not be confirmed.

The Mopane Project area falls outside Priority Area 1 {North Eastern Escarpment} for conservation as determined by the National Biodiversity Assessment (NBA) as contemplated in the National Protected Area Expansion Strategy (LEDET, 2008), and no NBA Endangered or Critically Endangered Ecosystems (2011) are affected by the proposed development. The study area is also not located within the following important biodiversity areas:

- Soutpansberg centre of endemism;
- Key vegetation community (Soutpansberg); and
- Delineation of the Soutpansberg escarpment.

1.3.2.3 Ground Hornbill research and conservation project

At present Southern Ground Hornbills are considered 'vulnerable' and a protected species under TOPS regulations (2007) but their numbers are still declining. Over 70% of this species natural habitat has been lost due to farming / agriculture and cattle over the past 50 years. Indirect poisoning, indirect trapping and snaring, loss of large nesting trees, the trade in exotic birds, an increase in ancient cultural uses and electrocution on power transformer boxes are some reasons provided for the decline in numbers.

The Mabula Ground Hornbill Research and Conservation Project are addressing these issues by:

- Harvesting and hand-rearing of second hatched chicks which die of starvation in the nests.
- Re-introduction and augmentation of non-viable groups in the wild.
- Provision of artificial nests for wild groups without nests.
- Research on behaviour and other important unanswered questions.
- Awareness Campaigns to educate the general public regarding:
    - unintentional poisoning;
    - trade in ground hornbills; and
    - secondary trapping and snaring.

In conjunction with the Musina Game Study Group, artificial nest boxes are being supplied to compensate for the lack of suitable nesting trees in the Musina / Mopane area. Large populations of ground hornbills have recently been spotted in the area (*pers. comm*. Vera/Mopane Landowners Committee); no nests (natural or artificial) have however been identified and/or reported.

Figure 49: Protected areas and conservation initiatives within the Vhembe Biosphere Reserve

1.4 DESCRIPTION OF LAND USE, CULTURAL AND HERITAGE ASPECTS AND INFRASTRUCTURE

1.4.1 LAND USE ACTIVITIES ON SITE AND NEIGHBOURING PROPERTIES

The study areas are defined in the figure below. The NOMR application area is included in the baseline socio-economic assessment on a broader level, where the mining footprint area and surrounding area is done in more detail.

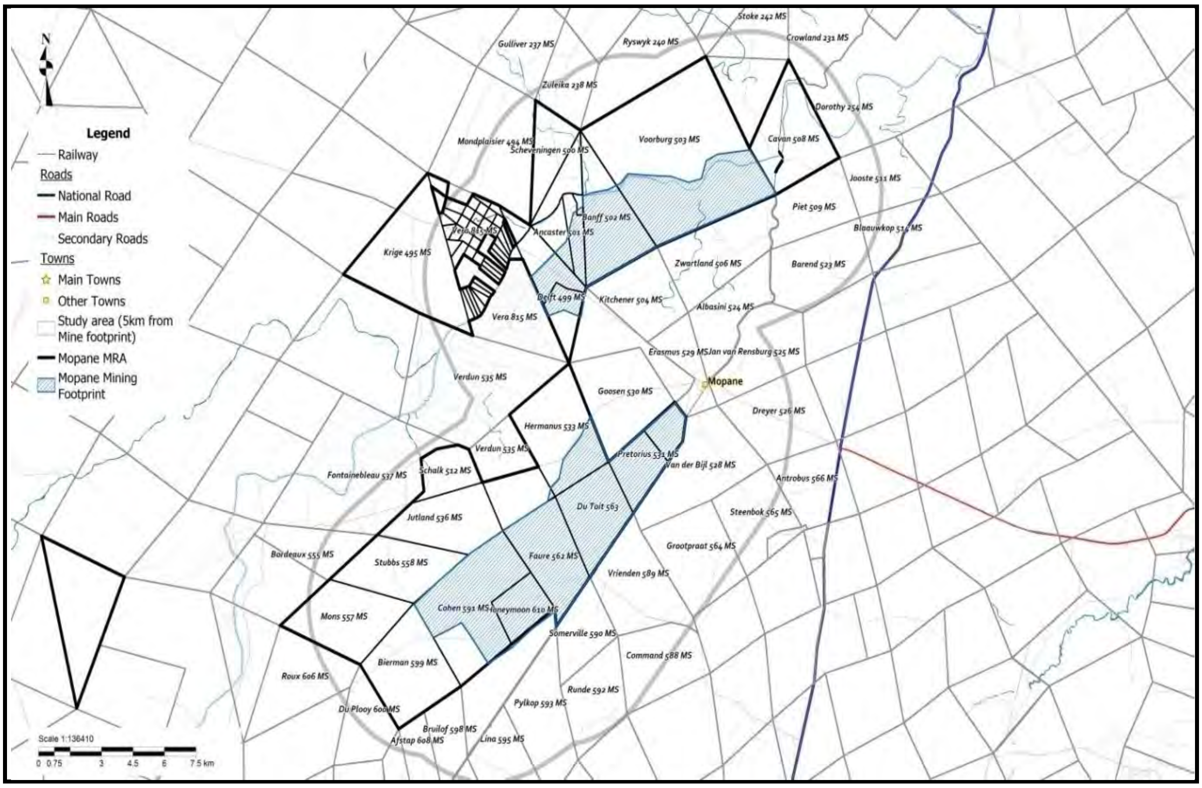


Figure 50: Socio-economic study area

The socio-economic activities in the area are mixed between agriculture, hunting and tourism. With the Vera agricultural holdings mostly used for dryland or irrigated arable land or grazing areas for livestock.

Some preliminary facilities, structures and activities have been identified as being sensitive from a socio-economic point of view. These may be influenced by other environmental factors, with a secondary socio-economic impact.

The facilities, structures and activities have been identified utilising aerial photography and satellite imagery.

Agricultural activities are focused on the Vera agricultural holdings, and neighbouring areas. Most of the NOMR Application area is utilised for game or livestock grazing. This information will be confirmed during the detail SEIA.

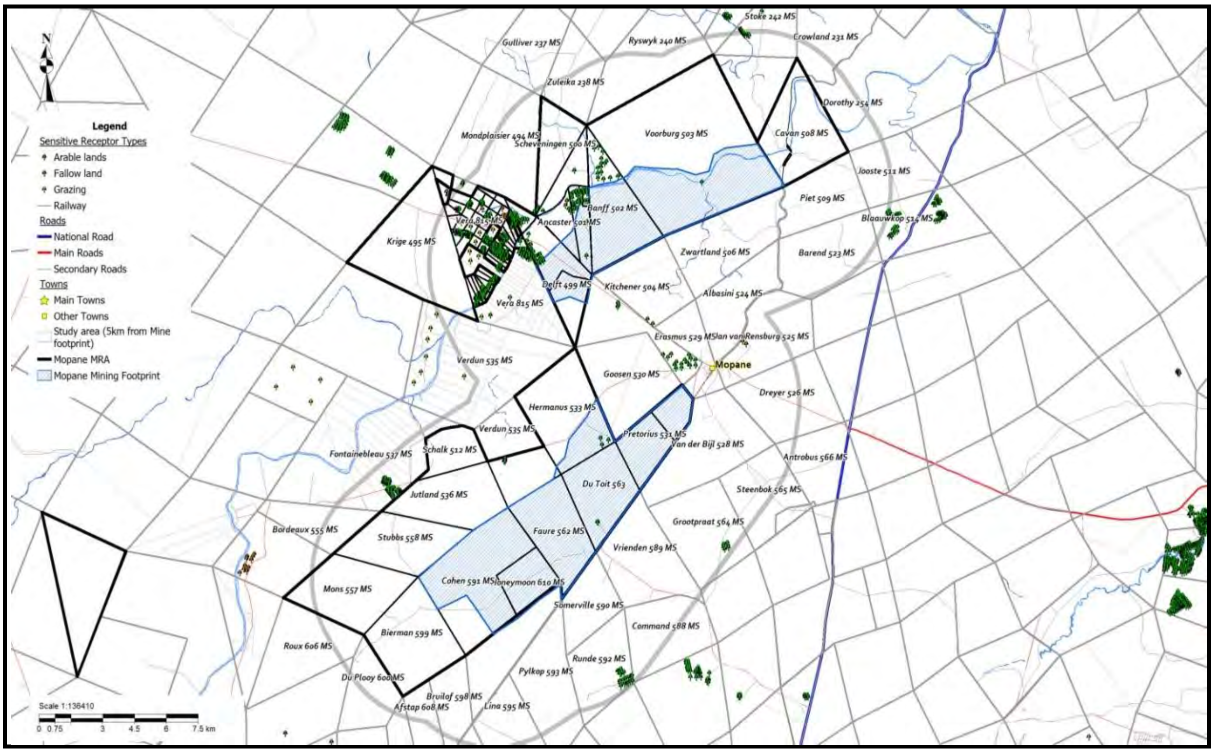


Figure 51: Agricultural activities

Hunting, game trading and Ecotourism is an established socio-economic driver in the area. The figure below indicates where hunting camps and other game activities could be determined via aerial photography. The information will be confirmed and further investigated during the EIA phase.

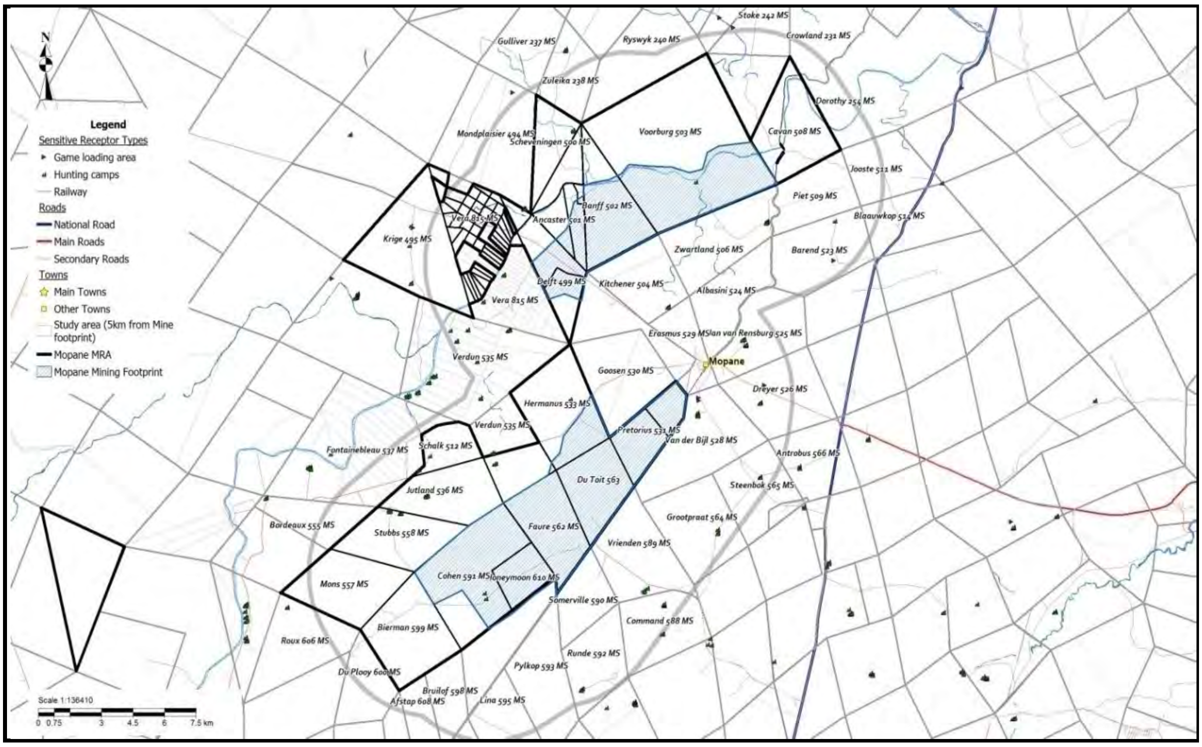


Figure 52: Hunting facilities and/or activities

The location of all structures, houses, institutional buildings such as schools, post offices, etc is important in the evaluation of their susceptibility to nuisance, noise, visual and air quality impacts. Changes to the sense of place and ambiance of the area have an impact on the socio-economic environment. Housing, labour houses and other structures are scattered throughout the area, as can be seen in the figure below.

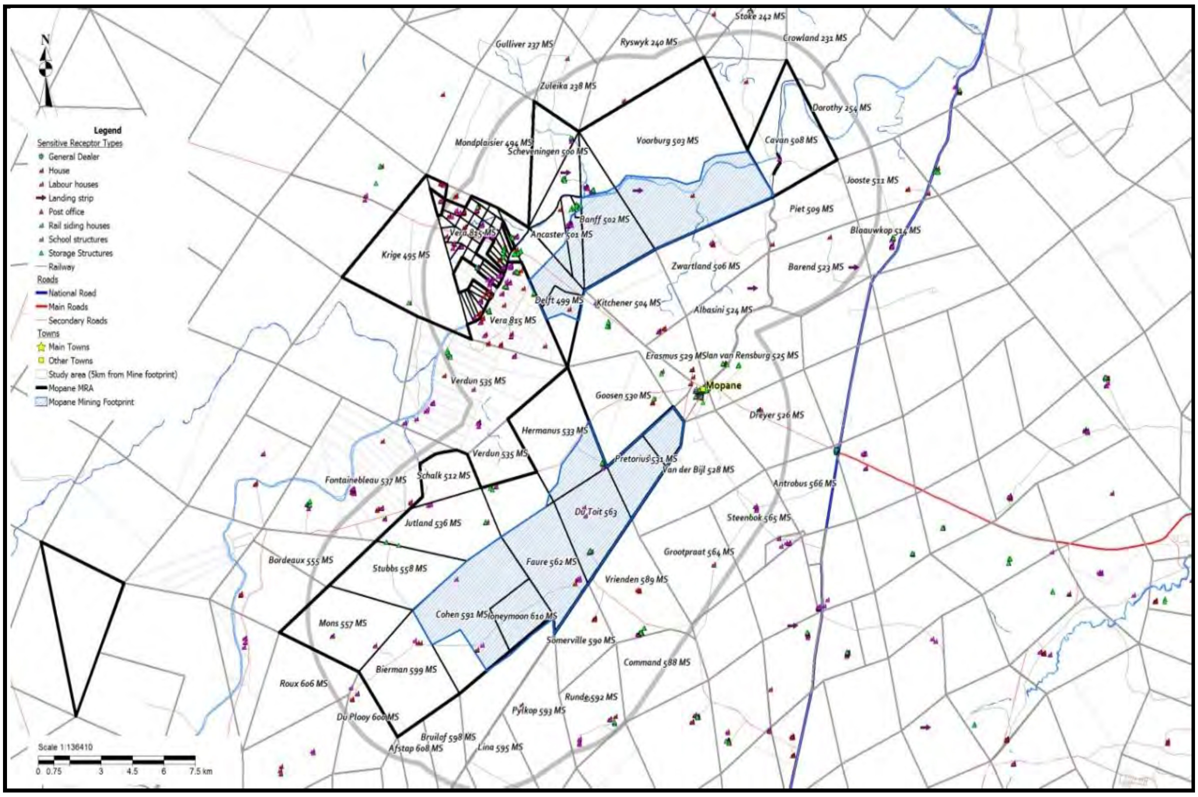


Figure 53: Houses, labour houses and other structures

The area is known locally to be water scarce therefore livelihoods in the project area largely rely on water sources to be able to sustain their socio-economic activities. Surface and groundwater is captured in dams for utilization on the various properties. In collaboration with the surface and groundwater specialists the water resources utilized and the purpose will be determined to evaluate the secondary socio-economic dependencies on water use in the area.

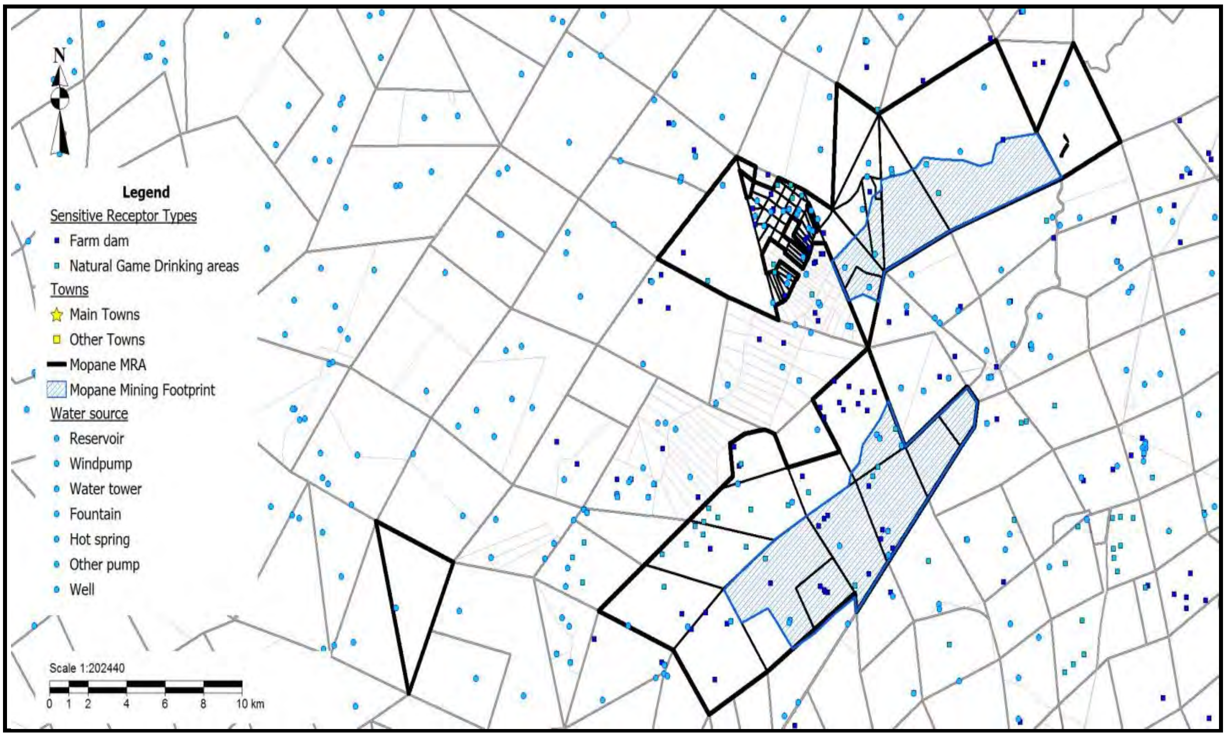


Figure 54: Water sources - dams, boreholes and drinking holes

The current land use activities within and surrounding the Mopane MRA area is discussed in detail in Sections 4.4 and 4.5 of the SEIA (ANNEX-9).

1.4.2 CULTURAL AND HERITAGE RESOURCES

1.4.2.1 Theoretical Framework

The following is an outline of the cultural sequence in South Africa and some heritage concepts that form the theoretical framework for understanding typologies of heritage resources in South Africa.

1.4.2.1.1 The Stone Age Culture

South Africa's human history and heritage span more than 3 million years. Hominid sites and their fossil remains are largely confined to dolomite caves on the highveld in Gauteng, Limpopo and Northwest Provinces. Hominid refers to primate species which are the immediate ancestors of man. The Stone Age which dates back more than 1 million years marks a more diagnostic appearance of the cultural sequence divided into three epochs, the Early, Middle and Late Stone Ages. Stone and bone implements manifest the technology of the period and fall into distinct typologies indicating chronological development. Material evidence of human activities is easily detectable in caves, rock-shelters and riverside sites, and very rarely seen in open country. The Late Stone Age is also associated with the execution of paintings mostly in rock shelters and caves.

The Early Stone Age

The Early Stone Age marks the earliest appearance of stone artefacts about 1.4 million years ago. Such tools bore a consistent shape such as the pear-shaped hand axe, cleavers and core tools (Deacon & Deacon, 1999). These tools, which have been called Acheulian after a site in France, were probably used to butcher large animals such as Elephants, Rhino and Hippo that had died from natural causes. Acheulian artefacts are usually found near sites where they were manufactured and thus in close proximity to the raw material or at butchering sites. The early hunters are classified as hominids meaning that they had not evolved to the present human form.

Middle Stone Age (MSA)

The Middle Stone Age (MSA), which appeared 100 000 years ago, is marked by the introduction of a new tool kit which included prepared cores, parallel-sided blades and triangular points hafted to make spears. By then men had become skilful hunters, especially of large grazers such as Wildebeest, Hartebeest and Eland. It is also believed that by then, men had evolved to become anatomically modern. Caves were used for shelter suggesting permanent or semi-permanent settlement. Furthermore there is archaeological evidence from caves indicating that people had mastered the art of making fire. These were two remarkable steps in cultural advancement.

Later Stone Age (LSA)

By the beginning of the LSA, humans were classified as Homo sapiens which refer to the modern physical form and thinking capabilities. Several behavioural traits are exhibited, such as rock art paintings and purposeful burials with ornaments, became a regular practice. The practitioners of the Rock Art Paintings are definitely the ancestors of the San and sites abound in the whole of South Africa. LSA technology is characterised by microlithic scrapers and segments made from very fine-grained rock. Spear hunting probably continued, but LSA people also hunted small game with bows and poisoned arrows. Because of poor preservation, open sites are usually of less value than rock shelters.

1.4.2.1.2 The Iron Age Culture

The Iron Age culture, which supplanted the Stone Age at least 2000 years ago, is associated with the introduction of farming and the use of several metals and pottery. Scholars have analyzed existing archaeological evidence using various models, the earliest attempts of which arrived at the conclusion that a sudden synchronized appearance of these technologies occurred in South Africa, indeed in the whole region of Eastern and Southern Africa, suggesting a fairly rapid spread of people. The concept of migration itself has been debated, since these people are indigenous to Africa. Thus current theoretical positions are in support of a gradual “expansion” or “spread” (rather than a migration in the strict sense) of populations of speakers of Bantu languages from a source or sources in the North. Pottery, even though broken into shards has a high survival rate, and has been a handy means for characterizing and identifying archaeological traditions within the broad Iron-using culture and to further isolate geographical variations, which have been called facies. Ceramic classifications rely largely on shape and decoration similarities and variations. Coupled with radiocarbon dates, which have been obtained at several sites, it has been possible to reconstruct a picture of the chronological and spatial development of Iron Age traditions.

Early Iron Age

Metal working represents a new technology not found among the Stone Age hunters.

As mixed farmers, iron-using peoples practiced agriculture and kept domestic animals such as Cattle, Sheep, Goats and Chickens amongst others. There is however increasing evidence that Sheep might have moved into the area much earlier than the Iron Age.

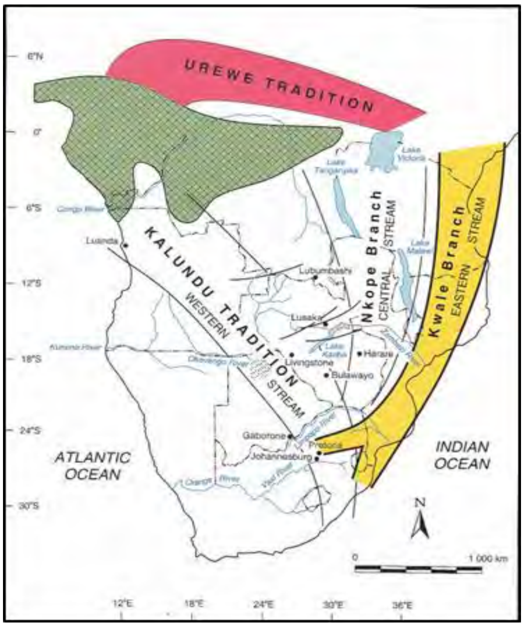
According to Huffman (2007) there were two streams of Early Iron Age (EIA) expansion converging in South Africa, one originating in east Africa which has been called the Urewe-Kwale Tradition (or the eastern stream) and another from the west spreading through Zambia and Angola called the Kalundu Tradition (or western stream).

Urewe Tradition spawned the following facies:

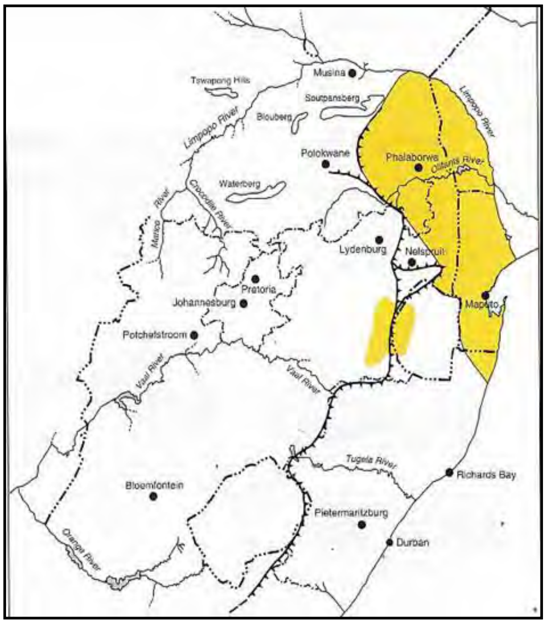
- Matola (Eastern Seaboard)
- Mzonjani facies (Broederstroom) AD 450 – 750)

Kalundu Tradition spawned the following facies:

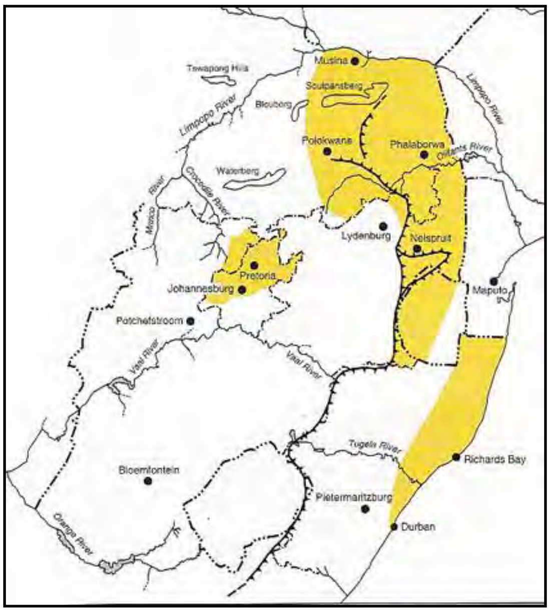
- Benfica Sub-branch:
  - Bambata facies AD 150 – 650
- Happy Rest Sub-branch:
  - Happy Rest facies AD 500 – 750
  - Malapati facies AD 750 – 1030



Spread of the Kalundu & Urewe Traditions in Southern Africa (Huffman 2007: 122)



Matola (Silver Leaves) Facies of the Urewe-Kwale Tradition (Huffman 2007: 123)



Broederstroom facies (later than Matola) (Huffman 2007: 127)

The Later Iron Age

Around the turn of the first Millennium AD, Archaeologists have noticed the growing importance of Cattle in the economy of farmers as houses and grain bins were arranged around a central area for cattle. This settlement behaviour dubbed the "Central Cattle Pattern" commonly occurs in South Africa, with sites usually sited near water and good soils that could be cultivated with an iron hoe. The growing importance of Cattle in defining social and economic rank is seen at K2 at the confluence of the Shashi and Limpopo Rivers. Subsequently and nearby at Mapungubwe (approximately 80km from the Project Area) further transformation in the spatial organisation of settlements occurred where the "Central Cattle Pattern" changed into the Zimbabwe Pattern which defines political elites.

Various factors contributed to these cultural and settlement changes, but important was the surplus wealth from the East Coast Gold and Ivory trade and the intensive cultivation of the Limpopo flood plains. From about 1300 AD, there is evidence of Venda, and Northern Sotho settlement in the area north of the Soutpansberg. They are recognised by their distinctive pottery, known after the farm Icon where the pottery was first found. After 1400 AD, there appear to have been movements from across the Limpopo River introducing the Zimbabwe-Khami culture. Early Venda history is a subject of on-going debate and research (Nemaheni, pers. com).There appear to be three chronological layers representing intrusions by the Ngona, Lembethu/Mbedzi/Thavhatsindi and Singo groups, possibly all coming from across the Limpopo River in that order.

Two stonewalled sites have been confirmed one in the Mopane Project Area and Chapudi Project, namely Verdun and Machema respectively. Both ruins fall within the Mapungubwe-Thulamela-Dzata continuum. Dzata, which dates to the 18th century, appears to be the youngest of the Zimbabwe type settlements, and is located approximately 40km to the east of the Mopane Project Area.

Various LIA facies have been identified on the basis of pottery typology and radiocarbon dates.

- Moloko (Sotho-Tswana) Branch
- Icon facies AD 1300 – 1500: This pottery is associated with the first Sotho Tswana people entering the country.
- Eiland facies AD 1000 – 1300
- Mapungubwe facies AD 1250 – 1300
- Mutamba facies AD 1250 – 1450
- Khami facies AD 1430 – 1680
- Thavhatshena facies AD 1450 – 1600
- Letaba facies AD 1600 – present

Letaba pottery is associated with modern day Venda people and can be found in any Venda village.

1.4.2.1.3 Other Heritage Concepts

Historical Archaeology

The frame of archaeological application is extended to cover the historical period. Archaeological evidence can be used to complement the large corpus of historical and oral data. One archaeologist has noted that, "one rule … is that documentary and archaeological data are kept distinct to avoid circular arguments as one is tested against the other". In other words written and oral documents are seen as independent sources of data.

The coming of the Voortrekkers in the area and the introduction of commercial farming in the 19th and early 20th centuries has a strong archaeological footprint in the Mopane Project Area. We noted a prevalence of house remains associated with pioneer commercial farmers and shifting semi-permanent dwellings of farm workers. Several graves both with inscriptions and "anonymous" mostly associated with pioneer farmers or their workers were also recorded. Archaeology of the historical and industrial periods brings forth new terminology – historical archaeology and industrial archaeology - to denote emerging sub-disciplines which find relevant application to this study, even if to complement the corpus of written records.

Cultural Landscapes

Over the past twenty years a territorial approach to heritage has shifted emphasis from sites to the recognition of broad territorial attributes of heritage. Within the international discourse which has ensued, a genre of heritage called Cultural Landscapes has emerged. Article 47 of the Operational Guidelines for the Implementation of the World Heritage Convention (2005) defines Cultural Landscapes as:

Cultural landscapes are cultural properties that represent the "combined works of nature and of man" designated in Article 1 of the World Heritage Convention. They are illustrative of the evolution of human society and settlement over time, under the influence of the physical constraints and/or opportunities presented by their natural environment and of successive social, economic and cultural forces, both external and internal.

Broadly, the Project Area, which is approximately 80km from Mapungubwe, may be considered as part of the Greater Mapungubwe Cultural Landscape. The following genres of cultural landscapes have been encountered:

Organically evolved cultural landscapes result from an initial social, economic, administrative, and/or religious imperative and have developed its present form by association with and in response to its natural environment. Such landscapes reflect that process of evolution in their form and component features. They fall into two sub-categories:

- A relict (or fossil) landscape is one in which an evolutionary process came to an end at sometime in the past, either abruptly or over a pera period. Its significant distinguishing features are, however, still visible in material form; and
- A continuing landscape is one which retains an active social role in contemporary society closely associated with the traditional way of life, and in which the evolutionary process is still in progress. At the same time it exhibits significant material evidence of its evolution over time.

Associative cultural landscapes have powerful religious, artistic or cultural associations of the natural elements rather than material cultural evidence, which may be insignificant or even absent.

Intangible Cultural Heritage

The elevation of Intangible Cultural Heritage has evolved out of a post-colonial discourse largely nurtured in the developing world. South Africa has participated actively in the debates which culminated in the UNESCO Intangible Heritage Convention passed in 2003.

The "intangible cultural heritage" means the practices, representations, expressions, knowledge, skills – as well as the instruments, objects, artefacts and cultural spaces associated therewith – that communities, groups and, in some cases, individuals recognize as part of their cultural heritage. This intangible cultural heritage, transmitted from generation to generation, is constantly recreated by communities and groups in response to their environment, their interaction with nature and their history, and provides them with a sense of identity and continuity, thus promoting respect for cultural diversity and human creativity. Intangible values give meaning to heritage sites.

1.4.2.2 Results

1.4.2.2.1 Current Conservation Status of Heritage Resources in the Project Area

The Mopane Project Area is under various land use systems including commercial farming (cattle ranching, game farming and crops). While it is noted that archaeological sites under plantation and irrigation fields have been disturbed, these new activities have also created a cultural landscape layer of heritage value. Cattle and game farming is practiced and it is noted that archaeological sites tend to remain stable under such conditions. The area still retains good natural woodlands some of which are fine examples of forest product harvest cultural landscapes.

1.4.2.2.2 Summary Data on Heritage Resources

One hundred and seventy-seven (177) heritage sites have been recorded under 7 typologies as follows:

	Heritage Typology	Quantity/Description
1	Provincial Sites (Grade 2)	1 Stonewalled site
2	Burial Sites	40
3	Stone Age Archaeological Sites	9
4	Later Iron Age archaeological Sites	45
5	Sites of the Commercial Farming Period (historical archaeology)	66
6	Cultural Landscapes (forest products)	34
7	Historic Buildings (Section 34)	3

A ranking system (refer to the HIA report in ANNEX-8 for further detail) has been used to isolate sites that will need attention before or during the operation phase of the project. Seventy-seven (77) heritage sites have been prioritized under Categories 1 and 2 as deserving the highest attention before or during the operation phase of the project.

	Ranking	Explanation	No of sites
1	Very high	One provincial heritage site, Verdun Ruins (Section 7 of NHRA), must not be disturbed. All burials (Section 36 of NHRA) require stakeholder consultations before relocation or other mitigation measures are considered.	42
2	High	Substantial archaeological deposits, buildings protected under Section 34 of NHRA. They require mitigation.	35
3	Medium	Mostly cultural landscapes (Mopani, Baobab, Marula stands) including modern farmsteads. They also include archaeological sites of lesser importance. They may require mitigation.	32
4	Low	Heritage sites deemed of less importance. The minimum requirement is that the sites have been recorded. Decisions on mitigation will be made by a heritage expert including options of destruction with or without salvage.	68
		TOTAL	**177**

The conclusions from the HIA are that:

- Seventy-seven (77) heritage sites must be prioritized under Categories 1 and 2 as deserving the highest attention before or during the operation phase of the project – refer to Figure 55 and Figure 56. These sites include 40 graves which may require consultation with local communities and other stakeholders before any action on them is considered. These prime sites marked in amber and orange are proposed for Phase II assessments. This means that if a grave will definitely be affected, then its relocation must be considered. The other sites will deserve further investigation (if they will be affected). Archaeological sites will require excavation and surface collection of artefacts.
- Material obtained from excavations will be deposited in Museums. Alternatively the Mine can establish its own holding facilities and/or exhibition/interpretive centre.

- Historic buildings will require further study and management guidelines. Management guidelines will include basis for decisions for retention or disposal. A case by case approach is recommended, i.e. each case according to its merits.
- Verdun Ruins must be treasured as a potential focal point of educational and touristic programmes.
- Thirty-two (32) heritage sites are considered to be of medium significance. These include cultural landscape exemplifying non-timber forest product exploitation. The fate of Baobab trees in the mineral extraction areas must be decided in consultation with SAHRA and other stakeholders, as it is difficult to make a unilateral decision on these trees given their importance. An interdisciplinary decision is required i.e. broad consultation with environmentalists. In practical terms it will be difficult to save all baobabs trees in a mining operation of the scale envisaged. A case by case approach is therefore favoured. Generally our view is that sites of medium significance, except Baobab trees, may go since they have been recorded.
- Sixty-eight sites (68) are considered to be of less importance. As they have been recorded as minimum requirement, they may be disposed of with or without salvage.

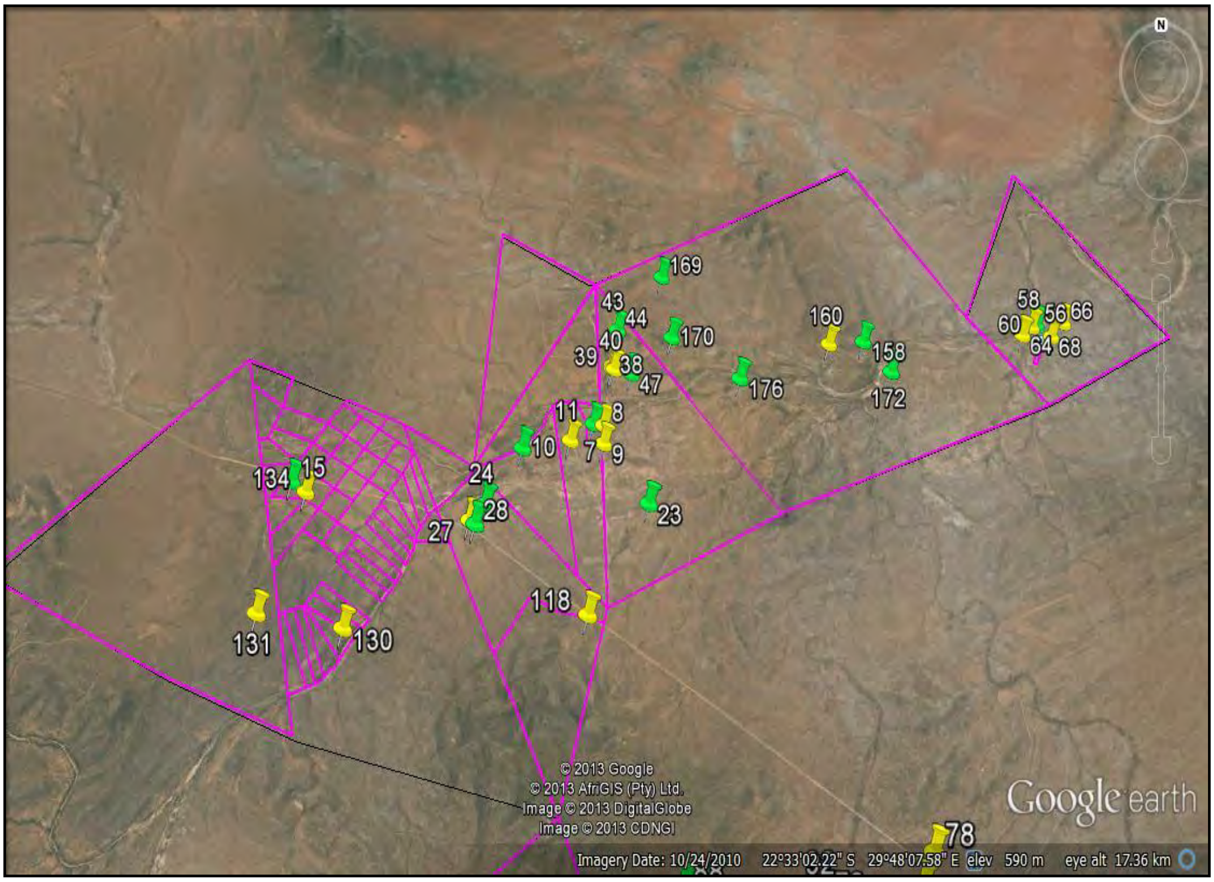


Figure 55: Priority heritage sites in the Voorburg Section (Left to right - Farms Vera Plots Banff, Delft, Ancaster and Voorburg) Yellow = Burials, Green = other sites

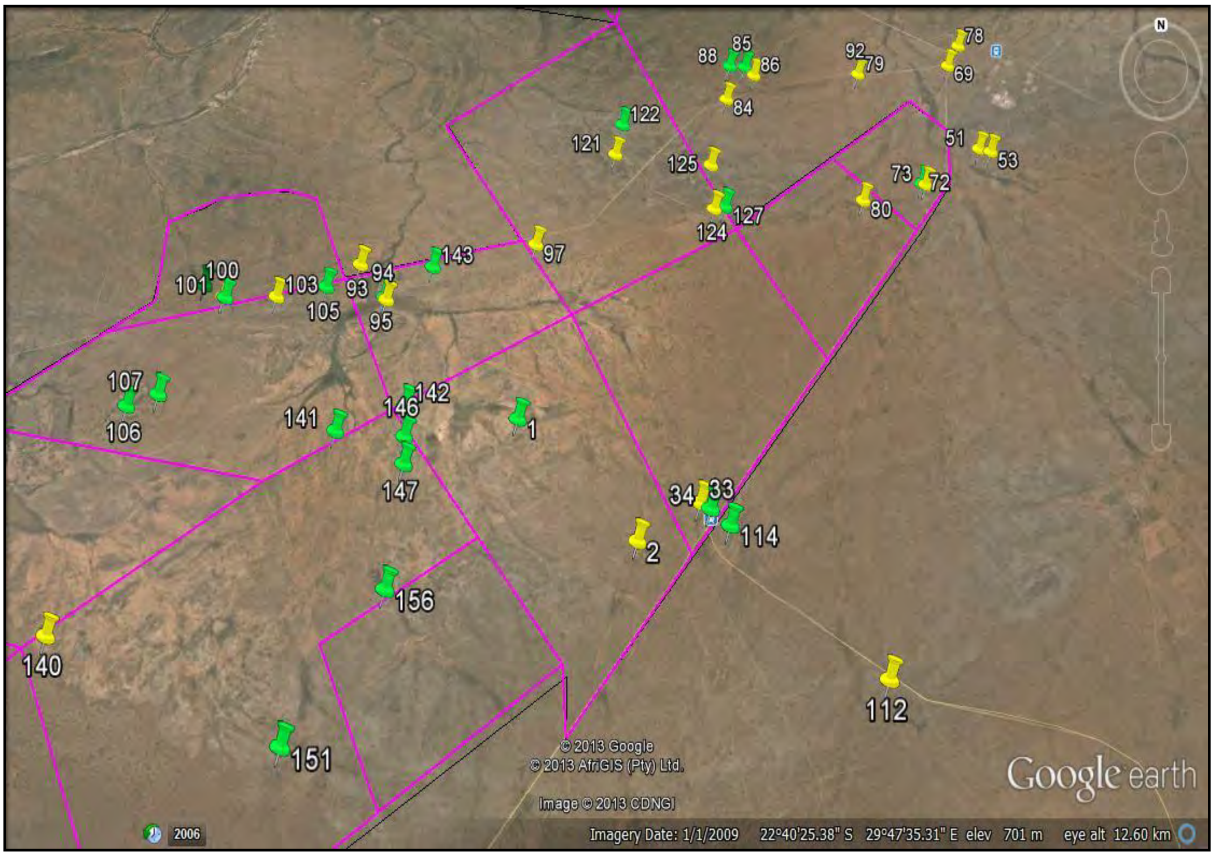


Figure 56: Priority heritage sites in the Jutland Section (Farms Cohen, Honeymoon, Jutland, Hermanus, Verdun, Pretorius 1 & 2, Vrienden, Van der Bijl, and Kitchener). Yellow = Burials, Green = other sites

1.4.3 INFRASTRUCTURE (BUILT ENVIRONMENT)

The Mopane Project is situated in the magisterial district of Vhembe, in the Limpopo Province, approximately 40 km (direct) and 63 km (via road) north of the town Makhado and 7 km west of Mopane in the Musina and Makhado Local Municipal areas. The nearest town is Musina, situated approximately 30 km to the north – refer to Figure 2. Musina and Makhado are connected by well developed road infrastructure.

The Mopane Project, consisting of the Voorburg and Jutland Sections (Figure 3), is well situated with respect to major infrastructure, including rail, road and power. The Mopane Railway Station is situated between the Voorburg and Jutland Sections to the east and is linked to the N1 with a surfaced road of 7 km length. The Jutland Section is traversed by the R525 road between Mopane and Alldays. Private roads to connect mine infrastructure will need to be established.

Access to the Mopane Project Infrastructure Hub is by way of the N1 towards Musina, turning west onto the D525 approximately 7 km to Mopane Railway Station. The main entrance to the Jutland Section is approximately 3 km south from Mopane Railway Station adjacent to the gravel road along the railway line. The D525 Provincial Road is a surfaced road which will be upgraded should it be necessary to carry the required future traffic loads. The existing access road to the mine infrastructure from Mopane Railway Station is gravel but will be surfaced during the mining development. The access to Voorburg Section is along the R525 approximately 7 km north west of Mopane Railway Station.

Mopane Project is close to the railway line running southwards from Beitbridge / Musina and is an important link to the main hub of the Transnet Freight Rail (TFR) network connecting at Pyramid South, near Pretoria. An important junction occurs at Groenbult, where a connecting line joins the Hoedspruit – Kaapmuiden – Komatipoort export channel avoiding the Pretoria complex.

There are no rural communities in the vicinity of the Mopane Project. The only settlement is that of the Mopane Town. There is a proposed development next to the Mopane Town for the development of 1 000 erven proposed by the Municipality. This development has recently obtained Environmental Authorisation.

1.5 SENSITIVE RECEPTOR MAP

A sensitive receptor for the purpose of this study is defined as a person or place where involuntary exposure to pollutants released by the proposed project could take place. Receptors surrounding the proposed site were identified from a site visit and through satellite imagery (Figure 57). They are as follows:

- The Mopane railway station which consists of a railway station, a school and a number of houses.
- Farm houses, guesthouses, lodges and local residences on farms.
- Schools located within the vicinity of the mining project.
- Clinics.

Other sensitive receptors within the area would be the local fauna and flora. It has been identified that dust may result in sickness and associated lung disease for wildlife and human which will arise as a result of mining operations.

The current land use activities and sensitive receptors within and surrounding the Mopane MRA area is discussed in detail in Sections 4.4 and 4.5 of the SEIA (ANNEX-9).

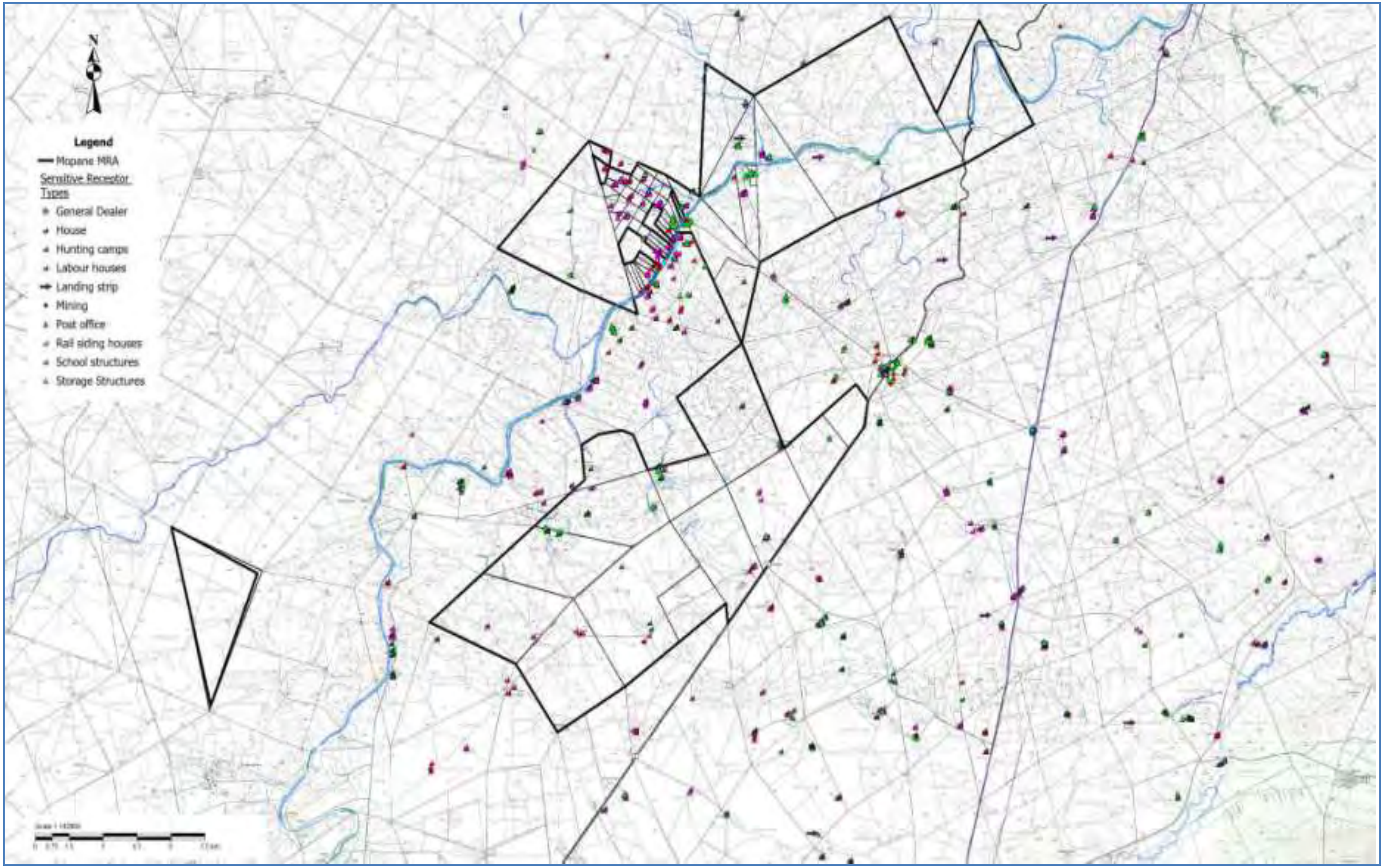


Figure 57: Sensitive receptor map for Mopane Project

1.6 SPECIALIST STUDIES

A number of specialist studies were performed for the Mopane Project, in line with the Plan of Study presented in the Scoping Report for the Mopane Project, June 2013. These are attached as Annexures as listed below.

Annexure	Aspect	Independent Consultant
ANNEX-1	Soils, Land Use & Capability	Gudani Consulting - EcoSoil Consortium
ANNEX-2	Surface Water	WSM Leshika Consulting (Pty) Ltd
ANNEX-3	Groundwater	WSM Leshika Consulting (Pty) Ltd
ANNEX-4	Biodiversity	Phaki Phakanani Environmental Consultants
ANNEX-5	Aquatic Systems	Scientific Aquatic Services
ANNEX-6	Ambient Noise	Gudani Consulting
ANNEX-7	Air Quality	Royal Haskoning DHV
ANNEX-8	Heritage Resources	Mbofho Consulting and Projects
ANNEX-9	Socio-Economic Aspects	Naledi Development Restructured (Pty) Ltd
ANNEX-10	Macro-Economic Aspects	Mosaka Economic Consultants cc

2 PROPOSED MINING OPERATION

2.1 MINERAL TO BE MINED

The Mopane Project has the potential to produce good quality semi soft coking coal and a domestic thermal coal product. Measured and indicated resources are approximately 633.48 million tonnes mineable in situ.

The resource outcrops and dips predominantly to the north. It is estimated that in most instances it is mineable to a depth of 200 m through open cast methods. Due to the flat dipping nature of the coal resource a normal strip open cast mining method is likely to prove the most cost effective.

The current planning is that construction and mining will commence at the Voorburg Section first, followed by the Jutland Section as capacity in infrastructure is developed. The Voorburg Section will be mined at 2.5 million tonnes per annum (Mtpa) product for a period of 33 years followed by the Jutland Section mined at 2.5 Mtpa product for a period of 28 years.

From the date of granting of the mining right (anticipated to be in 2015) further exploration, feasibility studies and final design studies will be undertaken. Construction is anticipated only to commence in 2018. Production at the Voorburg Section will commence in late 2019 and build up to 4 Mtpa Run-of-Mine (RoM) (2.5 Mtpa product) by 2020. Due to rail logistics constraints, mining at the Voorburg Section continues for ± 33 years to exhaustion of the resource.

It is expected that additional rail capacity will become available after 2030, allowing for an increase in coal production. Mine development at the Jutland Section will therefore commence in 2030 with first production in 2032. To cater for the additional production from 2033 onward, a further coal beneficiation plant will be required at the Jutland Section and a new Rapid Load-out Terminal (RLT) will be built at the rail loop.

The total life of the Mopane Project is in excess of 50 years.

The Soutpansberg Coalfield is situated north of the Soutpansberg Mountain Range in the Limpopo Province stretches for ± 190 km from Waterpoort in the west to the Kruger National Park in the east. The Soutpansberg Coalfield can be divided into 3 separate coal fields i.e. the Mopane Coalfield, the Tshipise Coalfield and the Pafuri Coalfield. The Pafuri Coalfield terminates at the northern limit of the Kruger National Park in the east.

The Mopane and Tshipise Coal fields are host to the Makhado Colliery as well as the GSP projects, including the proposed Mopane Project – Figure 58.

The regional geology consists of 3 main lithological groups i.e. The Limpopo Mobile Belt, the Soutpansberg Group and the Karoo Sequence rocks:

- The ***Limpopo Mobile Belt*** (LMB); forms the gneissic basement on which the overlying strata (Soutpansberg Group and the Karoo Sequence) was deposited. The LMB rocks are the metamorphic expression of the collision and welding together of the Kaapvaal craton and the Zimbabwe craton. The LMB has a long and complex history of deformation occurring from 3200 Ma (million years) to 2000 Ma. The LMB gneisses are made up of inter-cratonic sediments and volcanics, deformed and metamorphosed to granulite facies and intruded and by granite bodies which have themselves been metamorphosed to varying degrees. The rift fault systems controlling the various basins, in which the Soutpansberg and Karroo strata have been preserved, are major zones of crustal weakness preferentially re-activated during periods of tectonic instability over time.

- The ***Soutpansberg/Waterberg Group*** strata were deposited into rift basins controlled by these major fault systems between 1900 Ma and 1600 Ma. The strata consist of basaltic lavas, arenites and shales attaining a maximum preserved thickness of 5000m. Dips can vary from 20° to 80° to the north.
- The ***Karoo Sequence*** strata were deposited on LMB basement and/or Soutpansberg Grp. strata between 300 – 180 Ma. Karoo deposits are preserved in the same reactivated rift basins and are often terminated against major east-west trending faults on their northern margins. The dips are between 3° and 20° to the north with coal located at the base of the sequence. The nature of the coal deposits changes from a multi-seam coal-mudstone association (7 seams) approximately 40m thick in the west (Mopane Coalfield), to two thick seams in the east (Pafuri Coalfield in the Tshikondeni area).

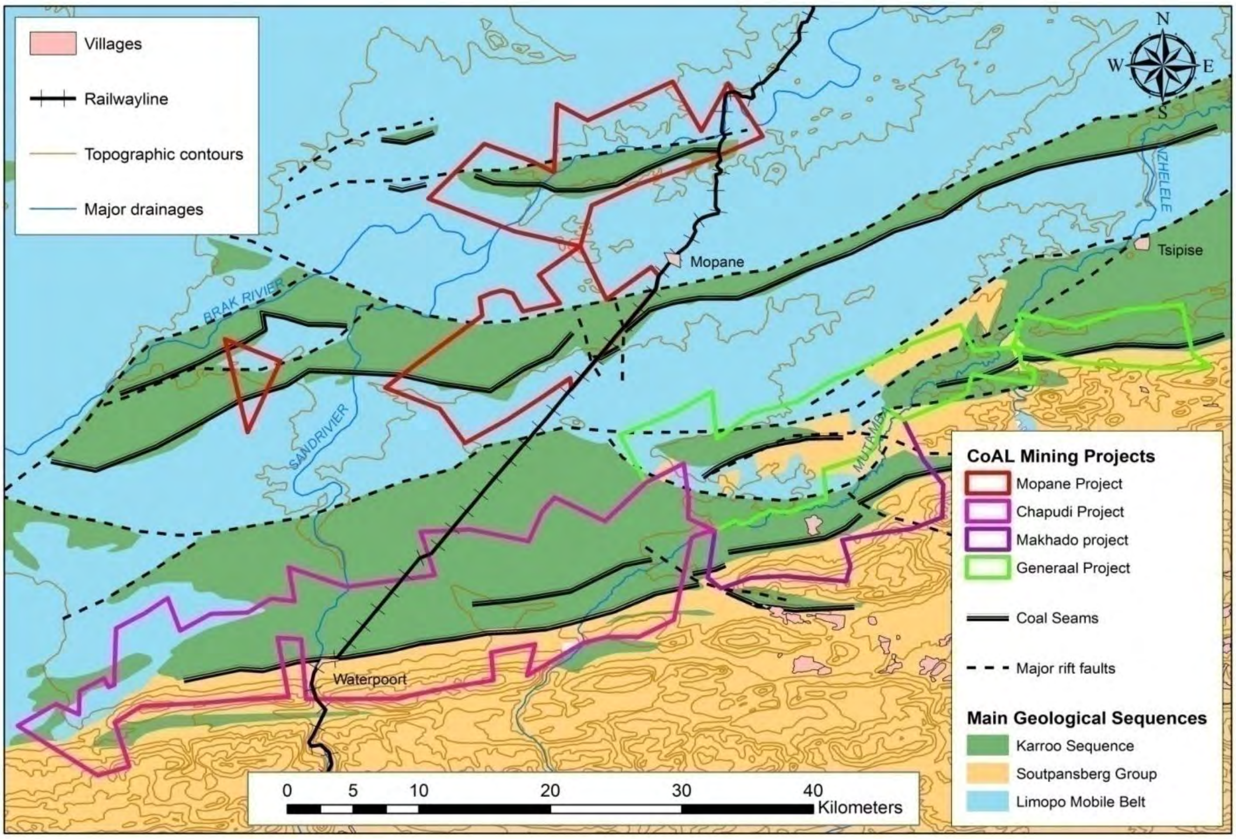


Figure 58: Regional geology in relation to the GSP projects

The Mopane Project consists of the Voorburg Section and the Jutland Section where Karoo sediments have been deposited directly onto gneissic basement and preserved in two separate fault bounded basins. For purposes of representation the Karoo Sequence is divided into Lower Karoo, Middle Karoo, the Clarens Fm and the Letaba basalts. See Figure 59 and Figure 60 for local geological map and cross-section.

The Lower Karoo consists of a basal glacial deposit overlain by carbonaceous and coaliferous mudstones. From oldest to youngest the stratigraphy is as follows:

- Tshidzi Formation; a 10m thick basal conglomerate/diamictite and can be correlated to glacial Dwyka Tillite in the main Karoo basin.
- The Madzoringwe Formation; a succession of alternating black shale, micaceous sandstone, siltstones and inter-bedded coal seams attaining a thickness of 190m. The coals seams have economic potential.
- The Mikambeni Formation overlying the above consists of dark grey mudstone and shale with subordinate sandstone attaining an approximate thickness of 140m. The Madzoringwe and Mikambeni Formations can be correlated with the Ecca Group of the main Karoo basin.

The Middle Karoo consists of overlying fluvial deposits made up of sandstones and grey, purple and red mudstones. The stratigraphy is as follow:

- The Fripp Sandstone Formation consists (10 – 20 m) of coarse feldspathic sandstone or “grit” and often forms a ridge on outcrop and marks a change from a mature meandering river depositional environment to a braided stream environment.
- The Solitude Formation; is a 110m thick inter-layered grey and purple shale with minor sandstone and grit intercalations.
- The Klopperfontein Formation (10 – 20 m) resembles the Fripp Sandstone Formation as a coarse, feldspathic “gritty” sandstone.
- The overlying Bosbokpoort consists of red very fine sandstone and dark red silty mudstone.
- The fluviatile Red Rocks Member (150 m) of the overlying Clarens fm. is also placed in the Middle Karoo strata.

The Tshipise Member (150 m) of the Clarens Formation caps the underlying fluvial sediments with aeolian sands as the final expression of sedimentary deposition in an ever increasingly arid environment.

The Letaba basalt ends Karoo Sequence deposition with widespread outpouring of continental lavas, heralding a period of tectonic instability and the start of the break-up of Gondwanaland. Dolerite sills and dykes served as feeders to the basalt lava and are the hyperbyssal component of this event.

Voorburg Section

The complete Karoo sedimentary package (no basalt) is preserved in this half graben basin. The Fripp Formation forms a small flat topped ridge into which the Lilliput Shaft was excavated (Figure 60).

The sediments are again truncated along its’ northern margin by a WSW trending rift fault with a down-throw of approximately 1,000m to the south. The strata on average dip at 5°N. Of all the exploration holes drilled in the past to present, only one hole intersected dolerite.

Jutland Section

The complete package of Karoo sequence strata from the basalts to the basal tillite is preserved in this half graben. Clarens sandstone forms prominent hills, surrounded by flat plains consisting of basalt to the north and mudstone to the south. The general dip is 10º - 12º to the north, terminating against a regional rift fault along the northern margin.

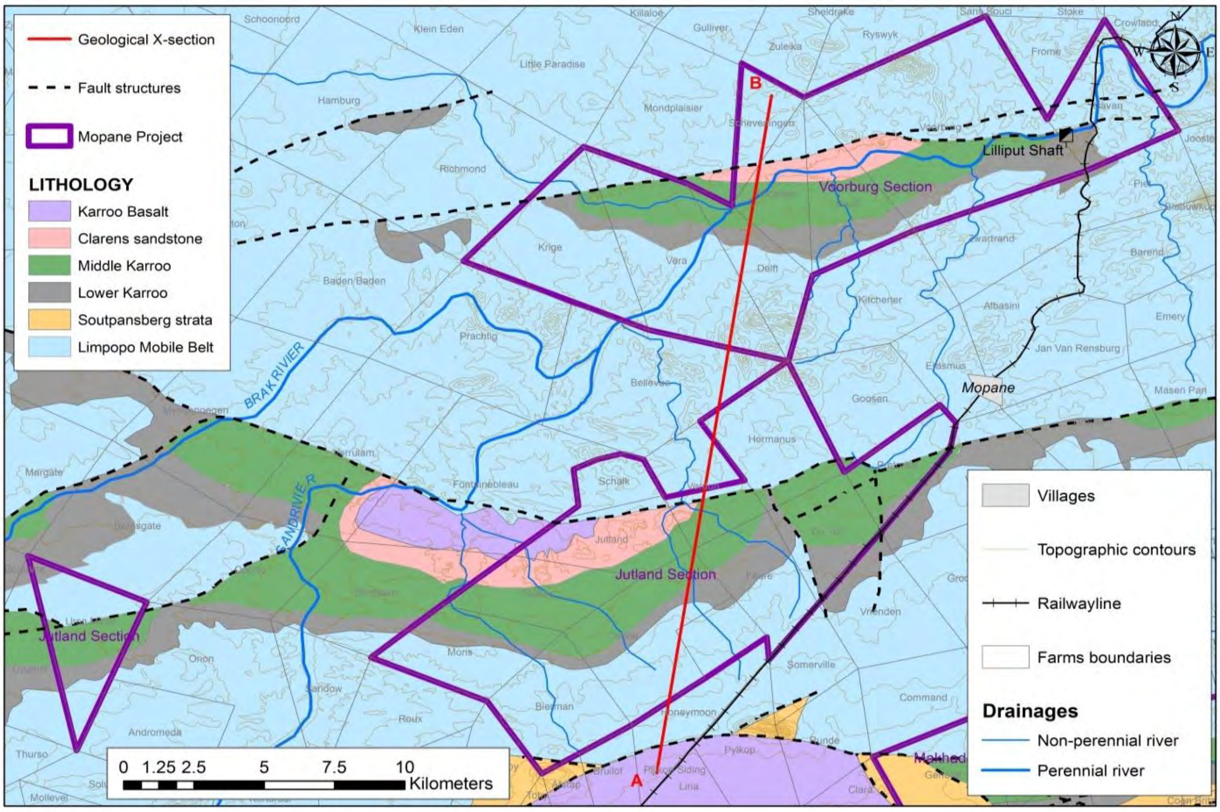


Figure 59: Mopane Project geology

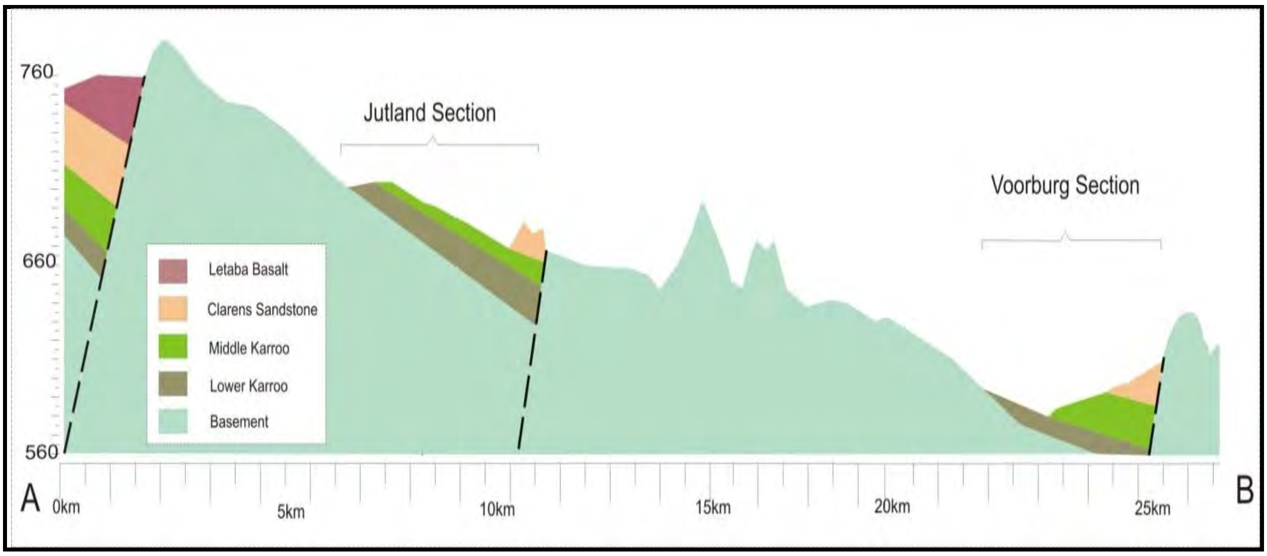


Figure 60: Mopane Project geological cross-section

2.2 EXTENT OF THE OPERATION

The Mopane Project footprint covers an area of 1 572 ha for mining and a further 1 964 ha for infrastructure development. The Voorburg mining pits cover approximately 905 ha and the Jutland mining pits a further 667 ha. The elongated mine footprint of the Voorburg mining pit is restricted by the Sand River running along the northern side of the mining pit.

The mining and infrastructure layouts are shown in Figure 61. This picture demonstrates the extent of mining and is not a moment in time. The pits will be backfilled concurrent to mining and it is anticipated that no more than 600 ha will be open at any one time.

Infrastructure to support the mining activities has been laid out and engineered to best suit the topography and mining pit layouts, but can be influenced by the environmental impact assessments and stakeholder engagement process.

Although the mining operation will start at the Voorburg Section, the centre of gravity for the infrastructure layouts will be on the farm Pretorius 531 MS next to Mopane Railway Station. The Voorburg Section will however be provided with a workshop and other necessary infrastructure required for the mining operation.

The centrally located Infrastructure Hub (at the Mopane Railway Station) will comprise the coal beneficiation plant, personnel support structures, vehicle support structures, water management structures and management and monitoring systems. A conveyor will be utilised to transport the ROM from the Voorburg Section to the coal beneficiation at the Infrastructure Hub.

Other mine infrastructure includes:

- Access and on-site haul roads
- Topsoil stockpiles and berms
- Overburden (carbonaceous and non-carbonaceous) stockpiles for initial placement, thereafter disposed in-pit
- ROM coal storage area
- ROM coal processing plant (primary, secondary and tertiary crusher)
- Associated conveyors from the processing plant to the product storage areas
- Product stockpile areas
- Carbonaceous discards stockpile
- Storm water management infrastructure (i.e. clean & dirty water run-off)
- On-site water management and reticulation systems
- Change houses and offices
- Wastewater (sewage) treatment plant
- Bulk electricity supply infrastructure
- Bulk water supply infrastructure
- Railway Siding and rail loop
- Rapid Load-out Terminal (RLT)

Once mining commences in the Jutland Section, further expansion of mine support infrastructure as well as an expansion to the coal beneficiation plant will be required.

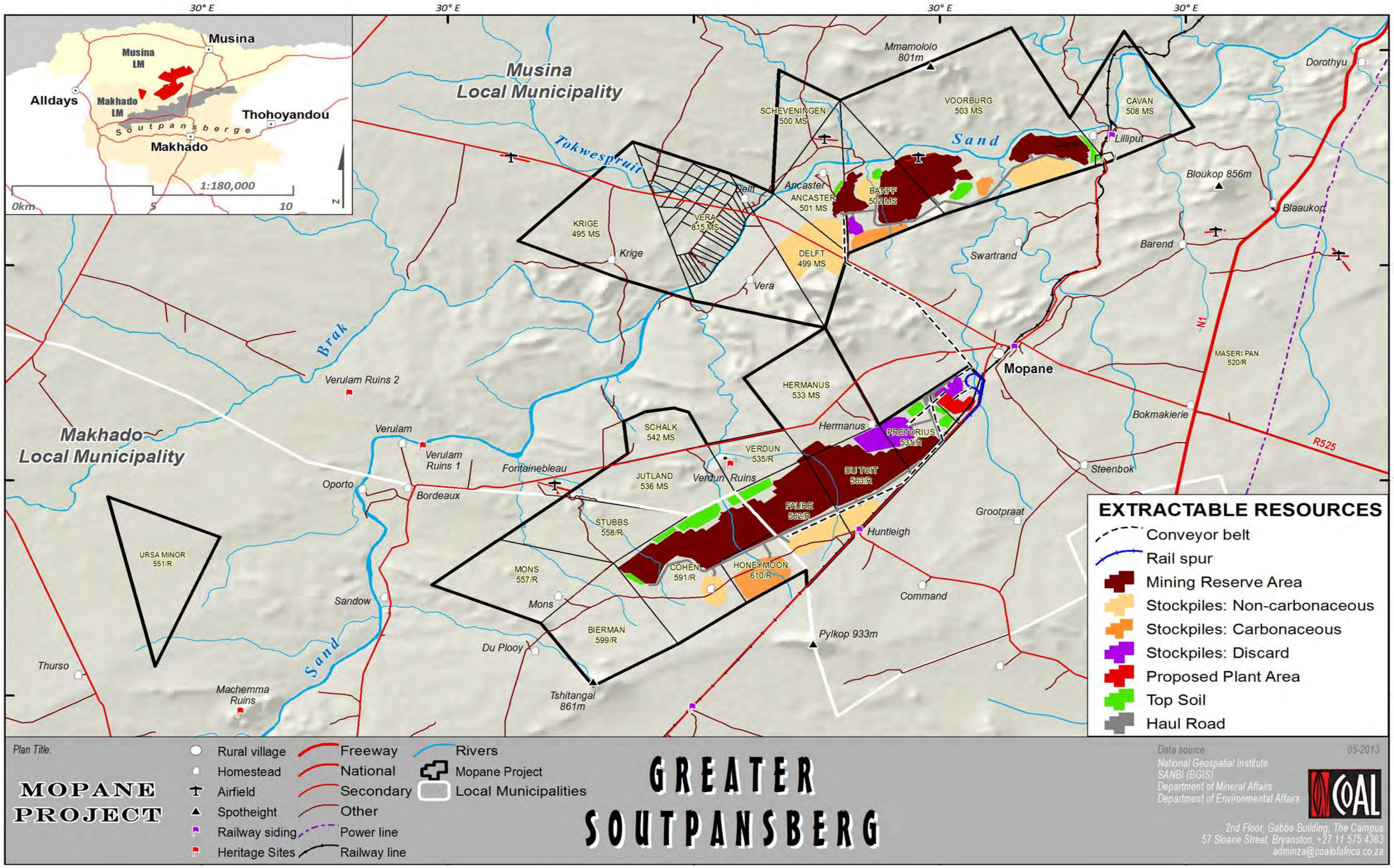


Figure 61: Mining and infrastructure layout for Mopane Project

2.3 MINING OPERATIONS

2.3.1 MINING METHODOLOGY

The Mopane Project has the potential to produce good quality semi soft coking coal and a domestic thermal coal product. Measured and indicated resources are approximately 633.48 million tonnes mineable in situ.

The resource outcrops and dips predominantly to the north. It is estimated that in most instances it is mineable to a depth of 200 m through opencast methods. Due to the flat dipping nature of the coal resource a normal strip opencast mining method is likely to prove the most cost effective.

Mine design has been based on development at a coal production rate at 4 Mtpa RoM for the full LoM production. This production profile yields sales tonnages of about 2.5 Mtpa, split between coking and thermal coal. The average yield for the wash plant is 26% for the coking product and 37% for the middlings thermal coal (30% ash). The overall yield is 63%. This profile extracts a reserve estimated to be 133 Mt over the full 33 years.

Coal will be mined with a conventional truck and shovel operation. Coal is modelled to be mined by excavators with a capacity of 1400 bank cubic metres per hour (bcm/h). Interburden units are modelled to be mined by excavators with a capacity of 1500 bcm/h. Overburden units are modelled to be mined by excavators with a capacity of 1650 bcm/h.

Recovery operations are intended to be conducted by large hydraulic excavators in backhoe configuration to manage the complexity of the deposit. Within the first 12 years of mine development, the annual waste movement varies from 14 to 24 million bank cubic metres (Mbcm) at an average rate of 22 Mbcm. The remainder of mine life is operated at an annual average waste movement of 11 Mbcm.

A fleet of trucks at 220 tonne payload has been allocated for waste movement. Coal mining and reject haulage has been modelled with a fleet of trucks at 150 tonne payload. The scheduled waste demand to meet a 2.5 Mtpa coal product production rate is such that 1 coal excavator is required with 3 interburden excavators and 2 overburden excavators. The fleet will be exclusively diesel powered.

2.3.2 MINING SCHEDULE

The current planning is that construction and mining will commence at the Voorburg Section first, followed by the Jutland Section as capacity in infrastructure is developed. The Voorburg Section will be mined at 2.5 Mtpa product for a period of 33 years followed by the Jutland Section mined at 2.5 Mtpa product for a period of 28 years.

From the date of granting of the mining right (anticipated to be in 2015) further exploration, feasibility studies and final design studies will be undertaken. Construction is anticipated only to commence in 2018. Production at the Voorburg Section will commence in late 2019 and build up to 4 Mtpa RoM (2.5 Mtpa product) by 2020. Due to rail logistics constraints, mining at the Voorburg Section continues for ± 33 years to exhaustion of the resource.

It is expected that additional rail capacity will become available after 2030, allowing for an increase in coal production. Mine development at the Jutland Section will therefore commence in 2030 with first production in 2032. The total life of the Mopane Project is in excess of 50 years.

The basic mine layout and schedule over LOM for the Voorburg and Jutland Sections are shown in Figure 62 and Figure 63 respectively.

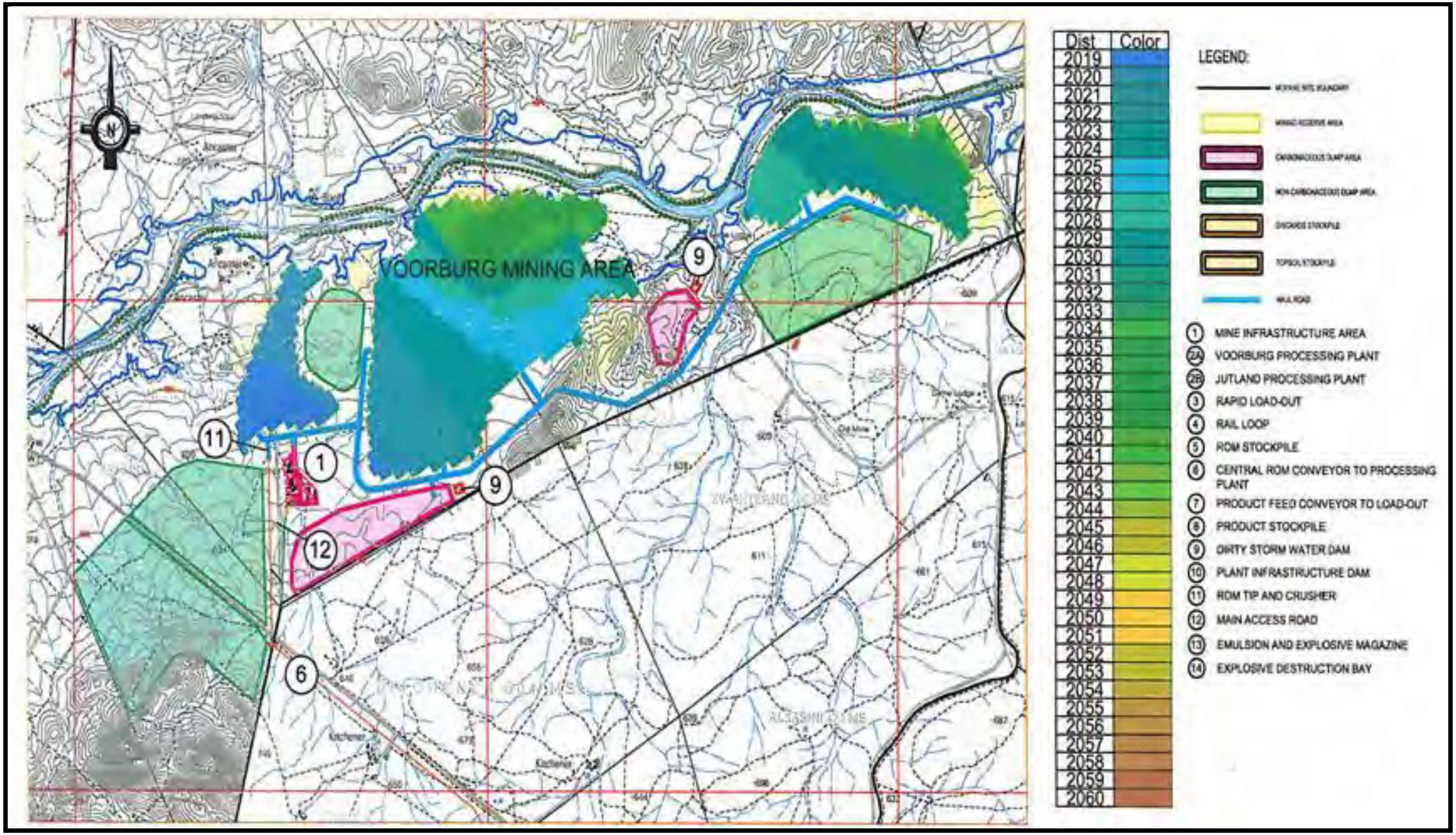


Figure 62: Mining layout and schedule for the Voorburg Section

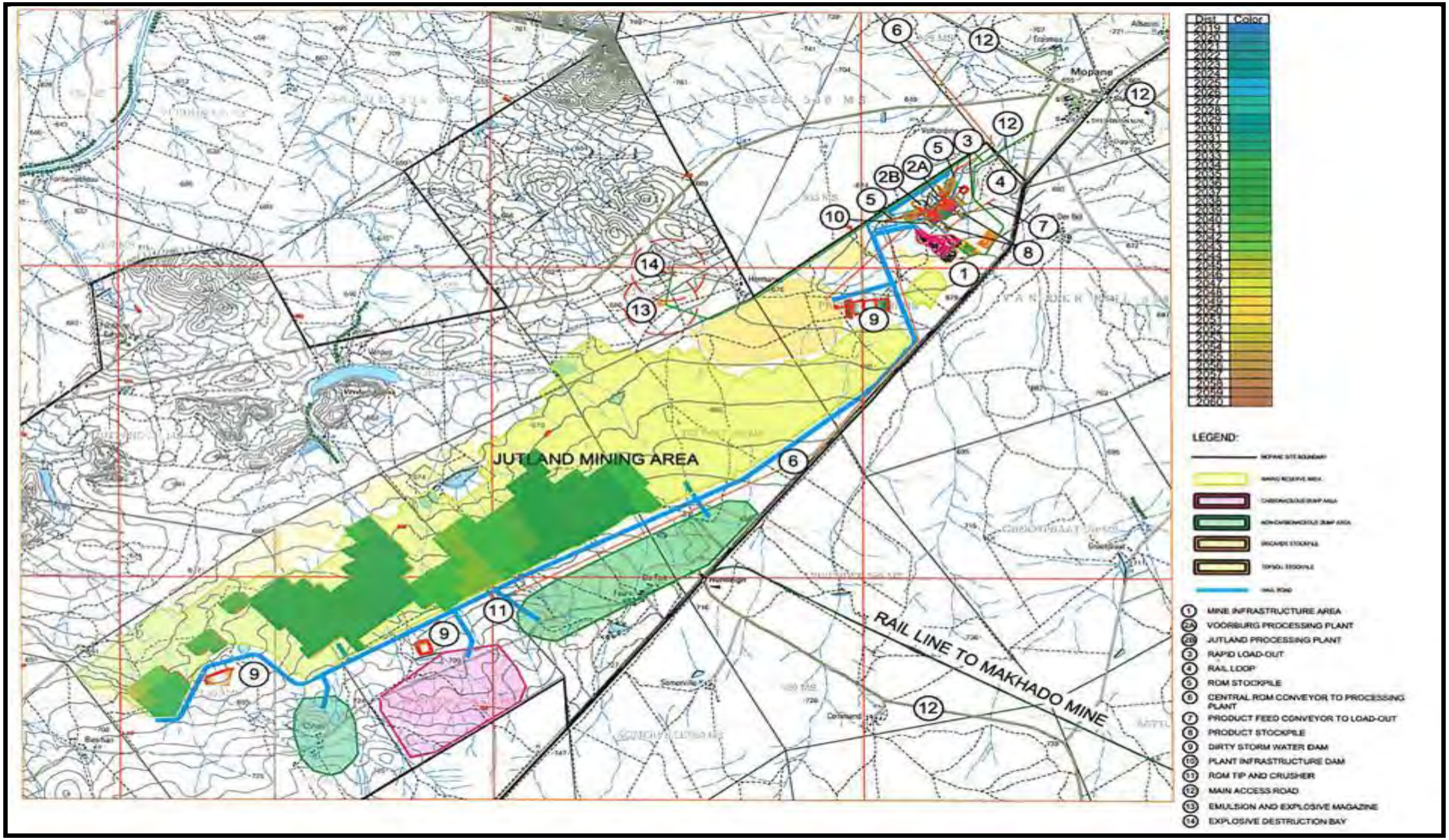


Figure 63: Mining layout and schedule for the Jutland Section

2.3.3 COAL PROCESSING

The first phase of development is to establish a coal beneficiation plant will process RoM coal from the Voorburg Section at a rate of 4 Mtpa and to establish a new facility (of the same capacity) to process RoM coal from the Jutland Section coming on-line a few years later. The mine schedules for the Voorburg and Jutland resources are similar in capacity but differ in yields of coking coal and middlings coal. It is therefore planned to install a plant of the same design to treat the Jutland resource next to the current proposed facility for the Voorburg resource – refer to Figure 64 for the expansion block flow diagram.

2.3.3.1 Design Overview

The proposed coal beneficiation plant is selected on the basis of using concepts that ensure efficient and effective beneficiation of the Mopane resource at the required quality within reasonable capital and operating costs. The technologies selected are well proven in the coal industry, that is, two-stage dense medium separation (DMS) for coarse coal (50 x 1mm) beneficiation using cyclone separators, up-flow classification for recovery of fine coal (1 x 0.3mm) using reflux classifiers and two-stage flotation using micro-bubble and conventional mechanical technologies for the recovery of ultra-fine coking coal (-0.3mm) product.

The coal beneficiation plant will produce two products namely a middlings product with an ash content of 30% and a coking product with an ash content of 10%. The processing plant will therefore use the following technologies:

- Two-stage DMS for coarse coal (50 x 1mm) beneficiation using cyclone separators to produce a coking and middlings product (refer to Figure 65 for block flow diagram);
- Two-stage of up-flow classification for recovery of fine coal (1 x 0.3mm) using reflux classifiers to produce a coking and middlings product (refer to Figure 66 for block flow diagram); and
- Two-stage flotation using micro-bubble and conventional mechanical technologies for the recovery of ultra-fine coking coal (-0.3mm) product.

The selection of dense medium cyclones allows for the treatment of raw coal with large variation in yield that will be treated during the proposed life of the mine. The use of two-stage reflux classifiers in the fines circuit improves the overall yield of the middlings product. The combination of different technologies in the flotation circuit improves the efficiency of separation of coking coal from ultra fine particles. The coarse products will be dewatered by centrifuges while the fines will be dewatered by filtration.

Fine tails will be dewatered using a thickener followed by tailings filtration before being discharged on a common discard conveyor feeding the discards stockpile. The development of the discards stockpile will be done in phases and will be compacted and the sides of the dump soil clad to reduce the risk of heating or spontaneous combustion.

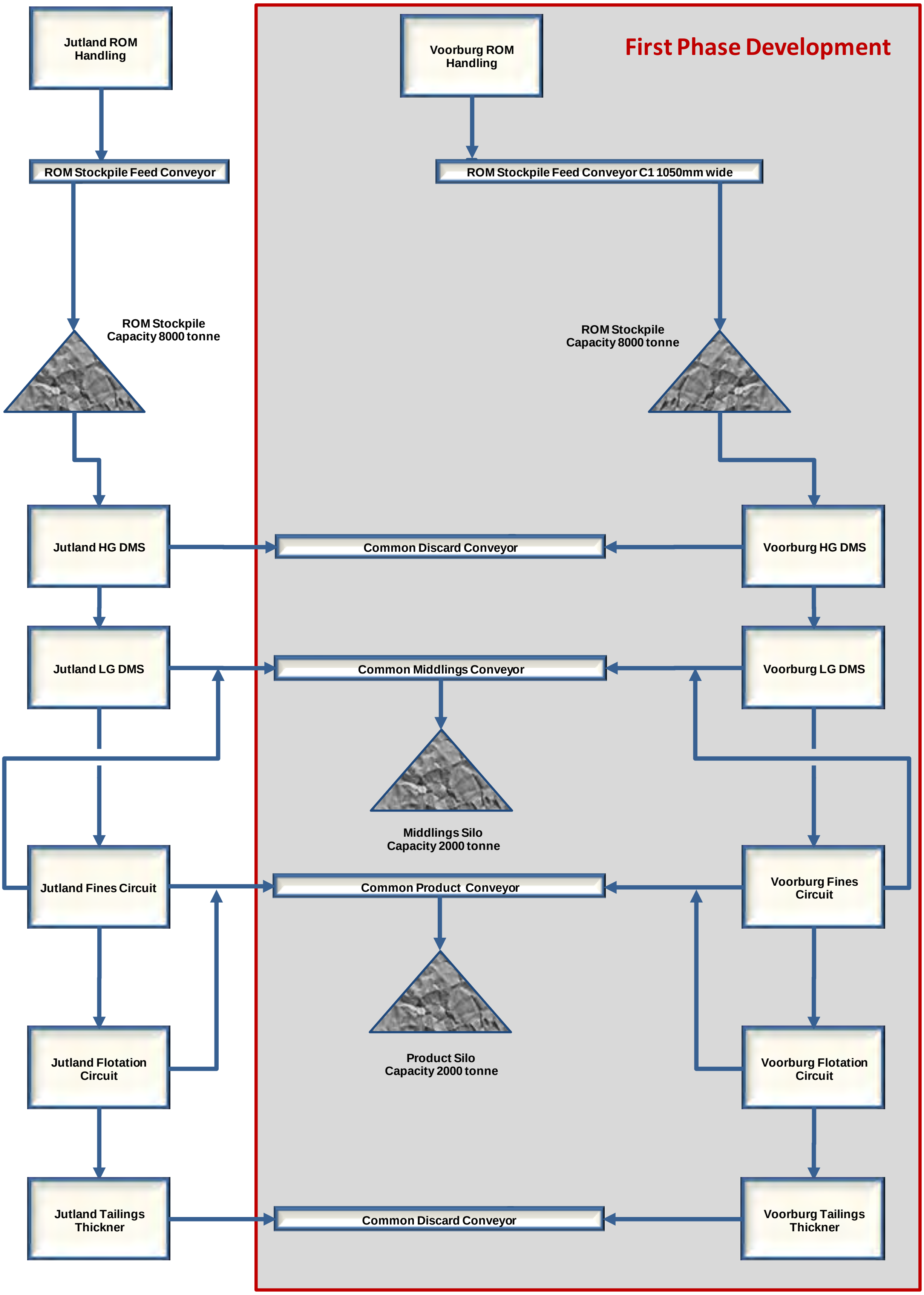


Figure 64: Expansion block flow diagram - Coal Beneficiation Plant

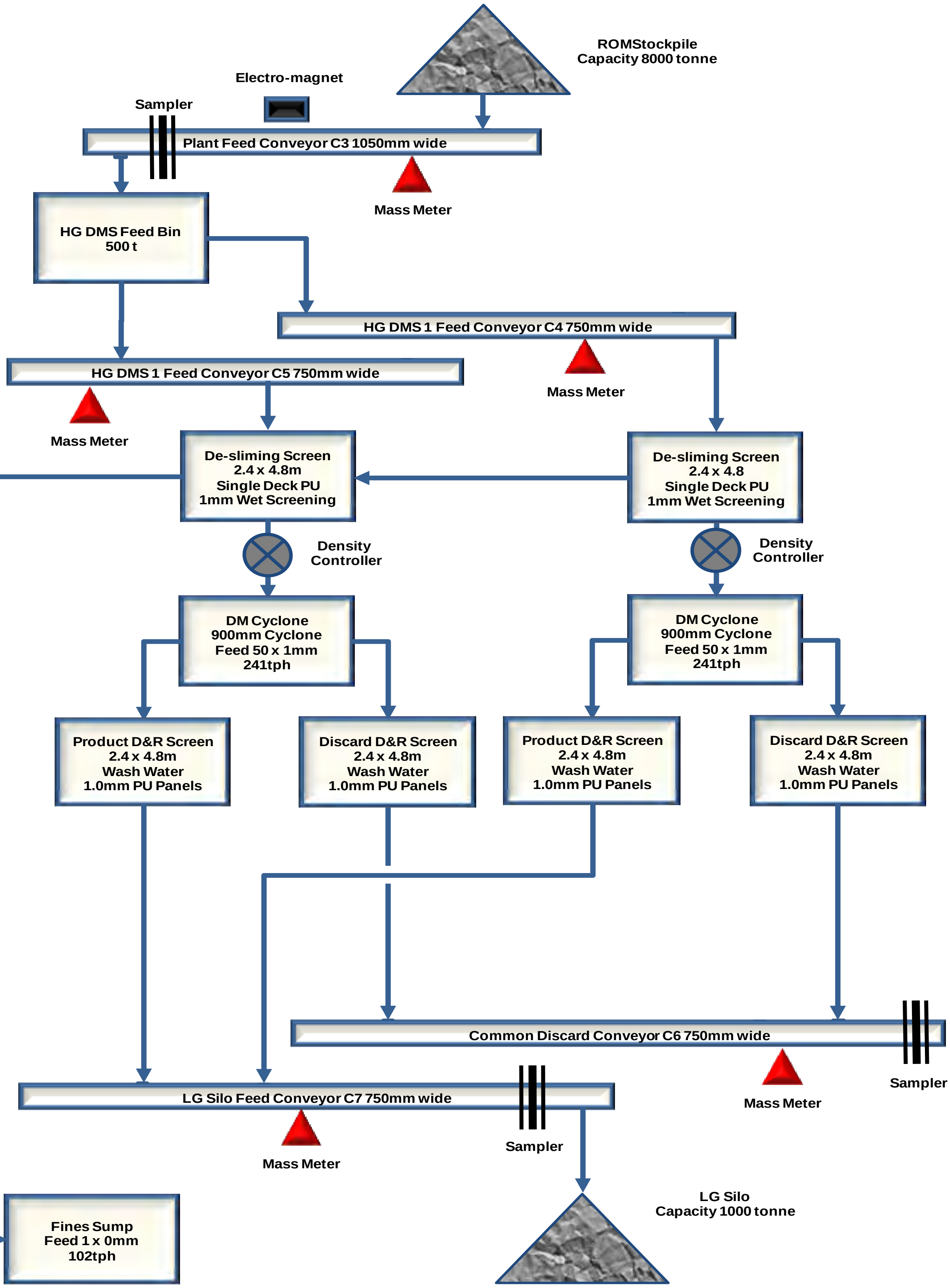


Figure 65: Coal beneficiation plant - block flow diagram DMS

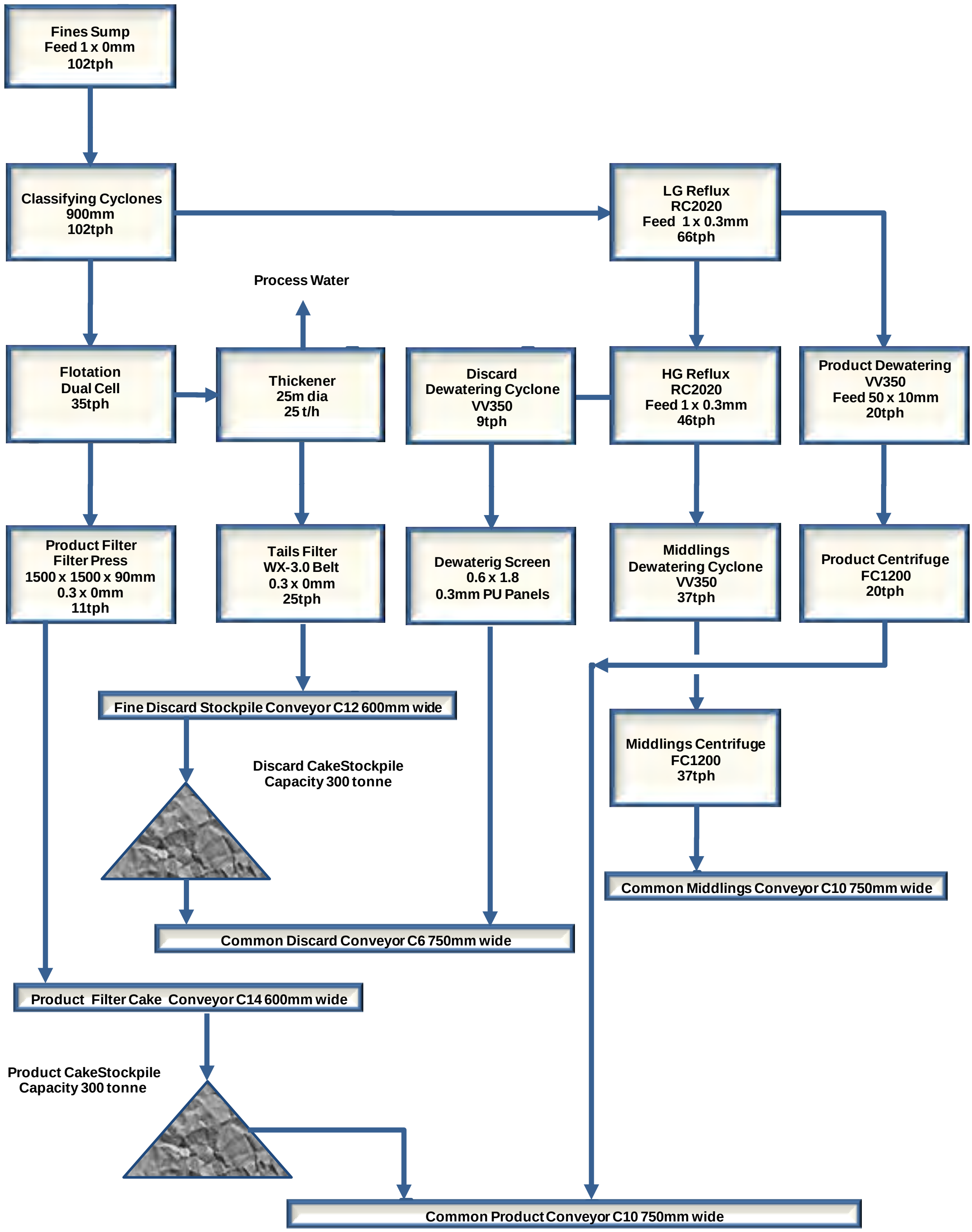


Figure 66: Coal beneficiation plant - block flow diagram Fines Plant

2.3.3.2 Product Handling

The coarse coking product (-50+1mm) from the DMS plant, fine coking product from the fines circuit (-1+0.3mm) and product filter cake from the product cake stockpile (-0.3mm) are transported to the 2,000 tonne product silo via a 750mm wide common product conveyor. The conveyor is fitted with a mass meter and an automatic sampler for metallurgical accounting purposes.

The product is withdrawn from the silo using a belt feeder that discharges onto common overland conveyors to transport final product to the RLT. The product silo has an overspill chute which feeds an emergency stockpile when the silo is full. The emergency stockpile has an additional 50,000 tonne holding capacity and the product from the emergency stockpile can be reloaded onto the overland product conveyor by means of a re-load conveyor that is fed using front-end loaders.

The coarse middlings (-50+1mm) from the DMS plant and the fine middling from the fines circuit (-1+0.3mm) are transported to the 2,000 tonne middlings silo via a 750mm wide common middlings conveyor. The conveyor is fitted with a mass meter and an automatic sampler for metallurgical accounting purposes.

The middlings silo feeds the common overland conveyors via vibrating feeders to transport middlings to the RLT. The common overland conveyors can only carry one product at a time to the RLT. The middlings silo has an overspill chute which feeds an emergency stockpile when the silo is full. The emergency stockpile has an additional 50,000 tonne holding capacity and the middlings from the emergency stockpile can be reloaded onto the overland product conveyor by means of a re-load conveyor that is fed using front-end loaders.

2.3.4 INFRASTRUCTURE

Although the mining operation will start at the Voorburg Section, the coal beneficiation plant is located centrally between the Voorburg and Jutland Sections close to the Mopane Railway Station on the farm Pretorius 531 MS. The Voorburg Section will however be provided with a workshop and other necessary infrastructure required for the mining operation.

The centrally located Infrastructure Hub (at the Mopane Railway Station) will comprise the coal beneficiation plant, personnel support structures, vehicle support structures, water management structures and management and monitoring systems – refer to Figure 67 for a layout plan.

A conveyor will be utilised to transport the RoM from the Voorburg Section to the coal beneficiation at the Infrastructure Hub.

Infrastructure to support the mining activities has been laid out and engineered to best suit the topography and mining pit layouts, but can be influenced by the environmental impact assessments and stakeholder engagement process.

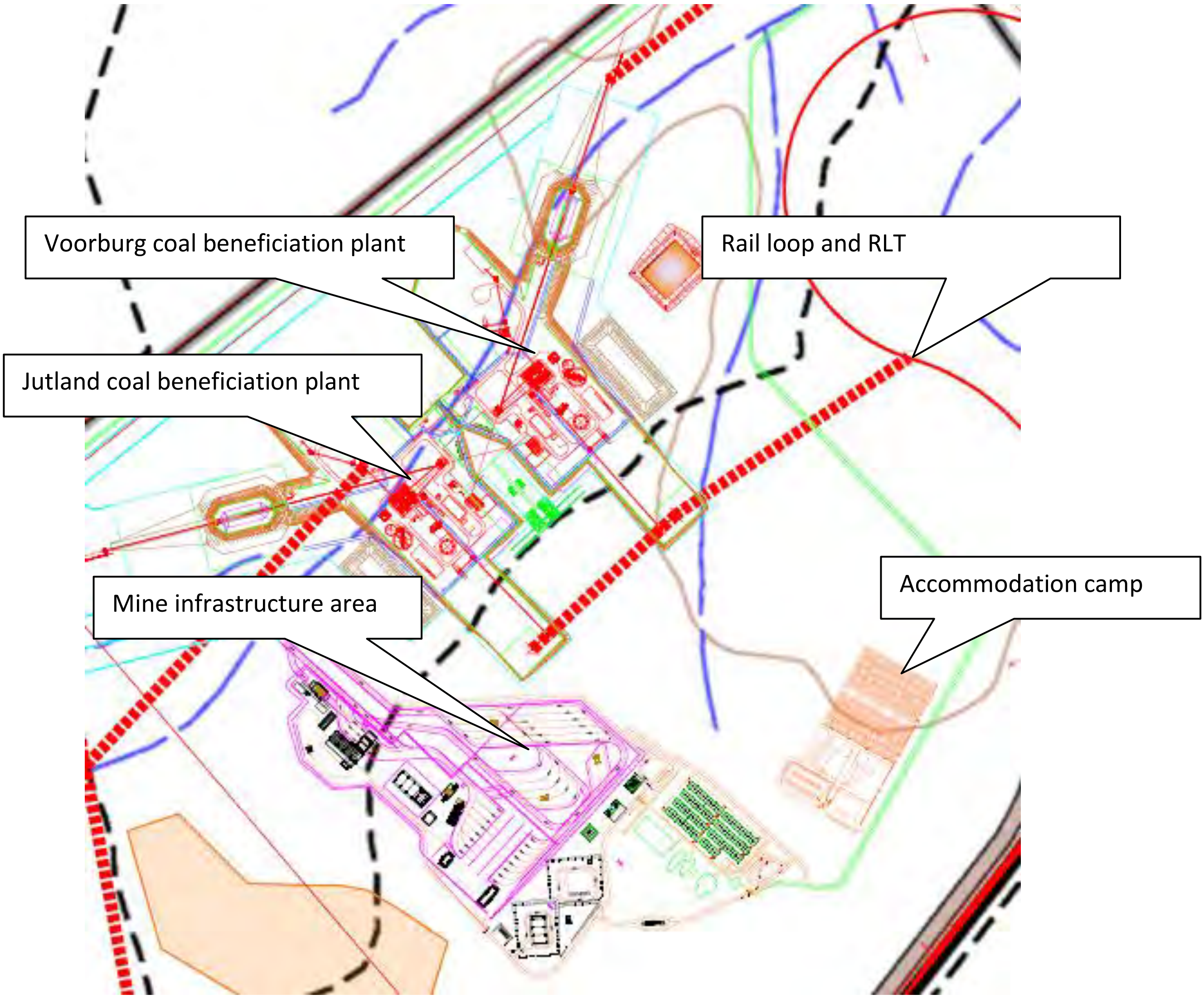


Figure 67: Mopane Project Infrastructure Hub layout plan

The major infrastructure items were designed and positioned to accommodate mining layouts at both pits, access to stockpiles, location of the beneficiation plants, and environmental requirements (including the management of dirty and clean water and protection of water courses and rivers).

The mine infrastructure areas (MIA) comprise all the facilities, roads, services and systems required for the mine to operate optimally. Other conventional mine infrastructure has also been allowed for, such as offices, mine change house, a medical and fire fighting facility, shift changing facility, security and access control, training centre, control room and accommodation camp (for construction purposes only). The usual facilities for vehicle support and stores have also been allowed.

2.3.4.1 Access Roads

Access to the Mopane Project Infrastructure Hub is by way of the N1 towards Musina, turning west onto the D525 approximately 7 km to Mopane Railway Station.

The main entrance to the Jutland Section is approximately 3 km south from Mopane Railway Station adjacent to the gravel road along the railway line. The D525 Provincial Road is a surfaced road which will be upgraded should it be necessary to carry the required future traffic loads. The existing access road to the mine infrastructure from Mopane Railway Station is gravel but will be surfaced during the mining development.

The access to Voorburg Section is along the R525 approximately 7 km north west of Mopane Railway Station.

2.3.4.2 Mining Roads

Haul roads link the west, central and the east sides of the Jutland and Voorburg Sections, the stockpile areas and the infrastructure areas on the east and west sides of the mining pits respectively. Haul roads have been planned to be 30m wide with gravel surfaces to meet the requirements of the hauling fleet.

Service roads will be constructed gravel roads and provide ease of access to remote areas for light mining vehicles. These roads are separate from the haul roads in order to separate light mine traffic from the heavy traffic (haul trucks) as a site safety measure.

2.3.4.3 Mine residue dumps

Mine residue dumps are required to accommodate mining overburden, partings and plant discards on the mine surface. It is cost effective to minimise the volume and surface area required for stockpiling by starting in-pit backfilling as soon as possible during the mining operation as double handling of the material is costly. It is envisaged that the dumping of material on the surface will be required for a period of three years after which the material mined from the pit and discards from the plant will be returned to the pit minimising the fill material during the rehabilitation process.

2.3.4.4 Topsoil dumps and berms

Topsoil will be stripped from the pit mining areas, roads and terrace areas and will be placed as close as possible to the point of stripping. The topsoil will be used as fill material, for the construction of berms and also be placed between the discards to act as isolating material. Topsoil will also be used as capping material during final rehabilitation of the stockpiles.

2.3.4.5 Storm water Management

Water is a scarce commodity and every effort has been made in the design of the water management systems to conserve and reuse as much water as possible. A water management strategy will be implemented on the Mopane Project to address the following salient issues:

- Water uses and users, with a particular focus on consumption rates;
- Engineering design basis for the water reticulation and distribution systems required to provide water to all the infrastructure, mining and beneficiation operations;
- Effluent management, including sewage treatment and disposal;
- Engineering design basis for the clean water diversion system; and

- Engineering design basis for the dirty water collection and management systems, including flood protection.

Clean storm water run-off along the various small water courses will be diverted around the proposed infrastructure, the mining pits and dump areas. These storm water drains and deflection berms have been positioned along the southern boundaries of the proposed mining pits to collect and convey clean water into the closest natural river course. Dirty water such as storm water run-off from the various terraces and plant area is captured and conveyed along lined channels towards the various dirty water dams positioned around the site. All water polluted on site as well as run-off from the carbonaceous dumps as well as seepage under carbonaceous dumps is retained and re-cycled on site. A detail water management strategy will be developed and implemented for the Mopane Project.

2.3.4.5.1 Clean Water Run-off

Clean storm water run-off along the various small watercourses will be diverted around the proposed infrastructure, the mining pits and dump areas. These storm water drains and deflection berms have been positioned along the southern boundaries of the proposed mining pits to collect and convey clean water into the closest natural river course.

2.3.4.5.2 Dirty Water Run-off

Dirty water such as storm water run-off from the various terraces and plant area is captured and conveyed along lined channels towards the various dirty water dams positioned around the site. All water polluted on site as well as run-off from the carbonaceous stockpiles and seepage under carbonaceous stockpiles is retained and re-cycled on site.

2.3.5 BULK POWER SUPPLY

The lengthy Eskom Tabor and Spencer 132 kV Distribution networks stretching 200 km from Polokwane to 50 km away from the Musina border-post result in low voltages and thermal constraints during transformation and line contingencies. The expected Tabor and Spencer 132 kV load growth is located 100 km north of Tabor and 70 km from Spencer - generally the area in which the Mopane Project resides - therefore, the Transmission outreach constraint will cap load growth.

The Polokwane Customer Load Network (CLN), including the Tabor and Spencer power corridor, remains susceptible to voltage instability and is the weakest part of the Northern Grid network due to being operated beyond its reliability power transfer limit. Eskom Transmission Division plan to strengthen the Northern Grid in the areas north of the Soutpansberg with a new 400 kV power line between the Tabor Main Transmission Substation and the newly approved Bokmakirie (Nzhelele) Substation.

Eskom is accordingly establishing additional Distribution and Transmission assets to cater for load north of the Soutpansberg, including the Bokmakirie Distribution station and the 4x250 MVA 400/132 kV Nzhelele Main Transmission Station (MTS).

The proposed network solution meets the 10 year Distribution load requirements in the Tabor and Spencer network area and it is also informed by the 20 year Transmission and Distribution load forecast in meeting the Transmission 20 year plan.

For the Mopane Project, electrical supply will be taken from the 132kV network and transformed to 11kV. The exact supply configuration is yet to be determined and the least environmental impact solution will be followed. The direct supply from Nzhelele / Bokmakirie 400/132kV MTS to both Voorburg (20MVA/132/11kV) and Jutland (10MVA/132/11kV) Sections has been identified as the preferred option.

132/11kV substations will be established for the both Voorburg and Jutland Sections in 2017 consisting of 132kV overhead lines, 132/11kV yard, 2x5MVA/132/11kV transformers, associated switchgear and equipment, control room, distributed mini-substations and MCC's.

2.3.6 BULK WATER

The water requirement estimate for the Mopane Project indicates that a maximum of 7 600 m^3/day of water is required at the mining peak in 2032.

The water supply to the mine will come from the following sources:

- Groundwater (boreholes and seepage into the mining pits;
- Storm water run-off impounded on site; and
- An external water source piped to site.

Storm water run-off on site is seasonal and, although it will be utilised, it is not a constant water supply and has therefore not been included in the water-supply chain.

For the Makhado Colliery Feasibility Study, a reconnaissance was done of all potential water sources to support the mine water requirements. Recently supply from the Nzhelele Dam has been formalised and CoAL has reached an agreement with the Nzhelele irrigation farmers to obtain 7.7% of their irrigation allocation for mining purposes. A further agreement with the farmers is that CoAL will invest significant effort into developing “new water” by investigating the possibilities to increase the yield from the Nzhelele River catchment. The yield of the dam can also be increased by either raising the dam or other methods of increasing the capacity of the dam. One such method that was considered was to de-silt the dam and all of these will be considered in more detail as part of the new water initiative.

The abstraction rights obtained by CoAL from the Nzhelele Dam is such that some spare water will be available from this system (even during the early stages of the mine) which can be utilised for the early stages of the Mopane Project. It will thus be possible to, if conservative assumptions concerning both demand and availability of groundwater and rain water harvesting in the Makhado Colliery has been made, to distribute the excess water to the Mopane Project.

2.3.7 LOGISTICS

The primary domestic destination for coking coal is located at ArcelorMittal, Vanderbijlpark. The intent is to export 0.5 Mtpa of coking coal, and transport 1.1 Mtpa to ArcelorMittal. Up to 3.1 Mtpa of middlings will be railed to either the domestic customer or to the Port of Maputo for export. The primary domestic location for middlings coal is Eskom's Tutuka, Majuba, Camden and Grootvlei Power Stations in Mpumalanga Province.

Mopane Project is close to the railway line running southwards from Beitbridge / Musina and is an important link to the main hub of the Transnet Freight Rail (TFR) network connecting at Pyramid South, near Pretoria. An important junction occurs at Groenbult, where a connecting line joins the Hoedspruit – Kaapmuiden – Komatipoort export channel avoiding the Pretoria complex.

From Pyramid South links are available to Richards Bay Coal Terminal (RBCT), Maputo or Durban. The export route through Mozambique to the Port of Maputo is in the process of being upgraded for the planned increase in volumes. Through agreements reached to expand the port facility as well as on-going negotiations with Transnet Freight Rail, the Port of Maputo is the export port of destination. These upgrades have been driven by the current tonnage being railed from the Vele Mine.

Following detailed evaluation, it was determined that the preferred option for coal despatch is a RLT on the farm Pretorius 531 MS connected by a balloon railway siding to a point between Huntleigh and Mopane – refer to Figure 68 for the proposed position of the rail loop and siding. Factors influencing this conclusion include the low long term operational cost for coal transport from plant to port, lower environmental impact and the lessening of community impact (lower road traffic, congestion and pollution). The elimination of a loading site at Huntleigh or Mopane by placing the loading site at farm Pretorius 531 MS removes a single-point impact of considerable significance. A rail link provides a seamless transition from the loading siding to a direct link to TFR mainline network at a point between Mopane and Huntleigh.

The Mopane RLT facility has been designed to allow flexibility for future increases in train lengths up to a maximum of 100 CCL wagons, with added flexibility to handle CCL Jumbo type wagons which are planned to be the standard wagon deployed on the TFR network for coal (although limited to a 60 ton payload to match the 20 ton axle load provisions). This wagon type is compatible for Eskom tipplers.

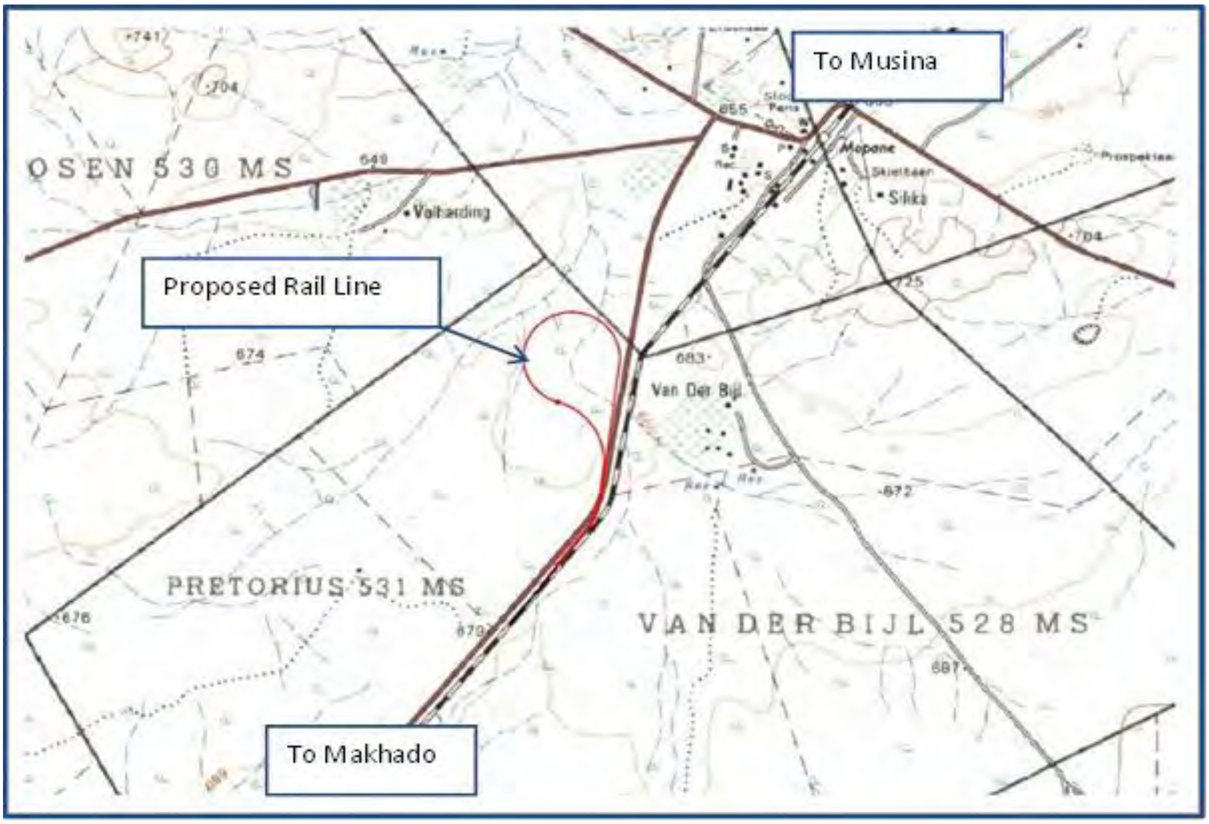


Figure 68: Position of the proposed rail loop and siding on the farm Pretorius 531 MS

2.4 MINE RESIDUE MANAGEMENT

2.4.1 NON-MINING WASTE

The following waste types will be generated during the course of the project:

- Domestic waste
- Hazardous waste
- Fluorescent tubes
- Glass
- Plastics
- Chemicals
- Medical waste
- Scrap metal
- Used oil/diesel/greases
- Building rubble (construction & demolition activities)
- Used tyres
- Old explosives

The different waste streams will be segregated and disposed of in appropriate designated receptacles. An approved, registered waste contractor will be appointed by the mine to manage the waste generation and safe disposal thereof. No landfill site will be established on the Mopane Project site. The waste removed will be either treated through the composting station, recycled through the Waste Transfer Station (WTS) and the remainder will be disposed through landfill at appropriate registered landfill sites.

No waste will be disposed of or buried on site, or in any other location that is not a licensed waste disposal site.

2.4.2 MINING (INDUSTRIAL) WASTE

Mine residue stockpiles are required to accommodate mining overburden, partings and plant discards on the mine surface. Design philosophy is based on the requirement to minimise the volume and surface area required for stockpiling by starting in-pit backfilling as soon as possible during the mining operation as double handling of the material is costly. It is envisaged that the dumping of material on the surface will be required for a period of three years after which the material mined from the pit and discards from the plant will be returned to the pit minimising the fill material during the rehabilitation process. Mine residue stockpiles are categorised as topsoil stockpiles, non-carbonaceous stockpiles and carbonaceous stockpiles.

A layout of the mine residue stockpiles for the Voorburg and Jutland Sections is shown in Figure 69 and Figure 70 respectively.

2.4.3 SEWAGE EFFLUENT

Sewage effluent will be managed as follow:

- An appropriate sewage treatment plant will be designed and constructed for the Mopane Project. The final treatment system will be selected during the Feasibility Phase and the necessary authorization applied for.
- As a minimum, treatment will adhere to the General Standards and chemical dosing will be applied for final effluent disinfection (chlorine contact basin).
- Treated effluent will be re-used in the processing plant.
- No sewage disposal will be allowed on site.

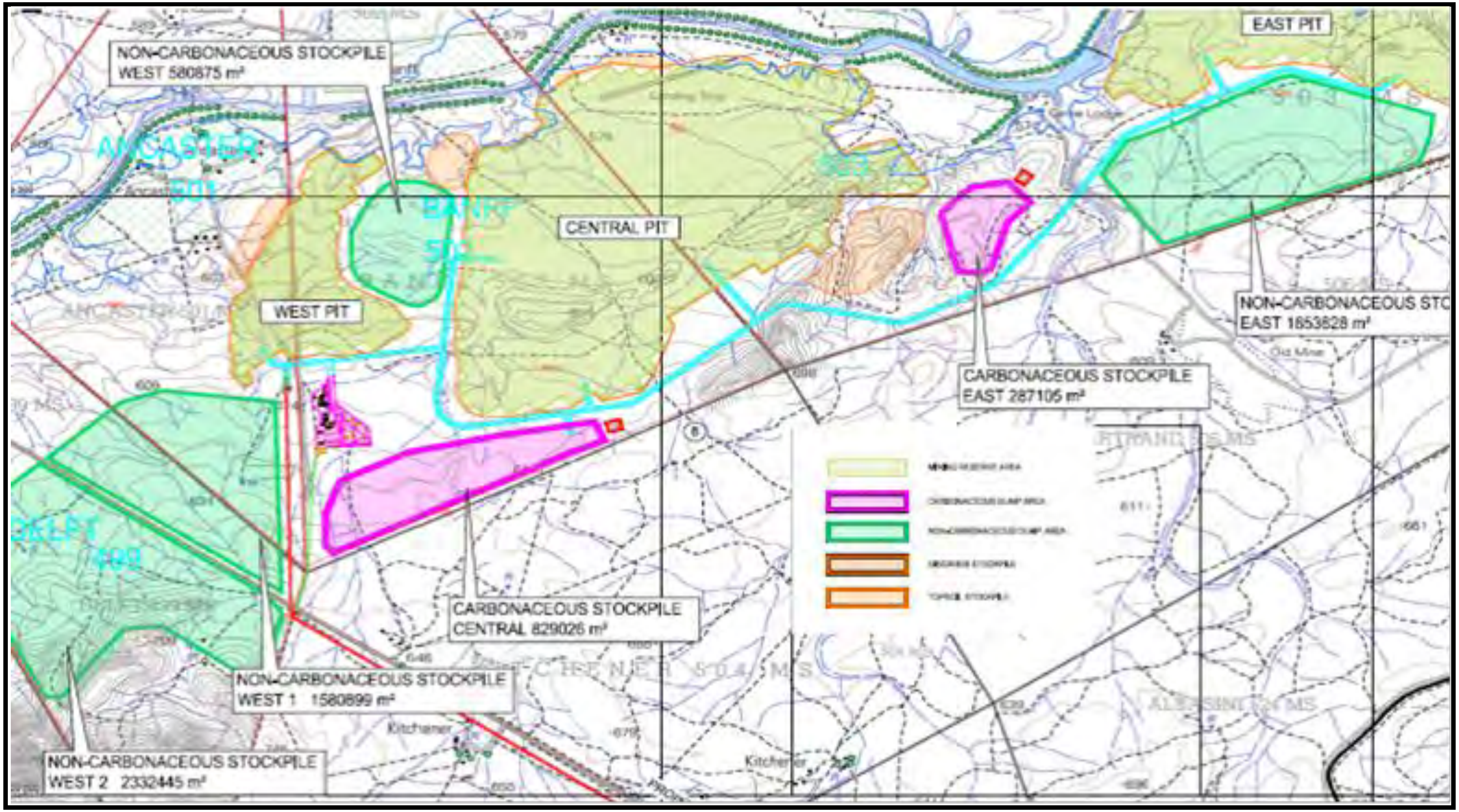


Figure 69: Voorburg Section mine residue layout

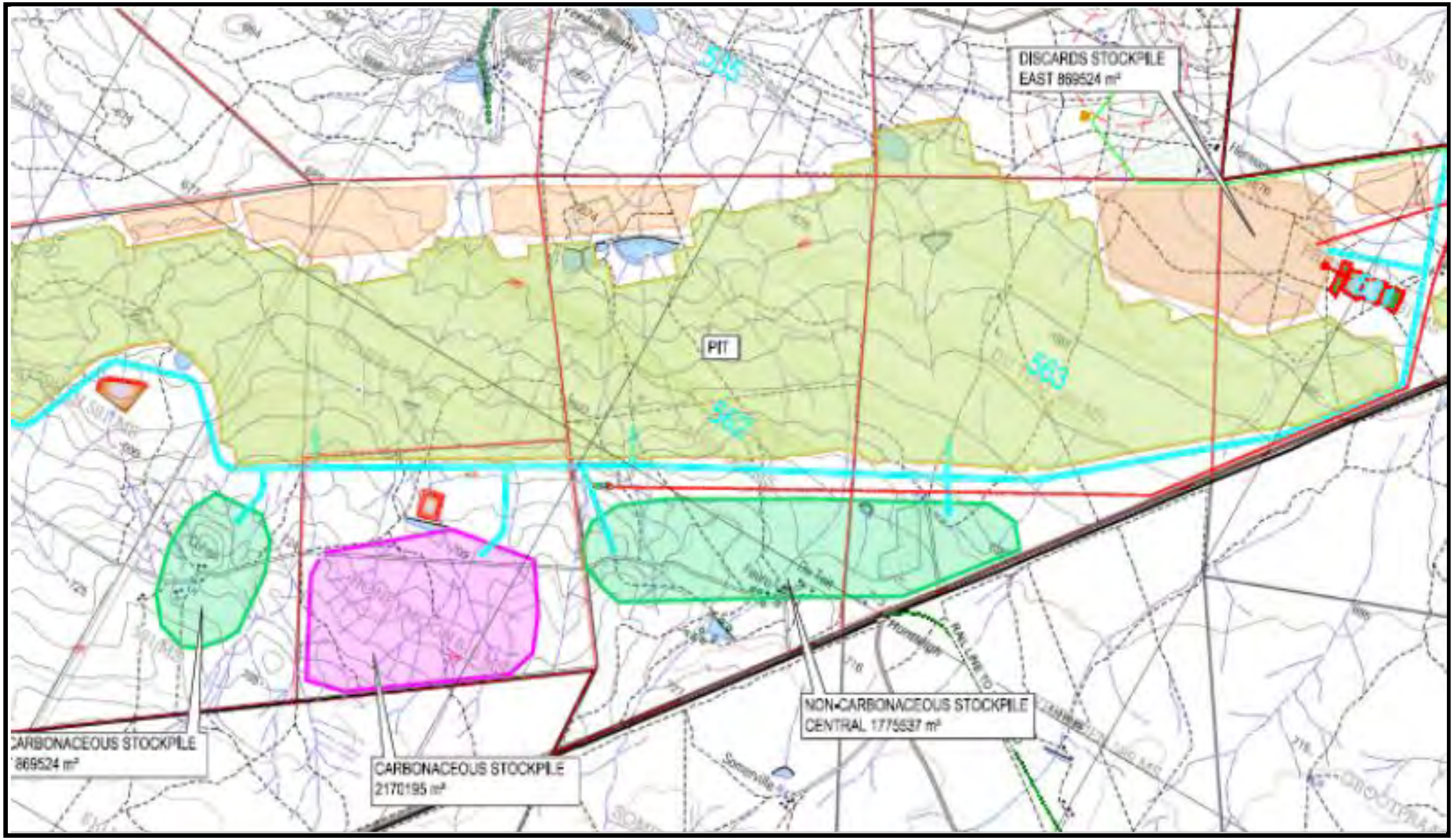


Figure 70: Jutland Section mine residue layout

2.5 LIST OF MAIN MINING ACTIONS, ACTIVITIES OR PROCESSES

Below a summary of the main activities / processes and their associated activities.

Main activities / processes	Associated activities
Opencast mining	Mining pits - Voorburg Section - Jutland Section ROM crushers In-pit water management - sumps - pumping systems
Processing plant & infrastructure	Process Infrastructure Area (PIA) - Plant stockpiles - Plant infrastructure - Clean water storage tanks - Dirty water holding dams - Silt traps / dirty water canals Mine Infrastructure Area (MIA) - Workshops - Wash-bay - Bulk hydrocarbon facilities Offices Communication Structures Explosive magazine Stores Waste Collection Area
On-site conveyance of ROM & product	Haul roads / service roads / conveyors - River crossings / culverts
Mine residue / waste management	Carbonaceous / discards stockpiles Non-carbonaceous stockpiles Topsoil stockpiles / berms In-pit disposal Waste management (general / hazardous)
Off-site product transport	Rapid Load-out Terminal (RLT) Balloon railway siding
On Mine water	Dirty and Clean Storm Water systems - Dirty water surge dams - Diversion and protection berms and channels - River diversions / storm water berms and channels Potable water plant Dirty and potable water pipelines Sewage treatment plant

2.6 APPLICABLE LEGISLATION

The legal framework within which the mining development, transport options and associated infrastructure aspects operate is complex and include many acts, associated regulations, standards, principle, guidelines, conventions and treaties on an international, national, provincial and local level. The main legal frameworks that require compliance in terms of Environmental and Water Use Authorisation are:

- Act No. 28 of 2002: Mineral and Petroleum Resources Development Act (MPRDA)
- Act No. 107 of 1998: National Environmental Management Act (NEMA)
- Act No. 36 of 1998: National Water Act (NWA)

Other legislative frameworks applicable to a development of this nature include:

- Act No. 25 of 1999: National Heritage Resources Act (NHRA)
- Act No. 10 of 2004: NEMA: Biodiversity Act (NEMBA)
- Act No. 43 of 1983: Conservation of Agricultural Resources Act (CARA)
- Act No. 84 of 1998: National Forests Act (NFA)
- Act No. 7 of 2003: Limpopo Environmental Management Act (LEMA)
- Act No. 39 of 2004: National Environmental Management: Air Quality Act (AQA)
- Act No. 57 of 2008: National Environmental Management: Protected Areas Act
- Act No. 59 of 2008: National Environmental Management: Waste Act (NEMWA)
- Act No. 101 of 1998: National Veld and Forest Fire Act
- Act No. 15 of 1973: Hazardous Substances Act
- GN No. R.527 of 23 April 2004: Mineral and Petroleum Resources Development Regulations
- GN No. 704 of 4 June 1999: Regulation on use of water for mining and related activities aimed at the protection of water resources
- GN No. R.544, R.545 and R.546 of 18 June 2010: NEMA: EIA Regulations
- GN No. 718 of 3 July 2009: NEMWA: Waste Management Activities
- GN No. 248 of 31 March 2010: AQA: Atmospheric Emissions Activities
- GN No. R.152 of 2007: NEMBA: Threatened or Protected Species (TOPS) Regulations

It is important to note that the approach for the Mopane Project is to first apply for a NOMR and follow the required Regulations in conducting the EIA and compile an EMP in terms of the MPRDA. Once this process is completed and the applicant has obtained further detail in respect of its planned development, the applications for environmental authorisation in terms of the NEMA and an IWUL in terms of the NWA will be conducted as separate processes. Refer to Table 38 for a high-level assessment of the listed activities (NEMA) and water uses (NWA) that may potentially be triggered by the Mopane Project.

The purpose of this document is to address the requirements of the MPRDA only. However, it is important to note that the construction and mining activities cannot commence without compliance to all the legislative requirements and before all the necessary permits / licenses are issued by the regulating authorities.

Table 38: Activity-based legal requirement assessment (high-level) for Mopane Project

ACTIVITY	NEMA/NEMWA	NWA
Opencast Mining		
- Voorburg Section - Jutland Section	GNR 545 – A15: *Physical alteration of undeveloped, vacant or derelict land for residential, retail, commercial, recreational, industrial or institutional use where the total area to be transformed is 20 hectares or more.*	S21(c)&(i) – impeding / altering of water courses S21(g) – dust suppression
- In-pit water management - {sumps / pumping}		S21(a)&(j) – Dewatering of pits S21(g) – Disposing of waste / water containing waste
- Storm water management - {river diversions / berms}	GN544 – A11: *The construction of (i) canals; (ii) channels; (iii) bridges; (iv) dams; (v) weirs; (vi) bulk storm water outlet structures; (vii) marinas; (viii) jetties exceeding 50 square metres in size; (ix) slipways exceeding 50 square metres in size; (x) buildings exceeding 50 square metres in size; or (xi) infrastructure or structures covering 50 square metres or more, where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.*	S21(c)&(i) – impeding / altering of water courses
Beneficiation plant and infrastructure areas		
- Access / haul roads	GN544 – A22: *The construction of a road, outside urban areas, (i) with a reserve wider than 13.5 meters or, (ii) where no reserve exists where the road is wider than 8 metres, or (iii) for which an environmental authorisation was obtained for the route determination in terms of activity 5 in Government Notice 387 of 2006 or activity 18 in Notice 545 of 2010.*	S21(g) – dust suppression
- Stream crossings - {bridges, pipelines, roads}	GN544 – A11: The construction of *(i) canals; (ii) channels; (iii) bridges; (iv) dams; (v) weirs; (vi) bulk storm water outlet structures; (vii) marinas; (viii) jetties exceeding 50 square metres in size; (ix) slipways exceeding 50 square metres in size; (x) buildings exceeding 50 square metres in size; or (xi) infrastructure or structures covering 50 square metres or more, where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.*	S21(c)&(i) – impeding / altering of water courses
	GN544 – A18: *The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock from (i) a watercourse; (ii) the sea; (iii) the seashore; (iv) the littoral active zone, an estuary or a distance of 100 metres inland of the high-*	S21(c)&(i) – impeding / altering of water courses

ACTIVITY	NEMA/NEMWA	NWA
	water mark of the sea or an estuary, whichever distance is the greater.	
- Infrastructure area, workshops	GNR 545 – A15: *Physical alteration of undeveloped, vacant or derelict land for residential, retail, commercial, recreational, industrial or institutional use where the total area to be transformed is 20 hectares or more.*	S21(g) – Disposing of waste / water containing waste
- Plant stockpiles		S21(g) – Disposing of waste / water containing waste
- Clean water storage tanks	*GN546 – A2: The construction of reservoirs for bulk water supply with a capacity of more than 250 cubic metres.*	S21(b) – Storage of water
- Dirty water dams	GNR 545 – A19: *The construction of a dam, where the highest part of the dam wall, as measured from the outside toe of the wall to the highest part of the wall, is 5 metres or higher or where the high-water mark of the dam covers an area of 10 hectares or more.*	S21(a)&(g) – Disposing of waste / water containing waste
- Bulk hydrocarbon facilities	GN545 – A3: *The construction of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of more than 500 cubic metres.*	
- Sewage plant (effluent)	*GN718 – Category B(7): The treatment of effluent, wastewater or sewage with an annual throughput capacity of 15,000 cubic meters or more.*	S21(e) – controlled activities (irrigation with waste water) S21(g) – Disposing of waste / water containing waste
Conveyance of ROM & product (on site)		
- Haul / service roads	GNR 544 – A22: *The construction of a road, outside urban areas, (i) with a reserve wider than 13.5 meters or, (ii) where no reserve exists where the road is wider than 8 metres, or (iii) for which an environmental authorisation was obtained for the route determination in terms of activity 5 in Government Notice 387 of 2006 or activity 18 in Notice 545 of 2010.*	S21(g) – dust suppression
- Stream crossings / culverts - {roads, pipelines, conveyors}	GNR 544 – A11: *The construction of (i) canals; (ii) channels; (iii) bridges; (iv) dams; (v) weirs; (vi) bulk storm water outlet structures; (vii) marinas; (viii) jetties exceeding 50 square metres in size; (ix) slipways exceeding 50 square metres in size; (x) buildings exceeding 50 square metres in size; or (xi) infrastructure or structures covering 50 square metres or more, where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.*	S21(c)&(i) – impeding / altering of water courses
Mine residue management		
- Overburden stockpiles - Discards stockpile	GNR 545 – A15: *Physical alteration of undeveloped, vacant or derelict land for residential, retail, commercial, recreational, industrial or institutional use where*	S21(g) – Disposing of waste / water containing waste

ACTIVITY	NEMA/NEMWA	NWA
	the total area to be transformed is 20 hectares or more.	
- In-pit disposal / rehabilitation		S21(g) – Disposing of waste / water containing waste
- General / hazardous waste	N/A – off-site disposal	
Product transport		
- Rail loop and siding, RLT - {stream crossings, storm water management / dams}	GN545 – A11: *The construction of railway lines, stations or shunting yards, excluding (i) railway lines, shunting yards and railway stations in industrial complexes or zones; (ii) underground railway lines in a mining area; and (iii) additional railway lines within the reserve of an existing railway line.*	S21(g) – Disposing of waste / water containing waste
	GNR 545 – A15: *Physical alteration of undeveloped, vacant or derelict land for residential, retail, commercial, recreational, industrial or institutional use where the total area to be transformed is 20 hectares or more.*	S21(c)&(i) – impeding / altering of water courses
	GN544 – A11: T*he construction of (i) canals; (ii) channels; (iii) bridges; (iv) dams; (v) weirs; (vi) bulk storm water outlet structures; (vii) marinas; (viii) jetties exceeding 50 square metres in size; (ix) slipways exceeding 50 square metres in size; (x) buildings exceeding 50 square metres in size; or (xi) infrastructure or structures covering 50 square metres or more, where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.*	
	GN544 – A18: *The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock from (i) a watercourse; (ii) the sea; (iii) the seashore; (iv) the littoral active zone, an estuary or a distance of 100 metres inland of the high-water mark of the sea or an estuary, whichever distance is the greater.*	S21(c)&(i) – impeding / altering of water courses

2.7 IMPLEMENTATION SCHEDULE

From the date of granting of the mining right (anticipated to be in 2015) further exploration, feasibility studies and final design studies will be undertaken. Construction is anticipated only to commence in 2018. Production at the Voorburg Section will commence in late 2019 and build up to 4 Mtpa Run-of-Mine (RoM) (2.5 Mtpa product) by 2020. Due to rail logistics constraints, mining at the Voorburg Section continues for ± 33 years to exhaustion of the resource.

The total life of the Mopane Project is in excess of 50 years.

The project schedule over the next 10 years is shown in Figure 71.

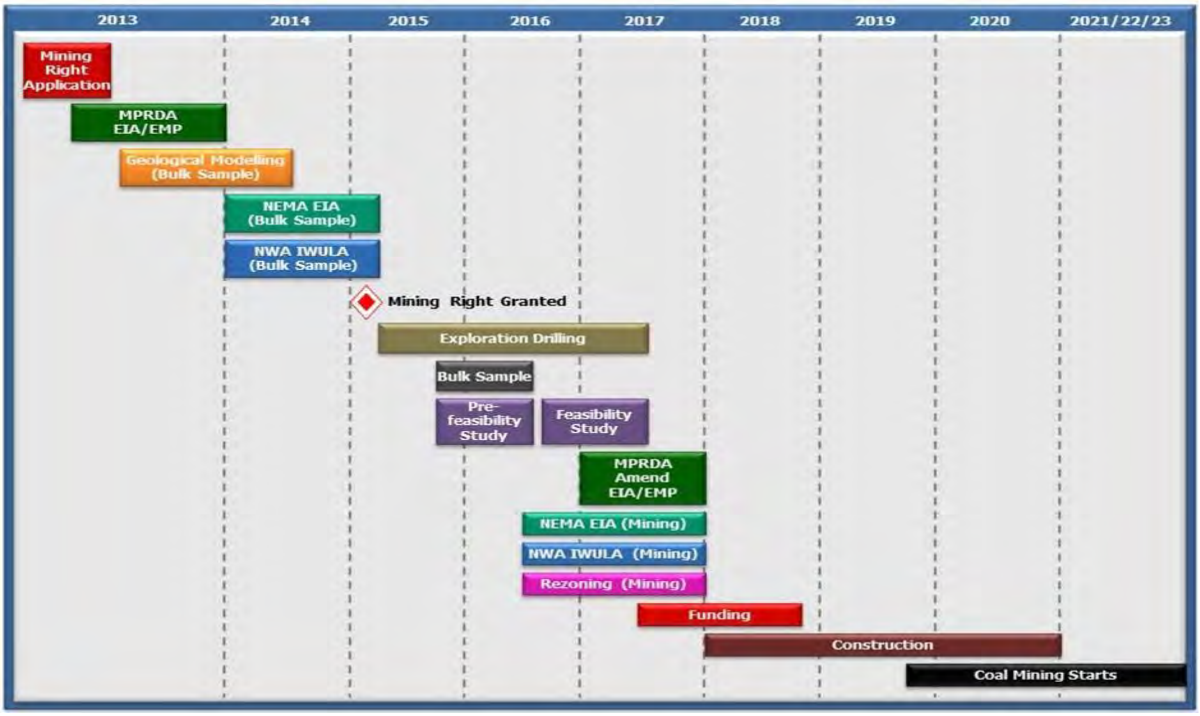


Figure 71: Project schedule for Mopane Project over the next 10 years

3 DESCRIPTION OF POTENTIAL IMPACTS ASSOCIATED WITH ACTIVITY

3.1 LIST OF POTENTIAL IMPACTS

Table 39 lists the potential environmental impacts for each of the main mining activities, processes and activities associated with the Mopane Project. These are described in more detail in the following sections.

Table 39: List of all potential environmental impacts for the Mopane Project

Activity	Environmental Aspect	Potential Impact
All activities	**Biodiversity / Land Use & Capability**	Surface disturbance of approximately 3,500 hectares for the purpose of mining and infrastructure development over the LOM will lead to impacts on the soil, land use and land capability, natural vegetation and fauna
		Increased poaching in region as a result of influx
All activities	**Waste management**	Poor waste management could lead to environmental impacts
		Poor sewage management could impact on water resources
All activities	**Bulk water**	Impact on water stressed catchment - fully allocated
All activities	**Bulk electricity**	Further impact on over-allocated electricity reticulation system
All activities	**Heritage resources**	Destruction of heritage & cultural resources as a result of mining and associated infrastructure (including linear activities)
All activities	**Sense of place**	Impact on conservation value of the region
Opencast mining	**Soils / Land Use & Capability**	Potential hard setting of soils post-reclamation
		Subsidence of rehabilitated areas
Opencast mining	**Surface water**	Impact on non-perennial streams cutting through mining areas leading to decrease in runoff
		Impact on wetland areas and aquatic ecosystems associated with non-perennial streams
		Impact on 1:100 year flood-line of the Sand River
		Increased sedimentation into Sand River due to uncontrolled surface run-off
		Potential impact on in-stream habitat and riverine vegetation as a result of decrease in runoff
		Impact of long-term decant on water quality
Opencast mining	**Groundwater**	Dewatering of aquifer as a result of mining
		Impact on surrounding vegetation as a result of dewatering and subsequent recovery
		Decrease in regional water quality due to seepage from rehabilitated pits
		Migration of pollution plume after full recovery of groundwater levels (prior to decant)
Opencast mining	**Air Quality**	Dust impact caused by vehicle movement
		Dust impact caused by blasting activities

Activity	Environmental Aspect	Potential Impact
		Dust impact caused by materials handling
		Methane emissions leading to air quality impacts
Opencast minin	**Noise**	Elevated noise levels caused by mining operation, dewatering (pumping) and blasting activities
Opencast mining	**Visual / Aesthetics**	The mining will have a negative on the aesthetics / sense of place
Opencast mining	**Socio-economic**	Impact on the communities and sensitive receptors as a result of blasting
Processing plant / infrastructure areas (including RLT & siding)	**Soils / Land Use & Capability**	Soil impacts as a result of poor hydrocarbon management and spillages
		Surface disturbance caused by infrastructure
Processing plant / infrastructure areas (including RLT & siding)	**Surface water**	Water quantity impact due to decreased surface runoff
		Water quality impact on Sand River
		Water quality impacts as a result of poor hydrocarbon management and spillages
Processing plant / infrastructure areas (including RLT & siding)	**Groundwater**	Water quality impacts due to infiltration of dirty water from the plant and infrastructure areas
Processing plant / infrastructure areas (including RLT & siding)	**Air quality**	Air quality impacts associated with processing activities and movement of vehicles
		Dust impact caused by crushing and screening operation
Processing plant / infrastructure areas (including RLT & siding)	**Noise**	Elevated noise levels caused by crushing and processing activities
Processing plant / infrastructure areas (including RLT & siding)	**Visual / aesthetics**	Processing plant will have a visual impact as a result of high buildings
Processing plant / infrastructure areas (including RLT & siding)	**Lighting**	Sky glow effect will have an impact on the sense of place at night
		Impact on invertebrates
On-site conveyance of ROM and product	**Air Quality**	On-site conveyance will increase the ambient air quality
On-site conveyance of ROM and product	**Surface water**	Stream crossings (road and conveyor) could potentially impact on the stream flow and lead to stream flow reductions downstream
		Spillages along conveyors/roads could impact on water quality
On-site conveyance of ROM and product	**Noise**	Elevated noise levels caused by trucking and conveying activities
On-site conveyance of ROM and product	**Soils / Land Use & Capability**	Surface disturbance caused by infrastructure
Mine residue stockpiles	**Groundwater**	Impact of carbonaceous stockpiles on groundwater resources
Mine residue stockpiles	**Surface water**	Impact on non-perennial streams cutting through mining areas leading to decrease in runoff
		Increased sedimentation in Sand River due to uncontrolled surface run-off and erosion
		Water quality impacts as a result of dirty water runoff / seepage from carbonaceous stockpiles

Activity	Environmental Aspect	Potential Impact
Mine residue stockpiles	**Visual / Aesthetics**	Large stockpiles will impact on the landscape
Mine residue stockpiles	**Air quality**	Increase dust emissions as a result of stockpiles
Mine residue stockpiles	**Noise**	Noise from stockpile construction leading to the main contributing factors to the noise at the sensitive receptors, especially at night-time
Off-site conveyance of ROM - conveyor between Voorburg & Jutland	**Safety**	Road / conveyor crossings could lead to safety risks to road users
Off-site conveyance of ROM - conveyor between Voorburg & Jutland	**Surface water**	Stream crossings where culverts may concentrate flow, leading to enhanced flow velocities and associated erosion problems
Off-site conveyance of ROM - conveyor between Voorburg & Jutland	**Surface water**	Potential for water quality impacts due to dirty runoff and spillages along the conveyor
Off-site conveyance of ROM - conveyor between Voorburg & Jutland	**Noise**	Increase of ambient noise levels along the conveyor route
Off-site conveyance of ROM - conveyor between Voorburg & Jutland	**Air quality**	Increase of dust emissions along the conveyor route
Off-site conveyance of ROM - conveyor between Voorburg & Jutland	**Biodiversity**	Land units will be divided into smaller units which may not be ecologically viable
		Potential impact on protected flora species identified along the route
		Creation of additional corridors which could lead to increased poaching
		Killing of animals crossing the conveyor
Off-site conveyance of product by truck (in emergencies)	**Safety**	Road transport of product will impact on the traffic along the route, safety risk to road users
Off-site conveyance of product by truck (in emergencies)	**Biodiversity**	Killing of animals and avifauna on the roads, especially nocturnal animals/birds
Off-site conveyance of product by truck (in emergencies)	**Surface water**	Potential for water quality impacts due to spillages and dirty runoff into the streams
Off-site conveyance of product by truck (in emergencies)	**Air quality**	Material and product loss from trucks
Off-site conveyance of product by truck (in emergencies)	**Noise**	Increase of ambient noise levels along the route

3.1.1 SOILS, LAND USE AND LAND CAPABILITY

The impacts identified for the soils, land capability and land use are considered collectively as all of these facets are inter-related and inter-dependant, and so the impact to the soil depth and land capability distribution includes all other facets e.g. opencast, plant infrastructure areas, discard dumps and pollution control dams will be the same. Thus a collective impact assessment has been derived in order to prevent repetition.

3.1.1.1 Construction and Operational Phases

Opencast mining results in total destruction (before mitigation) of the various facets of the following:

- Soils (i.e. slope, depth, order of horizons, organic carbon, microbial activity, fertility, perched water table, hydrology and relative compaction);
- Land capability (i.e. capability class and distribution) – land capability is downgraded; and
- Land use.

Areas that will be totally to largely altered by mining related activities include the sites of the various features/facilities in the infrastructure areas, the overburden stockpiles and the haul/access roads.

Areas that will only be partially altered by mining related activities include the conveyors, power lines, gravel service roads and temporary 'topsoil' stockpiles.

During the operational time all vegetation will be removed and creates a potential for wind erosion and therefore dust generation.

- A soil with low clay contents is susceptible to wind erosion, but has a low dust generation potential.
- Soils with high clay contents have an inherent stability and have a low dust generation potential, except for Vehicle movement. Vehicles can cause powdering and breaking of the soil structure. It is recommended that all roads should be graveled.
- Soils with clay contents between 12 and 25 percent have a high dust potential.

Three potential areas of dust formation are identified:

- Open pit areas: Dust control can be achieved by additives like molasses or watering.
- Stockpiling areas: Rock armouring of the stock piles can reduce wind and water erosion.
- All roads: Use of gravelled roads. Vehicle movement should be minimized and restricted to the construction site on gravelled roads, in order to reduce potential rill erosion and dust formation.

Table 40: Summary of the impact of mining on agricultural potential and land capability

Impact	Loss of agricultural potential and land capability	
	Without mitigation	With mitigation
Extent	Low	Low
Duration	Permanent	Permanent
Magnitude	Low	Low
Probability	Highly probable	Highly probable
Significance	Low	Low
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Medium
Irreplaceable loss of resources	No	No
Can impacts be mitigated	No	No
* The agricultural potential of the area is low, but the loss of agricultural land stretches far beyond the operational mining processes.		
* Soil erosion is a strong possibility due to increased surface run-off and occasional high intensity rain occurrences. Erosion control and adequate management is needed.		
* Loss of agricultural land is a long term loss. There are no mitigation measures that can combat this type of loss.		

3.1.1.2 Post-Mining Land Capability

Post-mining land capability may be considered from two different perspectives, namely according to:

- The Chamber of Mines post-mining land capability requirements; and
- The land capability potential (i.e. potential land use).

3.1.1.2.1 Land capability requirements

Rehabilitate to the Chamber of Mines (and Government Regulation R537) post-mining capability class standards. This scenario must represent at least equivalent (or increased) post-mining arable and grazing capability class percentages, relative to the pre-mining state. The aforementioned indicates a commitment by the mine to rehabilitate the post-mining land capability to the recommended standard.

3.1.1.2.2 Land capability potential (i.e. potential land use)

Soil is a living ecological entity, therefore it is unlikely that rehabilitated post-mining arable capability class areas in the totally and totally - largely altered (and rehabilitated) areas may be successfully cultivated in the post-mining state, this being due to both a lowered production potential of the soils.

The lowered potential / land capability could be attributed to the following:

Compaction, Consistency and Hard Setting

Soil compaction and hard setting can be attributed to the total destruction of soil structure in the stripping and redressing operations.

Consistency is the degree of cohesion or adhesion within the soil mass, or its resistance to deformation or rupture. given the above, soil consistence (in the area) appears to be directly related to soil texture and soil structure, whereby heavier textures and increasing grades of structure lead to increasing levels of hardness in the dry state.

Hard-setting of a cultivated soil involves slumping, a process of compaction that occurs without the application of an external load. Hard-setting involves the collapse of the aggregate structure during and after wetting, and a hardening without re-structuring during drying. This can be attributed to a decline in microbial activity, loss of organic carbon and subsoil material lying on the surface.

Mitigation measures such as suitable crops, the leaching of the soil to reduce the exchangeable sodium percentage, fertilizer applications to correct nutritional imbalances, mulching and organic matter, increasing irrigation water salinity, soil stabilizers, soil moisture, and suitable 'topsoiling' materials will be discussed.

These recommendations will be made in order that only high to moderate quality 'topsoiling' material will be replaced on the immediate surface during rehabilitation operations, thereby providing an acceptable medium for the growth of vegetative cover.

Subsidence

In the opencast and infrastructure areas, the pre-mining/pre-disturbance grade (slope), slope shape, contours and drainage density (not necessarily pattern) should be implemented where possible, at all times bearing in mind the critical erosion slopes (which will be calculated from the soil erodibility nomograph of Wischmeier, Johnson and Cross – 1971) for the various broad soil groups/phases which occur. This will be done by surface re-grading. Concave (rather than convex) slopes should be maximized wherever possible, while the creation of undulating 'basin and ridge' topography with frequent blind hollows should be avoided.

Limited surface subsidence of rehabilitated 'topsoiled' areas within the various pit footprints is likely to occur, this being caused by the settling of the spoil over time. Should a differential settling of the spoil occur, then this settling may lead to an interruption to the free-drainage of water, and thus the localized ponding of water. Furthermore localized soil erosion may begin to occur upslope of the same area due to the slope change and slower infiltration rates as previously discussed. Such areas must similarly be re-graded (re-sloped), 'topsoiled' and re-vegetated in order to re-establish a free-draining final topography as far as practically possible. Thus limited 'topsoil' (stockpiles) must be held in reserve for use in repair work during the operational, closure and post-closure phases of the mine.

3.1.1.3 Other Potential Impacts

Other impacts include the following:

- Alteration of the topography (changed slope shape, slope grade, drainage distribution, drainage density, and increased soil erosion);
- Alteration of soil horizons (decreased permeability, decreased moisture holding capacity, increased susceptibility to erosion, reduced fertility, and decreased levels of plant growth);
- Alteration of sub-surface layers; and
- Soil pollution.

3.1.2 BIODIVERSITY

3.1.2.1 Vegetation

The following impacts to vegetation and flora are expected as a result of the proposed mining activity, although additional impacts may be identified during the ongoing site assessment:

- Loss of vegetation
- Loss of floral species of special concern
- Increased risk of alien invasion
- Increased risk of soil erosion
- Disruptions to ecological corridors and loss of biodiversity conservation areas
- Aridification of the area as a result of mine de-watering

3.1.2.1.1 Loss of vegetation

The mining activity will result in the removal of vegetation from the mining footprint. This could result in permanent or temporary loss of habitat for both dependant and localised floral and faunal species. Furthermore, it could result in loss of intact vegetation and habitat for populations of localised and endemic species.

3.1.2.1.2 Loss of floral species of special concern

Removal of natural vegetation in the areas where opencast mining will take place will influence various listed protected species. Listed protected species will be damaged or destroyed during construction or operation of the mine, which could have an impact on the population and survival of the species.

There are potentially more than 28 listed and legally protected species that could occur in the area whose habitat may be affected by the various mining activities. An additional 16 species, confirmed to occur in the region, might occur, even though some might only occur sporadically.

Different species, or categories of species, have different legal requirements in terms of actions to be taken and permit requirements and the specific circumstances, land ownership etc. and will determine actions that need to be taken in order to protect such species.

Potential impacts include:

- Destroy or damage of protected species.
- Influence on specific species population numbers and survival.

3.1.2.1.3 Increased risk of alien invasion

Disturbances relating to mining activities and post mining rehabilitation may increase the risk of localised infestations of alien species in disturbed areas. This could either be in the form of introduced new species or the spread of existing species.

3.1.2.1.4 Increased risk of soil erosion

Disturbances relating to mining activities and post mining rehabilitation may increase the risk of soil erosion in disturbed areas. This could both be as a result of loss of vegetation cover, or altered drainage patterns and storm-water runoff.

3.1.2.1.5 Disruptions to ecological corridors and loss of biodiversity conservation areas

Large scale mining activities may result in the permanent or temporary disruption of important faunal and floral ecological corridors. Important faunal movement corridors may be disrupted, which could affect the population and survival of these species, as well as associated floral species as a result of disrupted pollination and seed dispersal mechanisms.

3.1.2.1.6 Aridification of the area as a result of mine de-watering

Mining at Mopane will involve open cast mining along extended open cuts down to 200m below surface, along the southern bank of the Sand River north of Mopane village (Voorburg Section) and southwest of Mopane village (Jutland Section).

Groundwater flow will be intersected by these pits when below the water table. The water flowing into the pits will need to be pumped out (dewatered) for safe mining operations to continue. The water pumped from the pits will be used on the mine for process water in the plant and dust suppression. The dewatering will result in a lowering of the water table (cone of depression) around the mine pits, extending for up to 25 kilometres at the life of mine. This is because water is taken mostly from aquifer storage, as recharge in the area is low and unable to sustain the dewatering. The north-east striking faults such as the Voorburg and Jutland (Bosbokpoort) faults are far more transmissive resulting that the cone of depression is elongated along their axis.

Impacts as a result of this could be significant. These include:

- A reduction in water available for evapotranspiration. Groundwater dependant floral species (trees with deep root systems) could be affected as the water table drops. Riverine vegetation is mostly sustained from surface flows and water stored in the alluvial deposits, however shallow groundwater may be important during extended dry periods.
- Depletion of ground water potential in the regional scale may reduce pasture irrigation so that dryland grazing becomes more prevalent leading to increased overgrazing and degradation

- A drop in the water table will lead to a decrease in surface water run-off. This will lead to a significant decrease in aquatic faunal diversity
- Reductions of perched areas, these areas are good habitat for breeding grounds for faunal species and act as eco tones with relatively high biodiversity at the local scale.

3.1.2.2 Fauna

In relation to the propose mine development, certain impacts have been identified within the study area. After looking at the habitats and the associated faunal communities, the impacts have been rated both with and without recommended mitigation and management measures. Impacts are rated for the full life cycle of the proposed mining, and cumulative effects have also been taken into account. The following impacts have been identified:

- Limited Food availability for Cape Vulture
- Habitat destruction
- Fragmentation of habitats
- Faunal mortality through mining operations
- Habitat creation (negative)

3.1.2.2.1 Limited food availability for Cape Vulture

The Cape Vulture is a scavenger of animal carcasses, as it relies on leftover food from kills made by large predators, such as lions. This bird also feeds off of animals which have died from natural causes and are thus natures' way of controlling animal carcasses. This bird has adapted to a life of flying extensive distances for food. As the proposed mining area falls within the birds feeding grounds, the large game will be removed due to the selling of the farms they inhabit. This will result in a decrease of food for the Cape Vulture.

The Blouberg Mountains (extension of the Soutpansberg Mountain Range) is home to the largest breeding colony of Cape Vultures in the world. They are attracted to this area due to the height and topography of the mountain, together with the food offered by the surrounding game farms. Cape vultures may have a 300 km foraging area surrounding their roosting sites.

3.1.2.2.2 Habitat destruction

Mining activities involve permanently disturbing the terrestrial faunal environment. The top soil will be removed together with the vegetation habitats, thus destroying the entire area which is subjected to the mining operation. The mining activities will destroy existing habitats. Habitat destruction leads to the displacement of fauna.

3.1.2.2.3 Fragmentation of habitats

Even though certain areas will remain unaffected by the proposed mining operations, these small habitats may become isolated. Thus the ecological continuity will be disrupted by the proposed mining activities. Individual faunal species (within the proposed mining site) are generally familiar with their surroundings.

For example, tortoises know their home ranges, and other animals (such as caracal) are familiar with their territories and feeding grounds. Certain amphibian species may only make use of water sources for breeding (tadpoles) and spend the rest of their life-cycle away from water. During breeding times, these amphibians could be prevented from gaining access to water. Precocial bird species (such as guinea fowl) could be affected due to the disruption in the continuity of the ecological corridor, up until the flight feathers are fully developed. Precocial chicks are flightless and vulnerable to predators and mining (such as trenches and piled rocks) may trap chicks when being pursued chase, thus increasing chick mortality unnaturally.

Mining activities (such as stock piling between faunal habitats) may alter critical behaviours, traits and survival technique, due to alteration, manipulation or destruction of the numerous corridors present within the proposed mining site. Certain faunal species may utilize specific corridors to gain for flight (escape) and to gain access to foraging and breeding areas. Since animals are creatures of habit, they are likely to get trapped or killed by new structures place inside their habitats if they are not familiar with the placement thereof.

3.1.2.2.4 ***Faunal mortality through mining operations***

Frequent truck/vehicle road activity (in the proposed site) will result in mortality of vertebrates and invertebrates. Reptiles frequent open sandy/rocky areas to searching for food, bask in the sun during the day, or simply traversing through. Amphibians may cross over the mining area to reach wetlands from aestivation areas. Rain is a key factor influencing amphibians, as (in times of rainfall) amphibians are at their most mobile and vulnerable. These factors all contribute to the above fauna being subjected to this impact.

Working machinery, blasting and conveyer belts, are additional factors which may contribute to faunal mortalities. It is likely that large birds (during flight) will collide into erected power lines/electrical cables or be electrocuted while roosting on said cables.

3.1.2.2.5 ***Habitat creation (negative)***

Mining activities not only leads to habitat destruction, but can often create alternative habitats. However, habitat creation may indirectly lead to negative impacts. In this case, the creation of habitats often alters the natural balance for certain faunal species. Small crevices between rocks in stockpiles may lead to chambers which make excellent micro habitats for bees to set up a hive, bats to roost and reptiles to take up residence.

Loosely compacted rubble and stones stockpiled within the site may indirectly provide habitats for reptiles. Lizards and diurnal snakes will bask on the warm ground surface and retreat into this man-made habitat. Thus due to this artificial habitat, there will likely be an increase of reptiles near roads and stock piles, however temporary. Snakes are likely to use these artificial habitats as breeding grounds and lay their eggs between the stored materials (for example, the Natal Green Snake). Although not gregarious, this species is often found in large numbers within a relatively small area.

Temporary water accumulation after rains may occur in mined areas, and this offers temporary habitats for frogs and toad. These animals may be harmed by vehicle and machinery activity.

Birds such as swifts and swallows build mud nests under structures (such as bridges), thus if bridges are constructed, potential habitats are created. Large non-vegetated rock faces (mine pits) are likely to be created as a result of the proposed mining activities, which could offer breeding habitats for bee-eaters and certain owls. This can result in the harming of birds.

3.1.3 AQUATIC ENVIRONMENT

3.1.3.1 Loss of In-stream Flow, Aquatic Refugia and Flow Dependent Taxa

The Sand River, and to a lesser degree the other systems in the vicinity of the Proposed Mopane Project are water stressed. The systems are extensively utilised for the abstraction of water for the production of crops such as peppers, squash and tomatoes. These water uses lead to the lower sections of the Sand River being dry for significant lengths and few refuge pools for aquatic biota occur in these lower areas. Any impact on in-stream flow will therefore be significant and can have a significant impact on the Sand River Ecology. It is also important to note that the Sand River is designated as a Freshwater Ecosystem Priority Area (FEPA) and therefore impacts on fish ecology are considered to be particularly significant. It is also important to note that the system is considered important as an upstream management area in support of downstream fish FEPA areas.

In terms of aquatic and riparian zone ecology in the vicinity of the project area the Sand River is the most significant and requires the most attention when considering impacts on reduced in-stream flow and aquatic refugia and the loss of flow dependant taxa.

There are however other larger drainage lines in the area which do support low abundances of tolerant aquatic taxa and well established riparian zones. In particular mention is made of the Tokwespruit as well as some smaller systems. For the sake of ease of identification the systems have been named based on the names of the farms on which they are located. Other specific examples of ephemeral rivers of particular concern are the Voorburg River, and the Banff north and South systems.

Mean annual run-off (MAR) from the Project site into the Sand River is anticipated to be primarily affected by the following:

- Direct rainfall in the opencast pits. Rain falling directly into the pits will collect in a sump at the bottom of the pit/s and thus be polluted. This water may be recycled for use, or evaporated in dirty water dams, thereby decreasing the MAR reaching the Sand River system;
- Run-off from stockpiles. Rain falling directly onto the ‘dirty’ stockpiles will either seep into the stockpile or run-off the sides of the stockpile. Any run-off or horizontal seepage from the stockpile will be captured in control dams or a leaching system for water quality control reasons, and thus subsequently be prevented to discharge to tributaries and into the Sand River;
- Concentration of flow when run-off is intercepted by canals. The canal system will intercept run-off that would otherwise have flowed naturally over the ground surface until reaching a defined watercourse. Vegetation and surface topography, particularly in flatter areas, would in the natural state have encouraged interception and infiltration. Once water has been

intercepted by a canal however, no further interception or infiltration is likely until the canal discharges the flow into a watercourse. Even once discharged back into a watercourse (if canals are not extended to the Sand River), the concentration of flow would still discourage interception and infiltration. There is thus likely to be a marginal increase in MAR resulting from the construction of the canal system. Stream flow regulation and recharge and a change in flow rates will however occur.

A substantial increase to the peak flow of flood events in the Sand River could cause erosion and change in channel character and dimensions, destroy riverine vegetation, alter bed roughness and cause eroded sediment to be deposited downstream.

It is expected that Project activities will cause a change to peak flows in the Sand River downstream of the Project site, due to the following factors:

- Change in surface coverage. Development of the Project area will change the surface coverage in some areas from vegetated soil to buildings, hardened gravel roads, paved areas (parking), and compacted earth. These new surface types will allow considerably less infiltration into the ground (typically 0-20%) as compared to the natural surface (typically 60-70%), resulting in more surface run-off following storms and consequently higher peak flow rates.
- Capture of run-off and capture of rainfall in the 'dirty' area would lower in-stream flow in the receiving environment.
- Canalisation of run-off. Intercepting run-off from the hill-slopes above the opencast pits and canalising the flow could reduce the amount of time that water would take to reach the Sand River. This is due to the decreased friction on the water associated with concentrated flow in a concrete-lined canal as opposed to sheet flow on the hill slopes, and the consequently lower flow velocities.

In technical terms, the time of concentration would be reduced, reducing the time of concentration results in higher peak flow rates. This effect is dependent on the design of the canalisation system, as increasing the length of flow paths, and implementing other detention measures, could negate this effect.

A cut-off canal system is required to separate unpolluted ('clean') and polluted ('dirty') water, which is a positive intervention. However, intercepting the tributaries that flow from the water divide across the mining areas, and redirecting them via canals around the pits, will starve those same water courses of water along their reach between the point of interception and the Sand River.

Furthermore, if the canals only extend as far as to route water around the outer edge of the opencast pits, then concentrated volumes of water will be discharged at point locations on the hill slopes, leading to altered surface and subterranean hydrology.

All the above factors are likely to lead to altered riverine recharge flood peaks and a general loss of runoff volumes successfully reaching the Sand River system as well as the other major drainage systems in the area which in turn lead to the loss of aquatic biota such as fish and aquatic macro-invertebrates which rely on the presence of surface water as well as the riparian zone which relies on base flows as well as recharge by larger rainfall events.

3.1.3.2 Impacts on Water Quality Affecting Aquatic Ecology

3.1.3.2.1 Increased sediment load in the Sand River

In the natural state of the project site, vegetation cover causes friction to rainfall run-off, that reduces flow velocities and consequently shear forces between the water and the ground surface, resulting in the ground surface remaining intact and not being eroded away. If for any reason flow velocities are increased, there is potential for increased erosion to occur.

Increased erosion of disturbed surfaces means that the run-off contains a higher silt or sediment load, which is discharged to the Sand River. A component of this sediment load is particles fine enough to remain in suspension, 'clouding' or 'muddying' the water.

The extent of this effect can be quantified by measuring a water quality parameter, suspended solids. If there are too many suspended solids in the water this can negatively affect biological life. In addition, a changed sediment load could have similar morphological effects to the river as changing peak flow rates, such as changes in channel character or dimensions and changes to bed roughness. Severe sediment deposition in the Sand River could lead to reduced surface flows in the system with a larger volume of water moving through a thickened sand layer. All of these changes could potentially affect biological life.

The following activities are likely to cause an increase in flow velocities, or directly increase erosion:

- Stripping (vegetation clearance) of mining areas prior to excavation of pits;
- Construction of hard-standing areas that increase run-off volumes, including roads, buildings and paved areas;
- Canalisation of run-off, particularly if canals do not discharge directly into the Sand River; and
- Construction activities that loosen the ground surface.

Furthermore, if run-off from the stockpiles is uncontrolled, such run-off would likely contain a high sediment load due to the fine particles in the waste product resulting from the ore crushing process. It can thus be stated that without any mitigation measures, the sediment load in the Sand River will increase as a result of mining activities associated with this Project.

3.1.3.2.2 Impaired water quality due to pollutants discharged from processing plant

Wastewater from the coal ore beneficiation process would contain pollutants in excess of the target water quality ranges for the water uses of the receiving water body and discharge of this would impact negatively on the surface water quality. A further consideration is the run-off of pollutants from the process plant area following rainfall, due to the activities within that area.

3.1.3.2.3 Impaired water quality due to pollutants in run-off from stockpiles

It is likely that run-off from the stockpiles will have a different chemical composition to natural run-off. In this event it is best practice to keep 'dirty' water from stockpile run-off separate from 'clean' water from natural run-off.

3.1.3.2.4 <u>Impaired water quality due to pollutants in water discharged from opencast pits</u>

Overflow of water (decant), whether surface or ground, from the pits could release pollutants to the surface water environment if geochemical testing indicates a possible acid mine drainage or other water quality issue.

3.1.3.2.5 <u>Impaired water quality due to petrochemical spills</u>

Fuel or oil spills from vehicles could contaminate surface water resources. Leakages, spills or run-off from vehicle wash bays, workshop facilities, fuel depots or storage facilities of potentially polluting substances could contaminate surface water resources.

3.1.3.2.6 <u>Heavy metal contamination</u>

Increase in metal concentrations is commonly associated with tillage and blasting of the upper crust of the earth’s surface. This releases metals into the associated surface and ground water systems (NSS, 2009). Under alkaline conditions, most of the metals remain biologically unavailable, however in the presence of acid mine drainage the metal-speciation changes and they become available (Bonta et al., 1993). This may alter the species composition of the aquatic biota inhabiting the river, in the vicinity of and downstream of the proposed development.

3.1.3.3 Loss of Aquatic Habitat

Habitat destruction is the alteration of a natural habitat to the point that it is rendered unfit to support the species dependent upon it as their home territory. Many organisms previously using the area are displaced or destroyed, reducing biodiversity. Globally modification of habitats for agriculture is the chief cause of such habitat loss. Other causes of habitat destruction include surface mining, deforestation, slash-and-burn practices and urban development. Habitat destruction is presently ranked as the most significant cause of species extinction worldwide. Additional causes of habitat destruction include water pollution, introduction of alien species, overgrazing and overfishing.

Riverine systems and particularly ephemeral riverine systems or river systems that have very low flows as part of their annual hydrological cycles are particularly susceptible to changes in habitat condition. The proposed mining activity of the Mopane project has significant potential to lead to habitat loss and/or alteration of the aquatic and riparian resources on the study area.

The risk to the local riverine systems is particularly due to the risk of reduced in-stream flow in the Sand River and the loss of refugia during periods of low flow. Based on the interaction of surface (incl base flow in the surface aquifers formed by the thick sands in the local rivers) and groundwater in the area as presented by the professional team a limited impact from the cone of groundwater dewatering will occur on the base flows in the river. Based on this information a limited impact on in-stream flow is deemed likely however losses of in-stream flow may affect the aquatic community within the Sand River and especially fish and aquatic macro-invertebrate species diversity and sensitivity.

3.1.3.4 Loss of Aquatic Biodiversity and Sensitive Taxa

Aquatic resources in the area can be considered scarce and in addition to being scarce are generally exposed to significant water stress. The aquatic resource in the area do however support, or potentially support, an aquatic community of significant diversity and sensitivity. This statement is considered particularly pertinent to aquatic macro-invertebrates and the fish community. On a national scale the system is also considered to be of importance and the lower sections of the Sand River are considered a FEPA system and a Fish FEPA support system

The aquatic ecology of the area can potentially be impacted by further reductions in in-stream flow, altered water quality and habitat loss.

3.1.3.5 Loss of Wetland and Riparian Habitat

The main land use constitutes game farming and to a lesser extent crop cultivation. As a result, overall landscape and vegetation transformation in the vicinity of water courses and depressions, within the study area, are considered to be low. Consequently, all features presently provide niche habitat for wetland and aquatic faunal and floral species within a water stressed region.

The ephemeral nature of smaller drainage lines does limit the ability for these features to provide optimum conditions for the formation of an extensive riparian zone. Therefore, larger tree species with root systems that can subtract water from deeper within the soil during winter months such as *Faedherbia albida* and *Xanthocercis zambesiaca* (Nyala) were restricted to river systems within the Voorburg section. None the less, the drainage lines within the Jutland and Ursa Minor sections do provide habitat for species such as *Combretum imberbe* (leadwood) (protected in accordance to the National Forests Act (Act No 84 of 1998 as amended September 2008).

Surface water that would provide habitat for aquatic species as well as drinking water for terrestrial wildlife, was also restricted to the river systems within the Voorburg section. Artificially created impoundments within drainage lines of the Jutland and Ursa Minor sections will however also retain water for longer periods increasing these features importance in terms of niche habitat as well as drinking water for wildlife and habitat for waterfowl.

Loss or impact on wetland and riparian habitat would result in loss of niche habitat for various faunal and floral species within a water stressed region. Due to the sandy nature of the soil it is doubtful that wetland and riparian habitat could be rehabilitated to resemble these unique habitat units presently within the study area.

3.1.3.6 Changes to Wetland Ecological and Sociocultural Service Provision

To determine feature specific importance in terms of function and service provision, the Sand River, Tokwespruit, Voorburg Steam, Banff Stream, smaller drainage lines as well as pans and wetland depressions were assessed separately. Following the assessment, all features are considered of intermediate importance in terms of function and service provision, with the highest scores calculated for biodiversity, tourism and recreation.

Loss or impact on wetland and riparian habitat would reduce a features importance in terms of function and service provision. Although deemed possible to reduce impact in terms of changes to ecological and sociocultural service provision it is doubtful that the level of importance could be reinstated after mine closure, unless all allocated 100m buffer zones are kept strictly off limits to any mining related activity, including general infrastructure.

3.1.4 SURFACE WATER

The surface water impacts of the Project can be divided into two aspects, namely:

- Impacts on surface water quantity
- Impacts on surface water quality

It should however be kept in mind that water quality is naturally linked to water quantity due to the fact that changes in water quantity are likely to affect the dilution of pollutants.

3.1.4.1 Impacts on Quantity

3.1.4.1.1 Impact on Sand River flood-line

The requirements of Government Notice 704 (GN704) state that mining activities may not be located within the 1:100 year flood-line or within a horizontal distance of 100 meters from any watercourse or estuary, whichever is the greatest.

Figure 72 below shows the 1:100 year flood-line as well as the 100 meter buffer zone for the Sand River within which it is proposed that no mining activity will take place. It is clear that parts of the pit footprints protrude the calculated 1:100 year flood-line for the Sand River. The protrusion typically occurs where smaller tributaries or streams discharges into the Sand River.

The calculated flood-line is wider than the buffer zone and it therefore controls the extent of mining activities. However, the aquatic assessment recommended a 100m buffer from the edge of the riparian zone (wetlands), in this instance the Sand River flood-line that implies that no mining activities should take place within 100m from the edge of the 1:100 year flood-line. It is therefore proposed that the footprints of the pits be reduced to adhere to the applicable legislation.

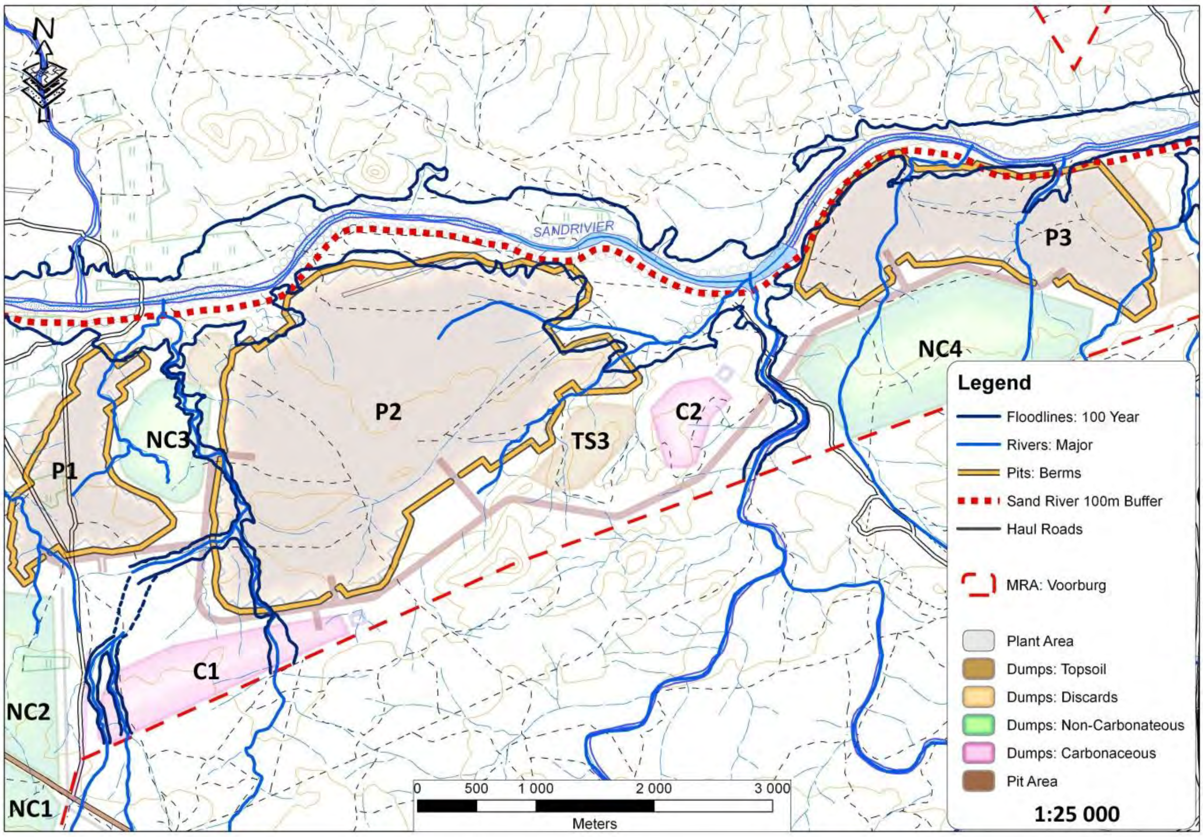


Figure 72: Sand River 1:100 year flood-line and 100m buffer

3.1.4.1.2 Impact of the proposed development on site streams and drainage lines

The Sand River and its site streams are shown in Figure 73 and Figure 74 overlain with the opencast pits and stockpile areas. With the drainage northwards towards the Sand River, the open pits span across a number of streams and unless diverted, and runoff to the river will be reduced.

The conceptual storm water drainage layout as described in the EMP (Section 2) indicates that a total of 13 streams/drainage lines will be disturbed by the mining activities. To reduce the impact on the streams, it is proposed that the revised surface layout plan as presented in the EMP be implemented.

With the implementation The runoff volumes and water quality of re-routed streams would not be materially affected, provided that scour of bed material is prevented so as to minimise turbidity during flood conditions. Lining of the canals and/or energy dissipating structures may be required at steep slopes. “Armorflex” lining or similar should be provided on steep sections to prevent scour by the associated high velocities and where required the side walls of flow control berms should be stabilised by a layer of soil cement to prevent scour.

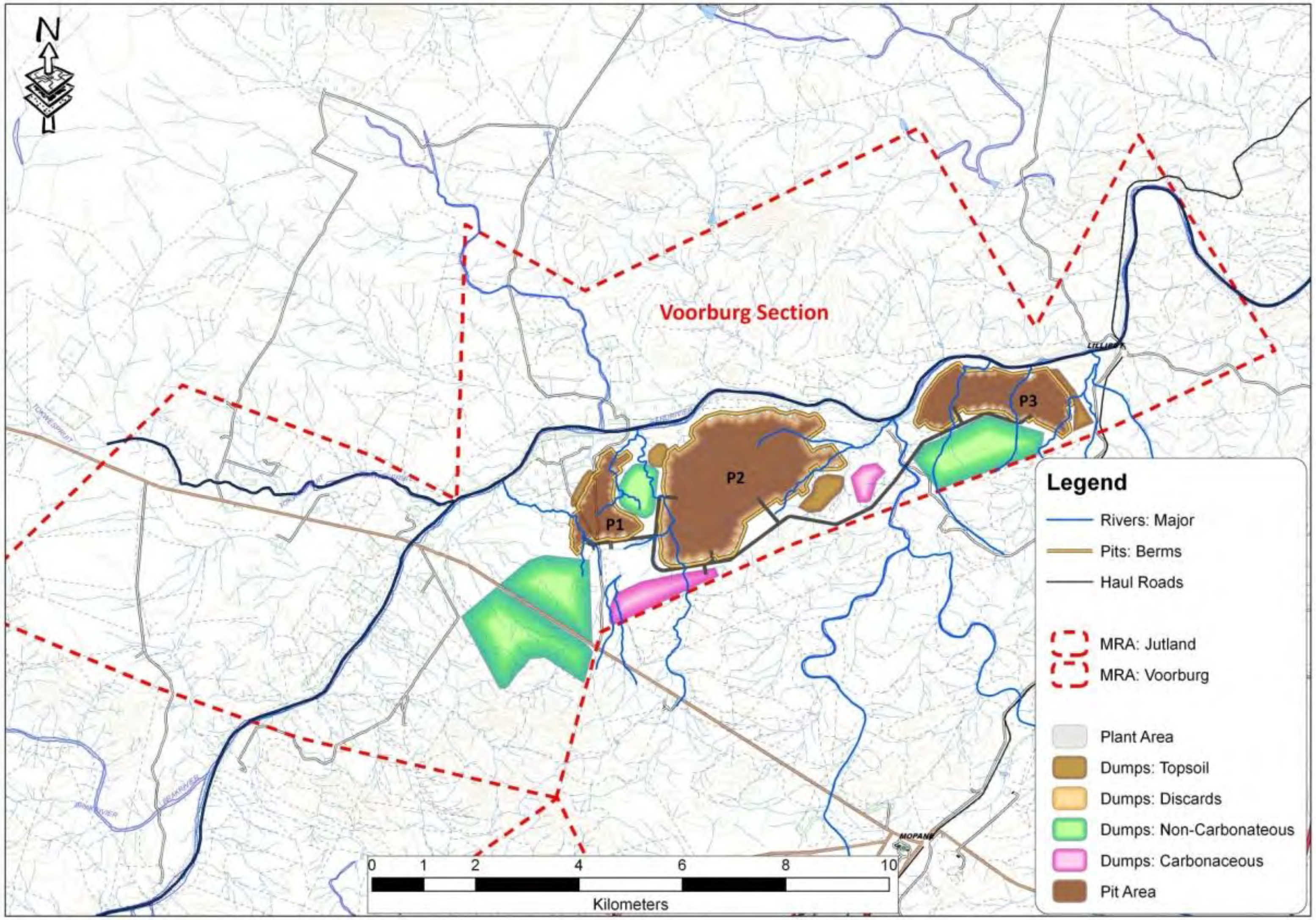


Figure 73: Mining layout plan - Voorburg Section

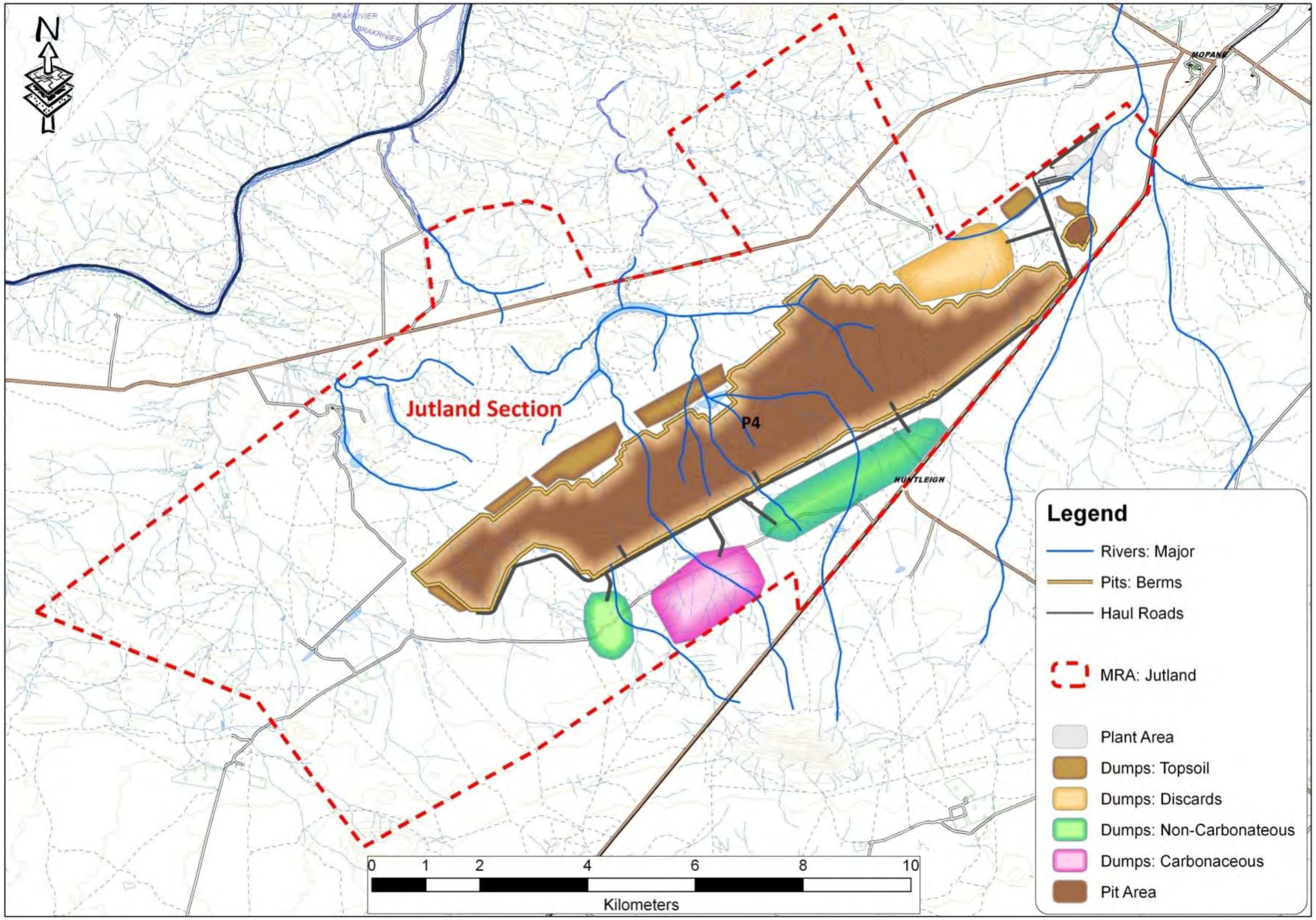


Figure 74: Mining layout plan - Jutland Section

3.1.4.1.3 Impact of the proposed mining development on surface water runoff

Rainwater falling on the open portions of the pits will be collected as dirty water and be re-used. Likewise, seepage and surface water runoff from the carbonaceous dumps will be collected as dirty water.

The total reduction in runoff shown in Table 41 is for the worst case scenario at the end of the life of the mine, assuming that no rehabilitation of the pits has been done and the carbonaceous dumps and plant areas retain polluted runoff. In this case the cumulated impact is a reduction in annual runoff of 147 541 m^3/annum, or 2.0% of the MAR of the downstream quaternary catchment A71K of the Sand River Basin.

Table 41: Estimated impact of proposed mine on surface water runoff in quaternary catchment area A71K (based on worst case scenario with no rehabilitation in place)

DESCRIPTION	AFFECTED AREA (ha)	% OF SITE AREA	RUNOFF INTERCEPTED* (m^3/a)	% OF MAR of A71K
Opencast mining (all pits)	2 825	80.0	126 842	1.7
Plant dirty water area, haul roads	132	3.7	5 927	0.08
Carbonaceous dump area	329	9.3	14 772	0.2
TOTAL FOR SITE	**3 286**	**93.0**	**147 541**	**2.0**

* Based on 4.49 mm runoff, the average for A71K

However, the pits will be continuously rehabilitated as mining progresses and the open areas are kept relatively small, namely 600 ha per pit. The actual affected area for two pits being mined simultaneously, would thus reduce from 3 286 ha to 1 661 ha. This would half the impact to 1.0% of the A71K runoff.

The current water use from the Sand River in the vicinity of the proposed mine is limited to small portions of irrigation, using water from boreholes or well points in the sand bed of the river which is regarded as groundwater. The sand bed is replenished by runoff events in the main river and from the tributaries and thus a small reduction in yield of 1% and less of the sand aquifer immediately downstream of the mining area may occur.

3.1.4.1.4 Potential impacts of utilizing or developing a surface water supply source

At this stage of the investigations, the large-scale development of a surface water source for use by the mine does not appear feasible. It is further recognised that storm water is a seasonal event and its contribution to the mine water demand will be small and inconsistent. It has therefore not been included as a source in the water-supply scheme.

Therefore surface water use would be limited to the direct rainfall on open pits and an increased evaporation loss.

3.1.4.2 Impacts on Quality

The philosophy supporting the following section of the report is that if all constituents in the cumulative discharge from the Project site are within the applicable target water quality ranges, then the Project activities will not contribute significantly to an unacceptable cumulative impact.

The converse of this statement is not necessarily true, as different activities within the catchment may discharge different pollutants at different concentrations, and the dilution effect may mean that a constituent that is out of the target water quality range in the cumulative discharge from the Project site is within the target water quality range when the discharge is combined with the Sand River flow itself.

However the Precautionary Principle requires that a conservative approach be taken, in this case to account for possible discharge of pollutants by future activities in the river catchment, and therefore the dilution effect of the Sand River cannot be relied upon.

3.1.4.2.1 Increased sediment load in Sand River

In the natural state of the project site, vegetation cover causes friction to rainfall run-off, that reduces flow velocities and consequently shear forces between the water and the ground surface, resulting in the ground surface remaining intact and not being eroded away. If for any reason flow velocities are increased, there is potential for increased erosion to occur.

Increased erosion means that the run-off contains a higher silt or sediment load, which is discharged to the Sand River. A component of this sediment load is particles fine enough to remain in suspension, 'clouding' or 'muddying' the water.

The extent of this effect can be quantified by measuring a water quality parameter, suspended solids. If there are too many suspended solids in the water this can negatively affect biological life.

In addition, a changed sediment load could have similar morphological effects to the river as changing peak flow rates, such as changes in channel character or dimensions and changes to bed roughness. All of these changes could potentially affect biological life.

The following activities are likely to cause an increase in flow velocities, or directly increase erosion:

- Stripping (vegetation clearance) of mining areas prior to excavation of pits;
- Construction of hard-standing areas that increase run-off volumes, including roads, buildings and paved areas;
- Canalisation of run-off, particularly if canals do not discharge directly into the Sand River; and
- Construction activities that loosen the ground surface.

Furthermore, if run-off from the stockpiles is uncontrolled, such run-off would likely contain a high sediment load due to the fine particles in the waste product resulting from the ore crushing process.

It can thus be stated that without any mitigation measures, the sediment load in the Sand River will increase as a result of mining activities associated with this Project.

3.1.4.2.2 Impaired water quality due to pollutants discharged from dirty areas

Unless proper measures are taken, polluted runoff will affect the streams and the Sand River. The following areas are considered to be polluted:

- Areas of carbonaceous materials mining and haulage including pits, haul roads, tips and loading areas.
- Areas of carbonaceous materials storage such as coal stockpiles, carbonaceous materials stockpiles and dumps, including discards and other carbonaceous spoils from the pit excavations.
- Areas of potential hydrocarbon pollution, such as fuelling areas, workshops and fuel or lubricant storage areas.
- Infrastructure Hub and RLT / siding.

A vital part of the storm water system is the prevention of pollution by separating dirty water areas from clean storm water systems. Therefore polluted runoff from the plant areas and stockpiles has to be collected in dirty water systems for storage and re-use as prescribed by law. If the system is properly implemented and maintained, the impact of the "dirty water" areas will be limited to a reduction in runoff.

Dirty water management infrastructure must be appropriately lined to prevent any seepage into the surface water resources.

Dirty water collection drains should be concrete lined to ensure minimal seepage into soils and aquifers. Water from these drains is then led via silt traps into pollution control dams from where it is re-cycled for re-use in the plant. The impact will therefore be limited to a reduction in runoff.

In the operational phase only major events or failures in the storm water management system will lead to pollution. In the long term, decant may occur which will cause pollution.

Fuel or oil spills from vehicles could contaminate surface water resources. Leakages, spills or run-off from vehicle wash bays, workshop facilities, fuel depots or storage facilities of potentially polluting substances could contaminate surface water resources.

3.1.5 GROUNDWATER

Mining can impact on groundwater by the cone of dewatering that forms from removal of inflows into the pit as it is deepened and by contamination of groundwater due to mining activities.

A numerical model was generated in order to quantify the impact of the proposed mine on the groundwater in the study area, and to determine inflows into the mine workings. Since many mines will be operated in conjunction, it was necessary to model a large area to determine cumulative impacts. The Makhado Colliery will be in operation before the Mopane Project, and will impact on water levels. In addition, the Chapudi and Generaal projects will overlap with Mopane, hence all the projects must be considered in conjunction.

The USGS MODFLOW2000 Finite Difference groundwater model was used in the US Department of Defense GMS 9.0 (Groundwater Modelling System) interface to simulate and plot groundwater flow.

The construction and calibration of the regional numerical model is discussed in detail in the Groundwater Specialist Report (ANNEX-3, WSM Leshika 2013) and is not repeated here.

3.1.5.1 Groundwater Inflows

The impacts of mining on the regional water balance are shown in Figure 75.

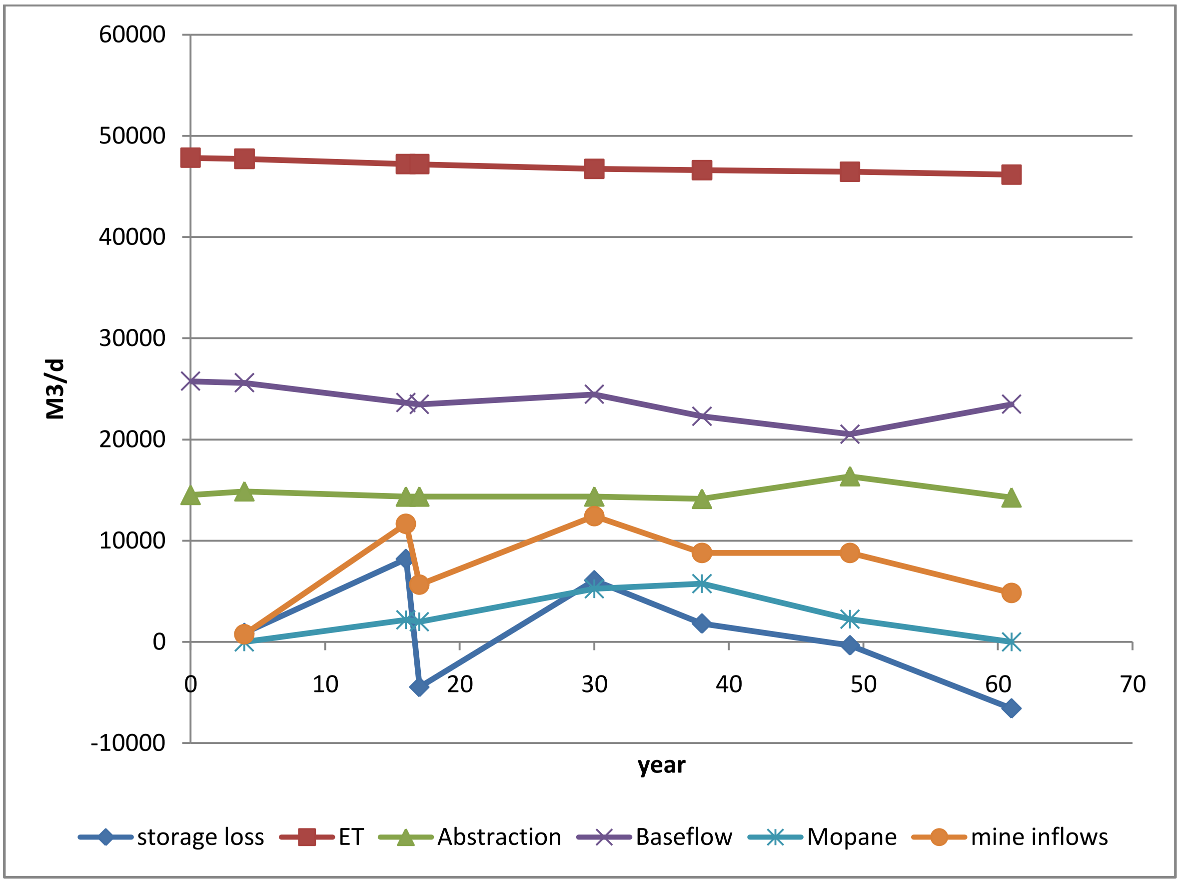


Figure 75: Mine abstraction from the aquifer and impact on the aquifer

Evapotranspiration from riverine areas is impacted and decreases from 47.8 Ml/d to 46.4 Ml/d. This reduction occurs largely along the river channels, where drawdown of the water level reduces the availability of shallow groundwater.

Abstraction of groundwater for existing users is reduced from 14.5 Ml/d to a minimum of 14.1 Ml/d.

The bulk of inflows into the pits and to boreholes originate from storage losses from the aquifer, which rises to 8.1 Ml/day by the end of the life of Makhado Colliery. They subsequently decline due to the refilling of Makhado and the closure of Mount Stuart underground mine and Wildebeesthoek Section. Inflows into mines peak at 12.4 Ml/d when all mines except Makhado are in operation, then decline to 8.7 Ml/d by the end of the life of Mopane. During the peak inflows, 5.2 Ml/d are inflows into the Mopane open pits.

Mine inflows exclude direct rainfall into mine workings, and surface runoff which is not diverted. This is because such inflows are not part of the average daily inflow, and occur only during storm events, which are highly variable. Post mining, recharge to the pits is included in the water balance, since this volume will not be removed as storm water and will replenish the pits.

3.1.5.1.1 Inflows into Voorburg and Jutland Section

Inflows into Voorburg increase to 2.9 Ml/d in mining year 30, 26 years after the pit starts, which were simulated assuming a progressive deepening of the pit. Inflows into Jutland increase to 3.2 Ml/d by year 38, before starting to decline.

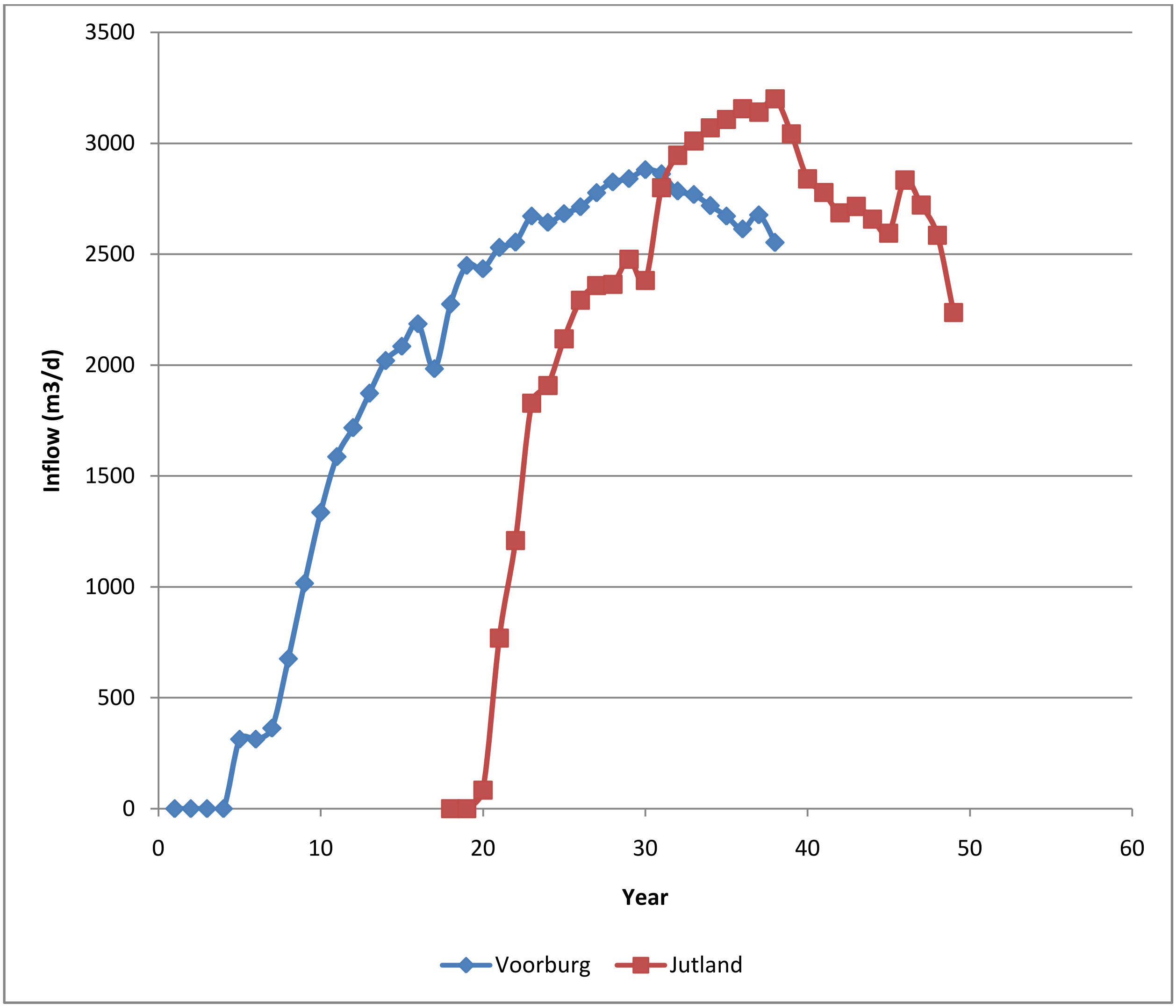


Figure 76: Inflows into the Mopane open pits

3.1.5.2 Cumulative Drawdown

Drawdown is the measure of water level decline taken from a bases point, in this case prior to commencement of mining i.e. year 2013. Drawdown of the water level after mining commences is shown for various periods of time in Figure 77 to Figure 80.

Significant drawdown in water level of over 5 m occurs by year 16, 12 years after the start of Voorburg, to a radius of 5-6 km. By mining year 38, 49, and the end of the life of the mines (year 61), significant drawdown occurs for a radius of up to 25 km, and the impacts from Mopane, Generaal and Mount Stuart, and Chapudi Projects are cumulative and overlap.

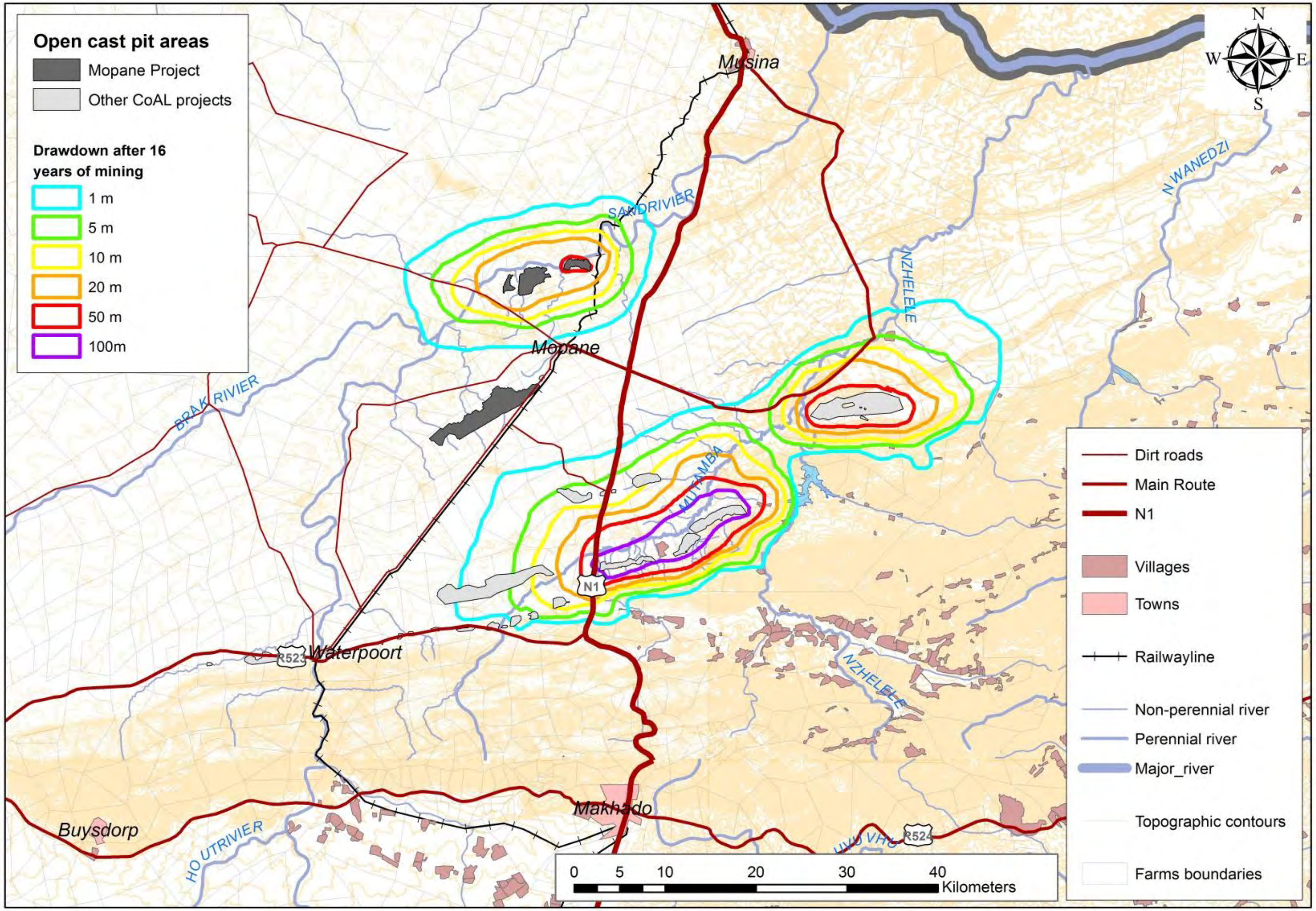


Figure 77: Cumulative drawdown in Year 16

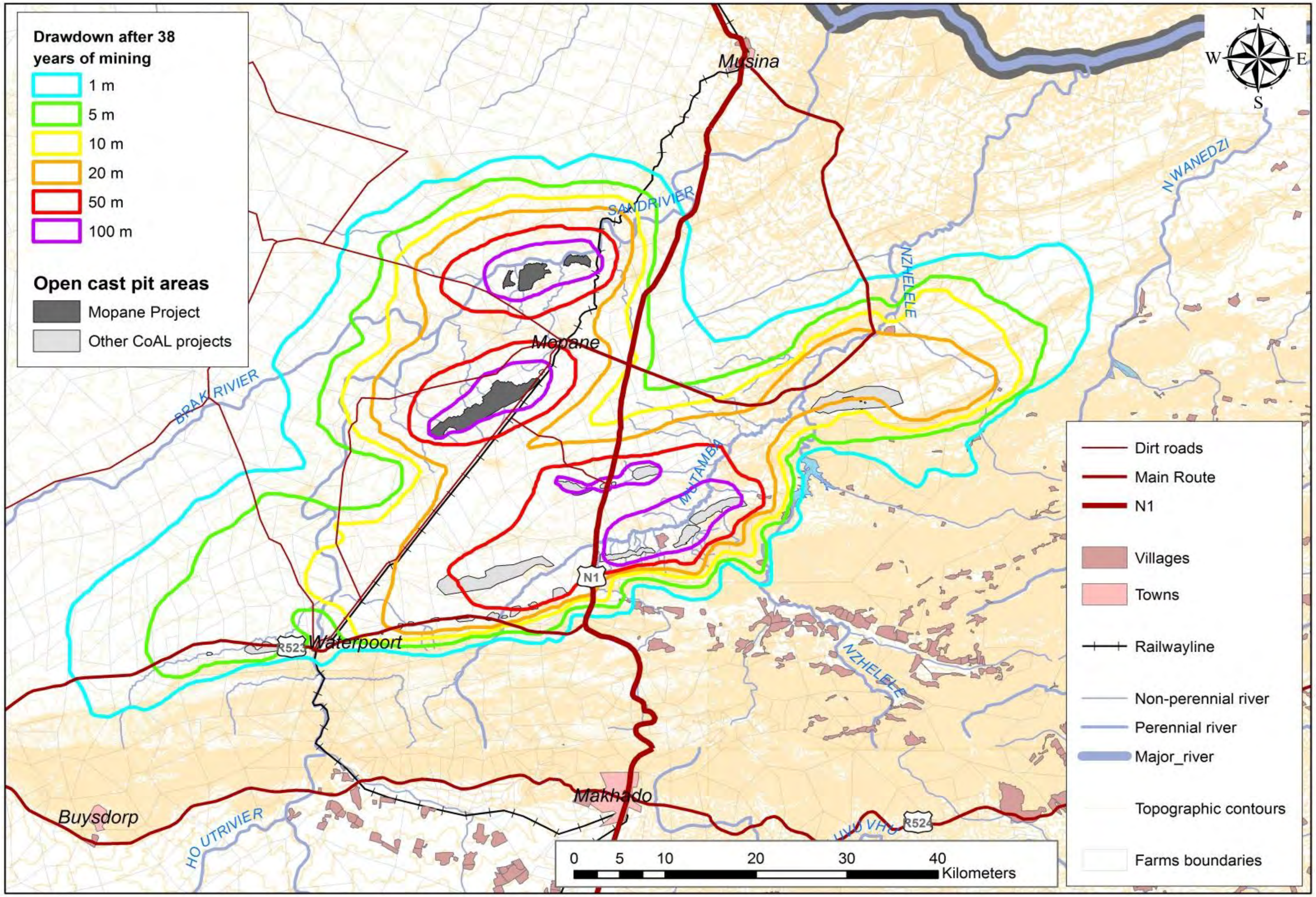


Figure 78: Cumulative drawdown in Year 38

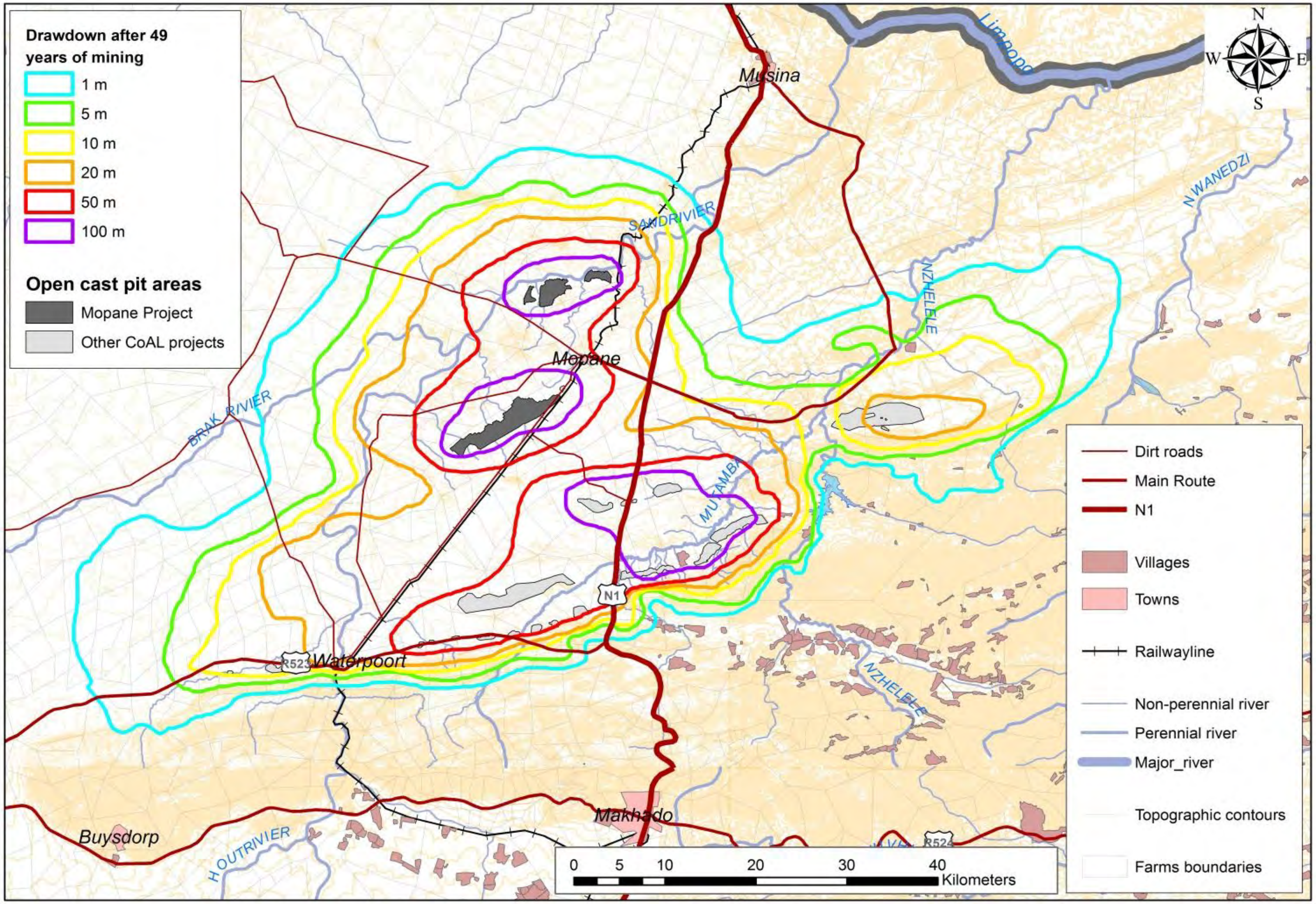


Figure 79: Cumulative drawdown in Year 49

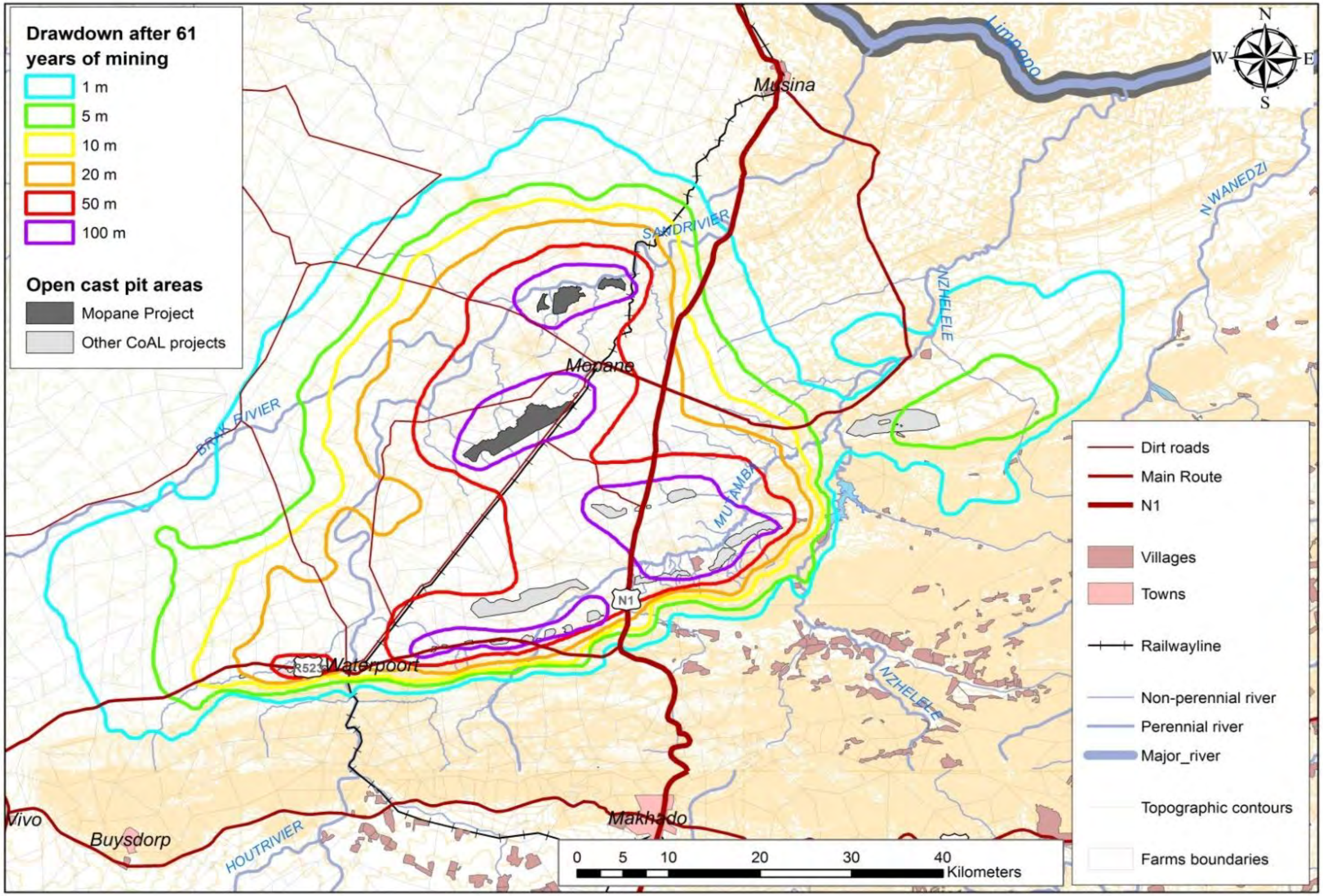


Figure 80: Cumulative drawdown in Year 61

3.1.5.3 Groundwater Impact Assessment for Mopane Project

Mining at Mopane will involve opencast mining along extended open cuts down to 200m below surface, along the southern bank of the Sand River north of Mopane Village (Voorburg Section) and southwest of Mopane Village (Jutland Section).

Groundwater flow will be intersected by these pits when below the water table. The water flowing into the pits will need to be pumped out (dewatered) for safe mining operations to continue. The water pumped from the pits will be used on the mine for process water in the plant and dust suppression. The dewatering will result in a lowering of the water table (cone of depression) around the mine pits, extending for up to 25 km at the life of mine. This is because water is taken mostly from aquifer storage, as recharge in the area is low and unable to sustain the dewatering. The north-east striking faults such as the Voorburg and Jutland (Bosbokpoort) faults are far more transmissive resulting that the cone of depression is elongated along their axis.

Impacts as a result of this could be significant. These, in order of significance, include:

- Reductions in water available for abstraction and discharge i.e. lower borehole yields or drying up of boreholes and the spring at Voorburg within the radius of influence.
- Contamination of aquifers down gradient due to seepage from the rehabilitated pits, discard dumps, stockpiles and dirty water dams.
- A reduction in water available for evapotranspiration. Groundwater dependant floral species (trees with deep root systems) could be affected as the water table drops. Riverine vegetation is mostly sustained from surface flows and water stored in the alluvial deposits; however, shallow groundwater may be important during extended dry periods.

3.1.6 SENSITIVE LANDSCAPES

3.1.6.1 Conservation Initiatives / Protected Areas

The Mopane Project area falls within the boundary of the VBR but does not fall within a buffer zone or core zone of the VBR (refer to Figure 49). Because of the large scale of a biosphere, various developments can be accommodated in the biosphere concept and the development of a coalmine within the borders of a biosphere can be accommodated. The sensitivity of environments and zone will determine the allowable activities in the VBR, which will determine if the mine is in compliance with VBR stipulations.

The nearest conservation area that is properly demarcated is the Musina Nature Reserve (SANBI BGIS, 2013), situated approximately 25 km to the north of the Voorburg Section and 30 km north of the Jutland Section / Infrastructure Hub. The proposed mine will not directly impact on any of the existing protected areas, but because of the remoteness of the areas, the main impacts will probably be through aspects such as ambience and character of the environment and wilderness quality (sense of place) through visibility, noise, air quality (dust), light etc. In addition, species that occur within the protected areas, but not restricted to its boundaries through fences (e.g. birds), might be influenced through a loss in habitat for feeding, nesting etc.

The LEDET has recently advertised an intention to declare a number of farms within and adjacent to the Voorburg Section as the Baobab Nature Reserve, including Sheldrake 239 MS, Zwartrand 506 MS, Rykswyk 240 MS, Lucerne 198 MS, Fontainebleau 212 MS and Voorburg 503 MS (City Press, 14/10/2012). In addition, the farm Fontainebleau 212 MS was declared a private nature in 1969 (Government Gazette No.512 of 21 May 1969). The legal status of these farms could not be confirmed.

Potential impacts can be summarized as follow:

- Loss in habitat and habitat quality for certain (migration) species.
- Change the ambience and character of the environment.
- Decrease the experience of the Soutpansberg and the VBR as an eco-tourist destination.
- Potential impact on the intention to declare the Baobab Nature Reserve a protected area – legal status to be confirmed.

3.2 CUMULATIVE IMPACTS

The Mopane Project forms part of the Greater Soutpansberg Project (GSP) situated to the north of the Soutpansberg in the Limpopo Province. Figure 1 depicts the locality of the various GSP projects, from which it is evident that they are within close vicinity of each other, all situated within the A80F and A71J, K & L quaternary catchments. Future operations planned for the Greater Soutpansberg area (MbeuYashu / CoAL only) are:

- Makhado Colliery (in decision-making phase)
- Mopane Project (NOMR application submitted)
- Chapudi Project (NOMR application submitted)
- Generaal Project (NOMR application submitted)

The total surface area associated with these NOMR applications is approximately 78 000 hectares.

The cumulative impacts of the high risk environmental aspects associated with the Greater Soutpansberg Project are summarized below.

Aspect	Unit of measurement	Makhado	Mopane	Chapudi	Generaal	Total
Surface disturbance / vegetation clearance (over 80 years of mining, ignoring continuous rehabilitation)	hectares	3 800	3 500	7 575	1 672	16 547
% of NOMR application area	%	4.9	4.5	9.7	2.1	21.2
Maximum bulk water requirements (make-up water at full production in 2035 at current mining schedule)	m^3/day	5 200	7 600	11 000	11 000	34 800
Groundwater Impact - area of drawdown influence	km^2	300	inclusive	inclusive	inclusive	3 600

Aspect	Unit of measurement	Makhado	Mopane	Chapudi	Generaal	Total
Maximum surface water runoff (yield) impact	m^3/annum	780 712	147 541	TBD	TBD	928 253
% of MAR	%	4	2	-	-	-
Direct employment opportunities (at full production)	persons	1 106	917	1 000	300	3 323
Impact on existing employment (estimate)	persons	370	128	TBD	TBD	TBD
Heritage sites impacted	sites	≈ 56	≈ 130	TBD	TBD	TBD
Burial sites impacted (inclusive to the above)	sites	≈ 8	≈ 16	TBD	TBD	TBD

TBD: Still under investigation as part of the Chapudi and Generaal EIA specialist investigations.

≈: Approximate number of sites, to be finalized once mining schedule and infrastructure layouts are confirmed during the Feasibility Phase.

The most significant cumulative impact is associated with the groundwater drawdown. The groundwater modeling indicate that the impacts from Mopane, Generaal and Mount Stuart, and Chapudi Projects are cumulative and overlap, and drawdown occurs for a radius of up to 25 km at the end of the life of the mines. The area of drawdown influence is in the order of 3 600 km^2.

The Sand River is an extremely important system with the system providing potable water as well as large volumes of water for the irrigation of crops to the north of the Soutpansberg mountain range. The irrigation of the crops is critical to their success and the crops produced can be considered to be of high significance as the crops are produced in winter when areas further to the south cannot produce food for the South African consumer. Prior to any large scale mining in the area the system can already be considered to be stressed from a water supply point of view. It is also important to note that no reserve determination has been undertaken for the Sand River. In addition the system has been identified as a FEPA river system and an upstream support area for a fish FEPA and is therefore considered important in fish conservation. For these reasons extreme caution must be used in decision making in the area with regards to any activity which may affect water supply.

The activities of the Generaal Project are unlikely to contribute to the cumulative impact on the Sand River although some very small impacts on the Limpopo River system may occur. There will however be a significant cumulative impact on the Sand River system from both the Chapudi and the Mopane Projects with both systems likely to have similar types of impacts on the Sand River system. The combined impact of both these projects is likely to significantly affect the water supply and possibly the water quality in the Sand River which in turn will affect the habitat available in the system as well as the availability of refuge pools in periods of low flow and an impact on aquatic and riparian community diversity sensitivity and abundance is likely to occur. In addition these projects have the potential to affect downstream socio-cultural service provision of the Sand River system.

For these reasons extreme caution and care should take place throughout the entire life cycle of these two projects, should they proceed, in order to ensure that the impact on the Sand River system and other ephemeral systems in the area with riparian vegetation is minimised to levels which would ensure an ongoing acceptable level of functioning and biodiversity in these systems.

The socio-economic cumulative impacts have been addressed in detail in the SEIA (Naledi, 2013) and are not repeated here. Refer to ANNEX-9.

The main conclusion arising from the SEIA assessment is that should all the Greater Soutpansberg Projects and other planned mining developments in the region be implemented at the same time and development cannot be staggered, the following cumulative socio-economic impacts and benefits are envisaged:

- Cumulative socio-economic impacts:
    - Additional influx of people into the area, thereby adding to congestion and pressure on local infrastructure and services.
    - Compounded impact on the area's sense of place, this in turn may cause a decline in tourism and hunting related activities in the surrounding area.
    - Impact on land use and availability for ecotourism and hunting.
- Cumulative socio-economic benefits:
    - Combined increased in local economic growth and employment.
    - Combined increase in local procurement opportunities causing local business to expand to fill the demand for goods and services.
    - Additional contribution to government tax, balance of payments and national growth.

Given the scale of mining planned in the region and if there is a lack of a concerted action by key stakeholders including government, local stakeholders and industry, there is a high likelihood that significant environmental and socio-economic impacts will occur in the area. It is therefore recommended that development be staggered in the area to optimise the sustainability of the long-term benefits and mitigate the environmental and socio-economic impacts.

3.3 POTENTIAL FOR ACID-MINE DRAINAGE

No geochemical testing has been done for the Mopane Project to date. This brief evaluation is based on the results of tests done for the neighbouring project Chapudi (SRK report Chapudi Project: Environmental baseline study, September 2009). This report covers a coal project in a similar environment to the Mopane Project.

The results of tests done on this project indicate the following:

- The overburden material stripped to access the coal seams are unlikely to generate acidity and in fact show strongly neutralising potential. There is however a possibility that they will produce salts which may negatively impact on the environment.
- The coal seams may or may not generate acidity and it will be necessary to conduct long term tests to confirm this. If it is assumed that acidity will be generated mobilisation of manganese, iron, barium and nickel and in some instances cobalt and strontium could occur.
- The inter-seam mudstones and dolerites are unlikely to be acid generating although there may be salt produced which may impact the environment

All the above conclusions can only be fully confirmed with the completion detailed testing including long-term kinetic test work.

The risks therefore include:

- Potential acid generation from coal stockpiles which will need to be managed.
- Salinity generated from overburden stockpiles in the form of alkalinity mainly sulphate with the major cations being sodium, calcium, potassium andmagnesium, depending on the lithologies.

4 ALTERNATIVE LAND USE OR DEVELOPMENTS THAT MAY BE AFFECTED

4.1 CURRENT LAND USE

The current land uses / economic activities in the region include:

- Live Stock Farming
  - Commercial Cattle
- Game Farming
  - Live Sales
  - Hunting, subdivided in "Trophy" and "Biltong"
    - Trophy hunting including the services of professional hunter, skinner, tracker, etc.
    - Biltong hunting including tracker, skinner, etc.
  - Hunting Accommodation
- Eco Tourism, visitors to the lodges without any hunting motivation.
- Cultivation (crop production): Irrigation and dry-land.

Refer to Section 7 of this report for more detail in this regard.

4.2 ALTERNATIVE LAND USE OPTIONS

Present land use is mainly cattle and game farming, but carrying capacity is questionable due to poor physical soil quality (erosion susceptibility, shallow soils, surface rock and poor climatic conditions).

Possible land use alternatives for the current trophy game hunting enterprises on farms surrounding the Mopane Project area might be to switch to the rearing of trophy game for catching and private sale/auction purposes and/or rare game rearing for auction or reverting to cattle farming.

Current cattle farming enterprises on farms surrounding the Mopane Project area could probably continue without the mining activities affecting their businesses negatively. Possible negative effects could be coal dust, general theft and increase in road traffic.

Large scale cultivation is not possible in the Mopane Project area for the following reasons:

- Although there are large areas of deep soils, these areas are sub optimal due to low clay contents. As a result of low rainfall, high temperatures (high evapotranspiration), susceptibility to compaction, present erosion and erodibility the soils in the area is study is not recommended for rain fed crop production.
- Fields presently used for irrigation are susceptible to salinity and sodicity due to poor water quality with high chloride values. The relatively high salt contents currently prevents dispersion, however rain water can cause dispersion and enhance crust formation on the soils.
- Water quality for irrigation purposes is of low quality with restriction to sensitive crops. Water samples were taken during the winter and it is recommended to make a continual assessment of water quality during the year, since it can change significantly during the year.

The only alternative land use option for this mine is the No-Go Option, in which case the status quo will be maintained.

4.3 DEVELOPMENT ALTERNATIVES – CONCEPT STUDY

A number of alternative options have been evaluated during the concept mine design. A high-level qualitative risk assessment was performed to determine the most preferred option from an environmental perspective.

4.3.1 MINE INFRASTRUCTURE

The Mopane Project footprint is in an environmental and ecological sensitive area and therefore the necessary diligence will be exercised when considering the final location, placement and orientation of the mine infrastructure and coal beneficiation plant. The following salient factors will be considered during the design and placement of the facilities:

- Energy efficiency
- Impacts of environmental conditions such as prevailing winds, dust and sun with respect to infrastructure placement
- Flood and rainfall immunity levels
- Human settlement planning and design
- Water recycling and reuse

4.3.1.1 Infrastructure Layout Options

Initially three mining layout options were developed of which one (Huntleigh Siding Load out) was not further considered as it did not offer the same benefits as the other option. The remaining two options were then compared and the more favorable option taken forward to the costing and submission stage. Refer to Figure 81 below showing the two mining pits in relation to the Musina-Makhado rail line and the National Road (N1) from where access to the mines will be gained via the surfaced Mopane Road.

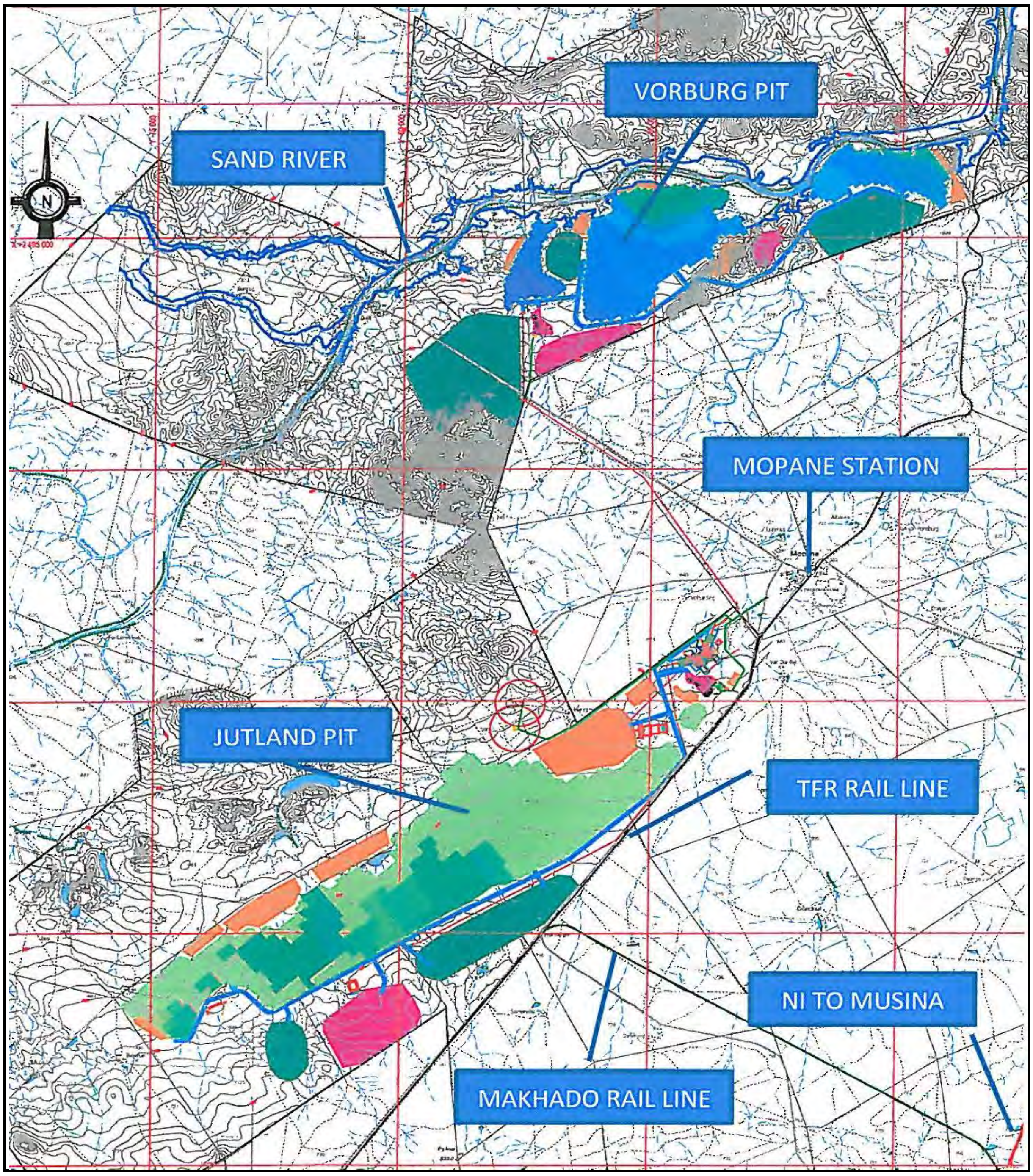


Figure 81: Jutland and Voorburg Sections in relation to existing infrastructure

The following factors were taken into considerations during the process where the alternatives were compared:

- Distance of product to be transported to the nearest rail link (in this instance Mopane Station);
- Mode of transport i.e. rail versus conveyor (for environmental reasons road transport was not considered);
- Topography and water courses (the Sand River runs past Voorburg);
- Sharing of facilities amongst the two mines;
- Positioning of carbonaceous and non-carbonaceous dumps, discards and topsoil dumps in relation to the mining pit;
- Discard dumps in relation to the plant position and layout;
- Positioning and orientation of infrastructure and layouts of haul roads, access roads, rail access routes and conveyor routes;
- Traffic movement around the plant and mine infrastructure areas; and
- Natural streams and drainage channels for discharge of clean and capture of polluted storm water run-off.

A comparison of the two remaining options is given below.

4.3.1.2 Option 1: Independent Mines

This option considered the mining of the Jutland and Voorburg Sections as two separate entities each with independent infrastructure and coal beneficiation plants.

4.3.1.2.1 __Voorburg Section__

Voorburg Section lies some 7 km to the north of the Mopane Rail Siding. Access to the Voorburg Section runs along the Provincial Road which passes by the south-west corner of the mine (refer to Figure 82). The main variables for this option are as follows:

- Positioning of the residue stockpiles;
- Positioning of the plant and infrastructure on site; and
- Transport of product to the rail siding.

The positioning of the residue stockpiles are dictated by the position of the Sand River which borders the pit on the north. The only alternative therefore was to spread the dumps along the southern edge of the pits.

The position of the plant and infrastructure area was considered by distance to the nearest access such as road and rail alignment as well as keeping within the prospect and mining areas. Once these options were considered, the position of the plant was decided. As the access to the mining site along the existing provincial road is well positioned and does not require new land or servitudes resulting in substantial cost savings, this option was selected.

Transport of product to the rail siding can be done by road, rail or conveyor. The road transport option which would involve high traffic frequencies is considered undesirable and was not further followed up. The advantage of a rail vs. a conveyor system in this instance is as follows:

- A rail load out is required in both instances;
- The cost for both systems are more or less the same; and
- The rail loop can be located on site next to the tip from where the product will be railed to the destination.

As the rail system showed more advantages than the conveyor system this was the chosen option.

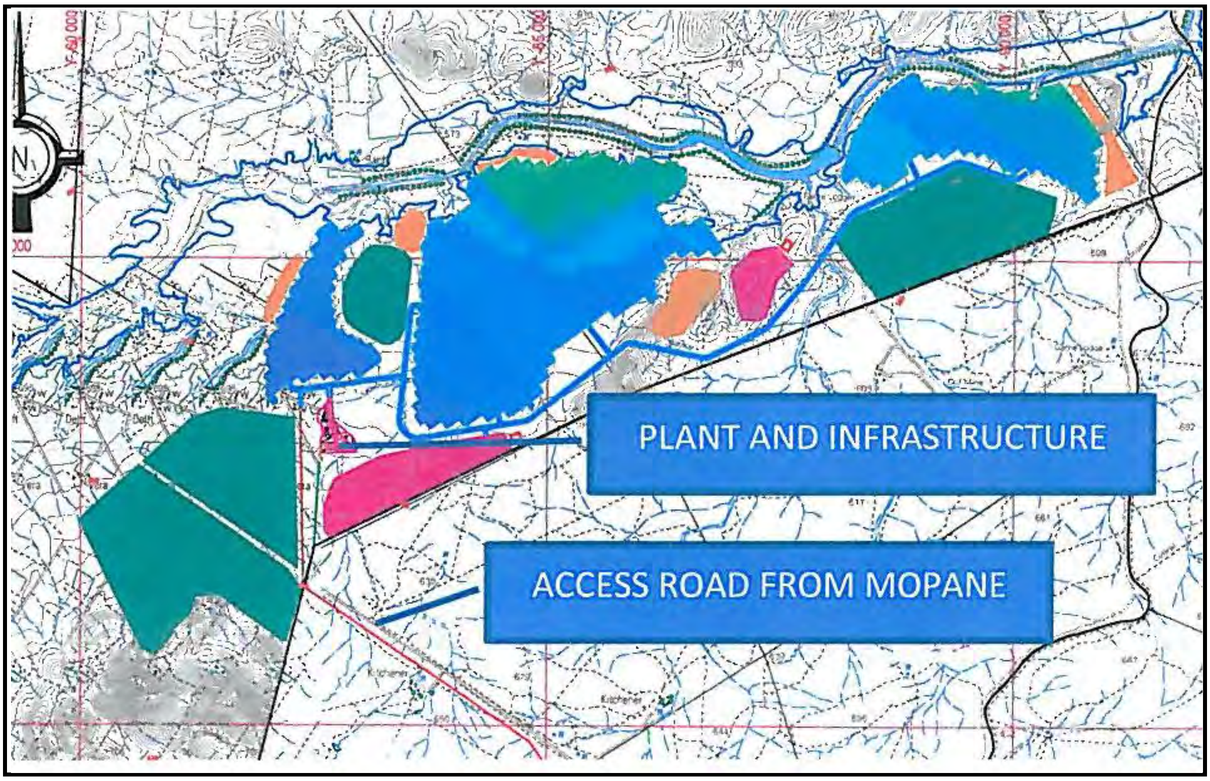


Figure 82: Option 1 - Independent Voorburg Section

4.3.1.2.2 Jutland Section

Jutland Mine lies about 2 km north-west of Mopane Siding next to the rail line. As such the rail loop is within the immediate vicinity of the product conveyor from where product is transferred to the RLT located on site. The access road takes more or less the shortest distance from the Mopane Provincial Road on the west side of the rail line onto the mining site. The advantages of easy access to and from the mine, as well as the available space, made this the preferred option compared to the positioning of the plant at Huntleigh Siding. A further drawback for the Huntleigh Siding option would have been that the existing access road to site along the Makhado rail line would have had to be upgraded at considerable cost. The Huntleigh Siding layout also requires product to be taken across the TFR rail to the rail loop on the east side of the TFR rail line due to space constraints on the west side. A further advantage was that the proposed position is better suited for the Combined Option as discussed below.

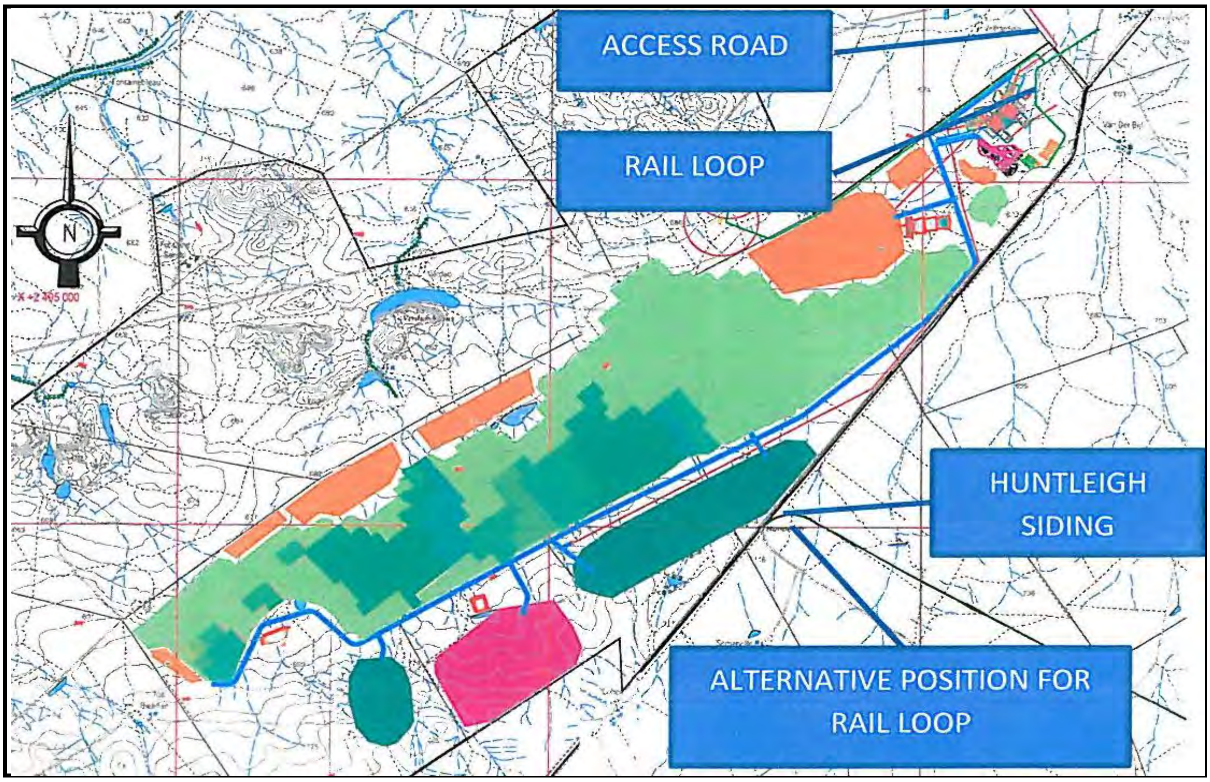


Figure 83: Option 1 – Independent Jutland Section

4.3.1.3 Option 2: Combined Mining Facilities

The combined mining option, as opposed to the individual mining options explored the advantages of the two mining pits sharing common facilities such as:

- Coal beneficiation plant;
- Infrastructure such as change house, managers offices etc;
- Single rapid load out facility;
- Balancing coal production between the two pits; and
- Explosives magazine etc.

For the combined option a second washing plant module, to process the Voorburg coal, will be placed next to the Jutland plant from where product will be transferred to the RLT close by. Two options were considered for the transport of product from Voorburg to Jutland i.e. by rail or by conveyor. The advantages of the conveyor option which was chosen are as follows:

- The Jutland RLT could be used for both plants instead of having a separate rail loading facility at Voorburg Section;
- There is no major difference between rail and conveyor construction costs; and
- The conveyor will have less impact on the environment compared to a rail line.

4.3.2 PRODUCT TRANSPORT

Following detailed evaluation, it was determined that the preferred option for coal despatch is a RLT on the farm Pretorius 531 MS connected by a balloon railway siding to a point between Huntleigh and Mopane. Factors influencing this conclusion include the low long term operational cost for coal transport from plant to port, lower environmental impact and the lessening of community impact (lower road traffic, congestion and pollution). The elimination of a loading site at Huntleigh or Mopane by placing the loading site at farm Pretorius 531 MS removes a single-point impact of considerable significance. A rail link provides a seamless transition from the loading siding to a direct link to TFR mainline network at a point between Mopane and Huntleigh.

Factors underpinning this decision to proceed with a RLT on the farm Pretorius 531 MS connected by a railway siding to a point between Huntleigh and Mopane include:

- The low long term operational cost for the coal transport from plant to port is achieved when replacing the road haul leg, with its expensive road over road crossings and access ramps, with a 4.2 km dedicated rail siding;
- Long term rail costs are significantly lower than road costs, when upgrading and ongoing maintenance costs are taken into account;
- Economies of scale are achieved even at the currently expected long term average throughput of 4.7 Mtpa including ramp up volume as other mines come on stream;
- A railway has a provably lower environmental impact when measured against a road haul option, under prevailing road and rural community conditions;
- A railway option largely internalizes the externalities associated with transport in the form of congestion, accidents, air pollution, carbon footprint, noise (the marginal difference between road and rail) and nuisance, which are not passed on to the community at large;
- The effect of approximately 757 x 34 t road vehicle trips per day (empty and loaded leg) is effectively removed as a source of ongoing community conflict, significant traffic hazard, noise and nuisance in a very confined rural environment;
- While a railway line will not be without its impacts, the dramatically lower level of intrusion into the fabric of public life allows due attention to be paid to those issues which do indeed materialize;
- With the proposed being a direct link and loading site at farm Pretorius 531 MS, opposed to loading site at Huntleigh or Mopane, providing a seamless transition from loading siding to direct link to TFR mainline network at a point between Mopane and Huntleigh; and
- Better environmental management of loading activities is possible, due to the provision of a RLT.

4.3.3 MINE RESIDUE MANAGEMENT

4.3.3.1 Slurry Management

Two options were evaluated:

- Surface slurry ponds
- Inclusion of filter press within the system

The inclusion of a filter press within the process would facilitate increased recycling of water, reduce the risk of spillages and acid-mine drainage and limit the impact on air quality as the residue will be consolidated. Thus, even though this would mean a higher capital cost input, from an environmental perspective this is the preferred option.

4.3.3.2 Discard Management

Three options were evaluated for the management of the mine residue (discard and slurry) associated with the proposed project. Two surface facilities were looked at, namely surface discard dumps and slurry facilities and a co-disposal facility catering for both. The third option that was evaluated is in-pit disposal of mine residue during rehabilitation of the opencast pits.

From a groundwater perspective, the in-pit disposal is the option that would (potentially) cause the least impact owing to the fact that the residue could be placed at the bottom of the pit, allowing the residue to be inundated with water. This would reduce the potential for oxidation and the formation of acid-mine drainage.

In-pit disposal would also facilitate a free-draining final profile as far as practically possible which from a visual and end-land use perspective is the preferred option. Surface residue facilities would have a huge visual impact as well as long-term maintenance issues.

Due to constraints in the mining schedule and the bulking factor of the overburden, a combination of surface and in-pit disposal will be employed at Mopane.

4.4 DEVELOPMENT ALTERNATIVES – FEASIBILITY STUDY

The following alternative options were proposed by stakeholders during the various engagement sessions and will be investigated further during the Feasibility Phase of the project:

- Relocation of the Mopane Infrastructure Hub to either the farm Van Der Bijl 528 MS or the farm Vriendin 589 MS.
- Re-alignment of the overland conveyor from the Voorburg Section to the Infrastructure Hub, aligning it along the Nieuwelust road and then along the Musina-Makhado railway line, rather than cutting through undisturbed areas on the farm Goosen 580 MS.

5 POTENTIAL SOCIAL AND CULTURAL IMPACTS

5.1 SOCIO-ECONOMIC ENVIRONMENT

5.1.1 AIR QUALITY

5.1.1.1 Construction Phase

During the construction assessment phase it is expected that, the main sources of impact will result due to the construction of access roads and the mining area. These predicted impacts cannot be quantified extensively, primarily due to the lack of detailed information related to scheduling and positioning of construction related activities.

Construction is commonly of a temporary nature with a definite beginning and end. Construction usually consists of a series of different operations, each with its own duration and potential for dust generation. Dust emission will vary from day to day depending on the phase of construction, the level of activity, and the prevailing meteorological conditions (USEPA, 1996).

The following possible sources of fugitive dust have been identified as activities which could potentially generate dust during construction operations at the site:

- Product Transport
  - Conveyor corridor clearing;
  - Scraping;
  - Debris handling;
  - Debris stockpiles; and
  - Truck transport and dumping of debris.
- Processing Plant
  - Clearing of area for infrastructure;
  - Debris handling;
  - Debris stockpiles; and
  - Truck transport and dumping of debris.
- Opencast Mining
  - Removal of overburden; and
  - Haul Roads (scraping etc).

Access roads are constructed by the removal of overlying topsoil, whereby the exposed surface is graded to provide a smooth compacted surface for vehicles to drive on. Material removed is often stored in temporary piles close to the road edge, which allows for easy access once the road is no longer in use, whereby the material stored in these piles can be re-covered for rehabilitation purposes. Often however, these unused haul roads are left as is in the event that sections of them could be reused at a later stage.

A large amount of dust emissions are generated by vehicle traffic over these temporary unpaved roads (USEPA, 1996). Substantial secondary emissions may be emitted from material moved out from the site during grading and deposited adjacent to roads (USEPA, 1996). Passing traffic can thus re-suspend the deposited material. To avoid these impacts material storage piles deposited adjacent to the road edge should be vegetated, with watering of the pile prior to the establishment of sufficient vegetation cover. Piles deposited on the verges during continued grading along these routes should also be treated using wet or chemical suppressants depending on the nature and extent of their impacts.

A positive correlation exists between the amount of dust generated (during vehicle entrainment) and the silt content of the soil as well as the speed and size of construction vehicles. Additionally, the higher the moisture content of the soil the lower the amount of dust generated.

The periodic watering of these road sections will aid in the reduction of dust generated from these sources. Cognisance should be taken to increase the watering rate during high wind days and during the summer months when the rate of evaporation increases.

The following components of the environment may be impacted upon during the construction phase:

- ambient air quality;
- local residents and neighbouring communities;
- employees;
- the aesthetic environment; and
- possibly fauna and flora.

A quantitative assessment of the construction phase was calculated based on the US EPA Heavy construction emission factors. The construction activities took into account the construction of the Voorburg and Jutland pits.

Figure 84 below illustrates the maximum predicted daily concentration (µg/m^3) of PM_{10} from construction related activities. The predicted PM10 concentration falls below the average daily concentration of 120 µg/m^3. The maximum predicted annual concentration of particulate matter was estimated at 2.00E-01 (Figure 85) which falls below the annual standard of 50 µg/m^3.

Table 42: Maximum predicted ambient ground level concentration (µg/m3) of Particulate Matter during the construction phase

Source	Maximum predicted ground level Concentration of PM_{10} (µg/m^3)	Ambient air quality standard	Fraction of the standard (%)
Daily			
Cumulative impact	0.700	120	0.6
Annual			
Cumulative impact	0.200	50	0.4

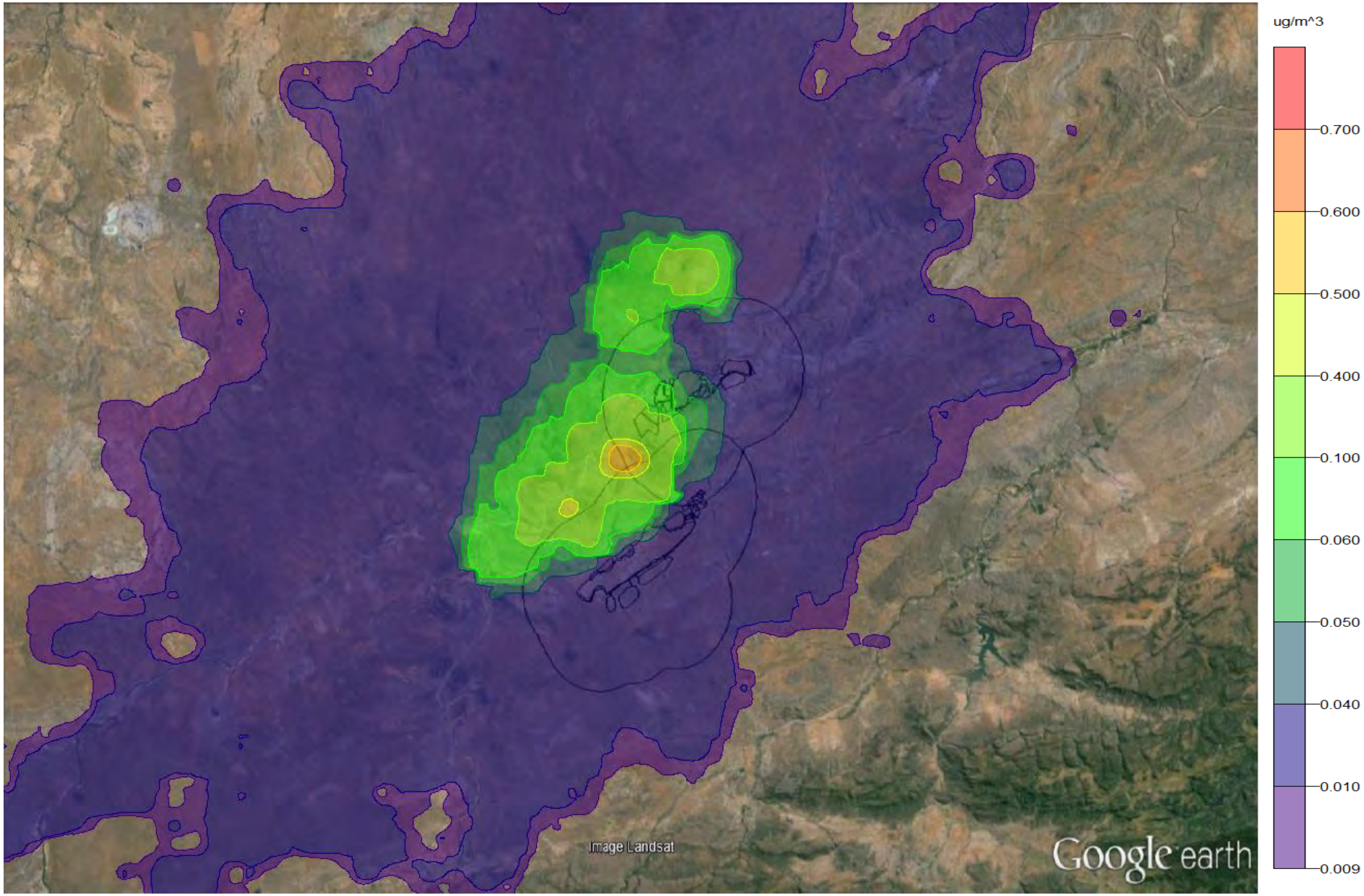


Figure 84: Maximum predicted Daily concentration (µg/m³) of Particulate Matter

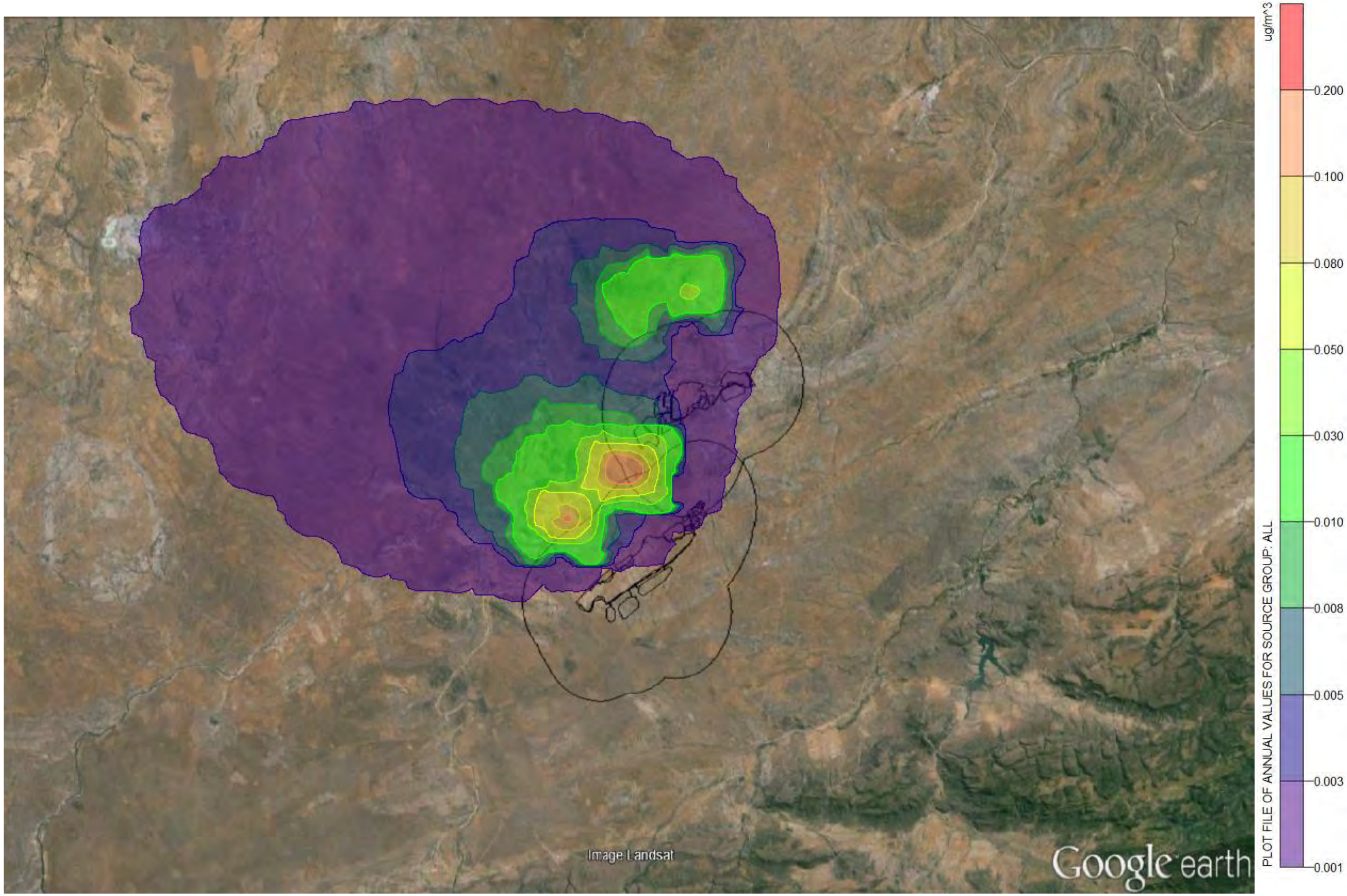


Figure 85: Maximum Predicted Annual ground level concentration (µg/m^3) of Particulate Matter

5.1.1.2 Operational Phase

Details regarding the source characteristics were extrapolated from site layout plans. Sources that were included in this assessment are:

- Coal processing (storage piles, crushing and screening activities); and
- Opencast mining and in-pit activities (blasting, drilling, bulldozing, tipping).

Table 43 indicates the maximum predicted daily ground level concentrations for PM_{10} during the operational conditions of the Mopane Project. The cumulative impact of 30 µg/m^3 falls below the daily standard of 120 µg/m^3 for PM_{10} (**Figure 86**). When compared against the stricter standard of 75 µg/m^3 to be implemented in 2015, the maximum predicted ground level concentration still falls below this daily limit. The highest contributor of particulate matter during the operational phases is from Jutland and Voorburg pit activities such as bulldozing, drilling, crushing and tipping activities.

Table 43: Maximum predicted ambient ground level concentration (µg/m^3) of Particulate Matter during the operational phase

Source	Maximum predicted daily ground level Concentration of PM_{10} (µg/m^3)	Ambient air quality standard	Fraction of the standard (%)
Mining Pit activities Jutland	30.00	120	25
Mining Pit activities Voorburg	20.00	120	17
Stockpiles	7.00	120	6
Cumulative impact	30.01	120	25

Table 44 indicates the maximum predicted annual ground level concentration for particulate matter during the operational activities at the Mopane Project. The cumulative impact recorded a maximum annual emission concentration of 7µg/m^3. This predicted annual concentration falls below the annual standard of 50 µg/m^3 for Particulate matter. Figure 87 illustrates the annual concentration dispersion potential. The highest contributor to the Particulate Matter concentration is mainly from the Jutland and Voorburg pit activities.

Table 44: Maximum predicted annual ground level concentration (µg/m^3) of Particulate Matter during the operational phase

Source	Maximum predicted annual ground level Concentration of PM_{10} (µg/m^3)	Ambient air quality standard	Fraction of the standard (%)
Mining Pit activities Jutland	7	50	14
Mining Pit activities Voorburg	4	50	8
Stockpiles	1	50	2
Cumulative impact	7	50	14

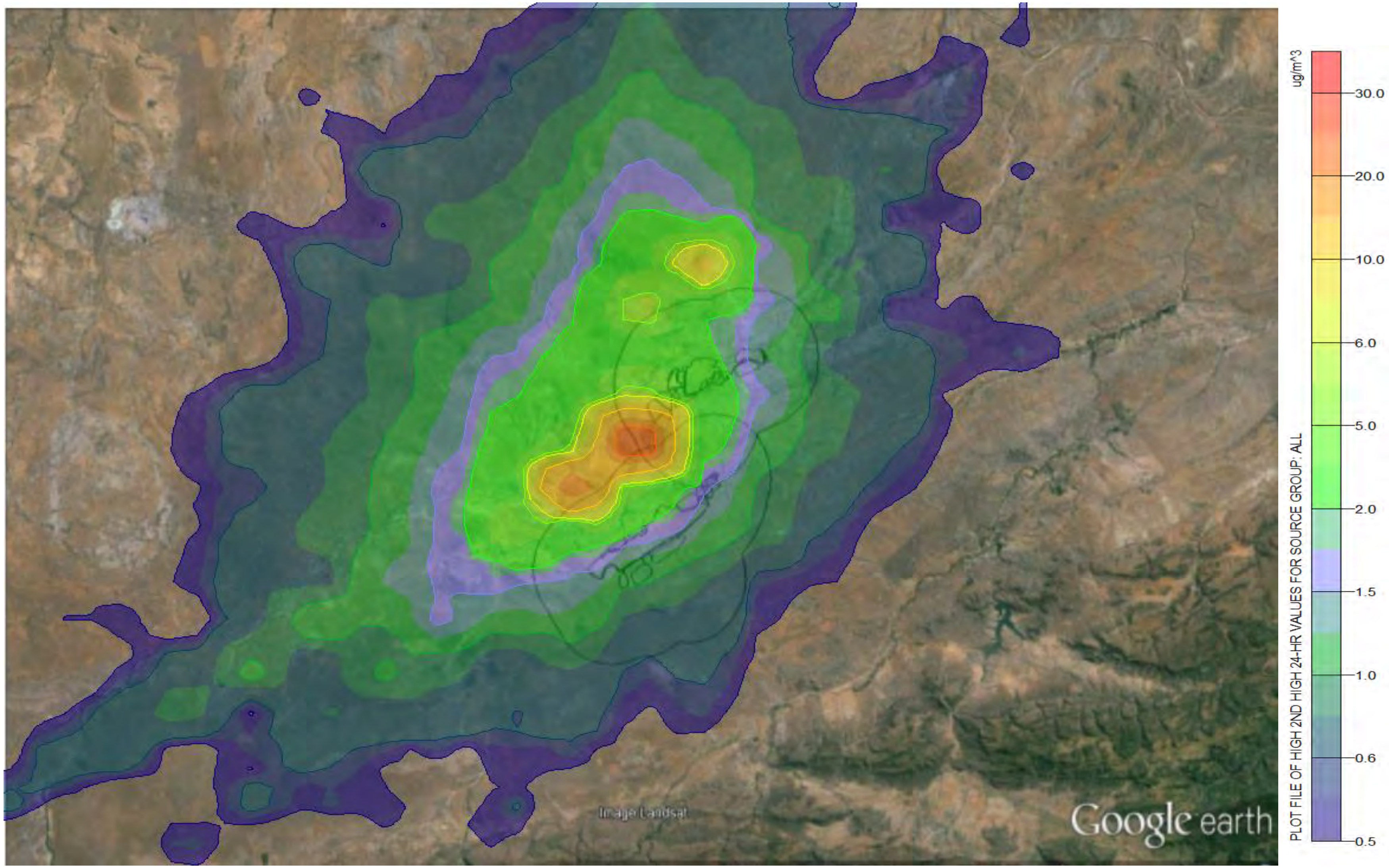


Figure 86: Maximum cumulative Predicted daily ground level concentration (µg/m³) of Particulate Matter

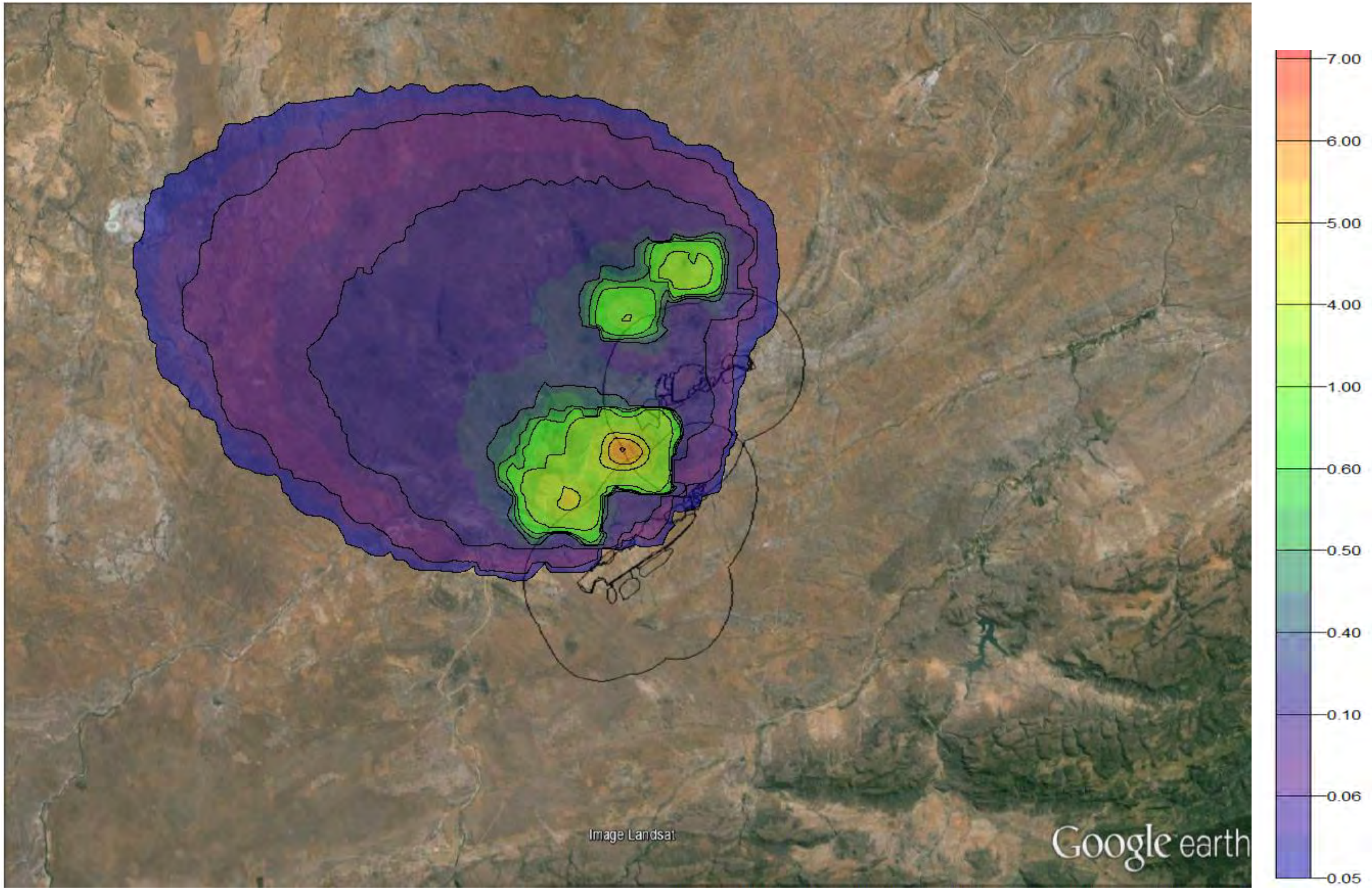


Figure 87: Maximum cumulative Predicted annual ground level concentration (µg/m³) of Particulate Matter

The blasting impacts were modelled separately as blasting was modelled at an average of 3 times per week for intervals of approximately 10 minutes. Figure 88, Figure 89 and Figure 90 indicate the hourly, daily and annual concentrations of particulate matter from blasting activities respectively. The daily and the annual concentrations for blasting activities both fell below the daily and annual standard for particulate matter.

Blasting is not a continuous activity and is limited to a maximum of three times a week, thus the initial impact of blasting is relatively high with the annual concentration being minimum.

Figure 91 illustrates the maximum predicted dust fallout impacts anticipated to occur during the operational activities at the Voorburg and Jutland mine. The dust fallout threshold of 600 mg/m^2/day occurs at the boundary between the Voorburg and Jutland mines, where the stockpiles are expected to be. There were no exceedances of the 1200 mg/m^2/day limit for a non- residential site. The concentration at the mine boundary was estimated at 300 mg/m^2/day.

When compared to the monitored data of Makhado Colliery (August 2010 – April 2013), the average dust fallout threshold was 390 mg/m^2/day. Higher dust fallout rates are expected during the winter months of July – August. An increase in activity will result in an increase in the dust fallout rate.

5.1.1.3 Decommissioning Phase

The decommissioning phase is associated with activities related to the demolition of infrastructure and the rehabilitation of disturbed areas. The total rehabilitation will ensure that the total area will be a free-draining as far as practically possible covered with topsoil and grassed. The following activities are associated with the decommissioning phase (US-EPA, 1996):

- Existing buildings and structures demolished, rubble removed and the area levelled;
- Remaining exposed excavated areas filled and levelled using overburden recovered from stockpiles;
- Topsoil replaced using topsoil recovered from stockpiles; and
- Land and permanent waste piles prepared for revegetation.

Possible sources of fugitive dust emission during the closure and post-closure phase include:

- Smoothing of stockpiles by bulldozer;
- Grading of sites;
- Transport and dumping of overburden for filling;
- Infrastructure demolition;
- Infrastructure rubble piles;
- Transport and dumping of building rubble;
- Transport and dumping of topsoil; and
- Preparation of soil for revegetation – ploughing and addition of fertiliser, compost etc.

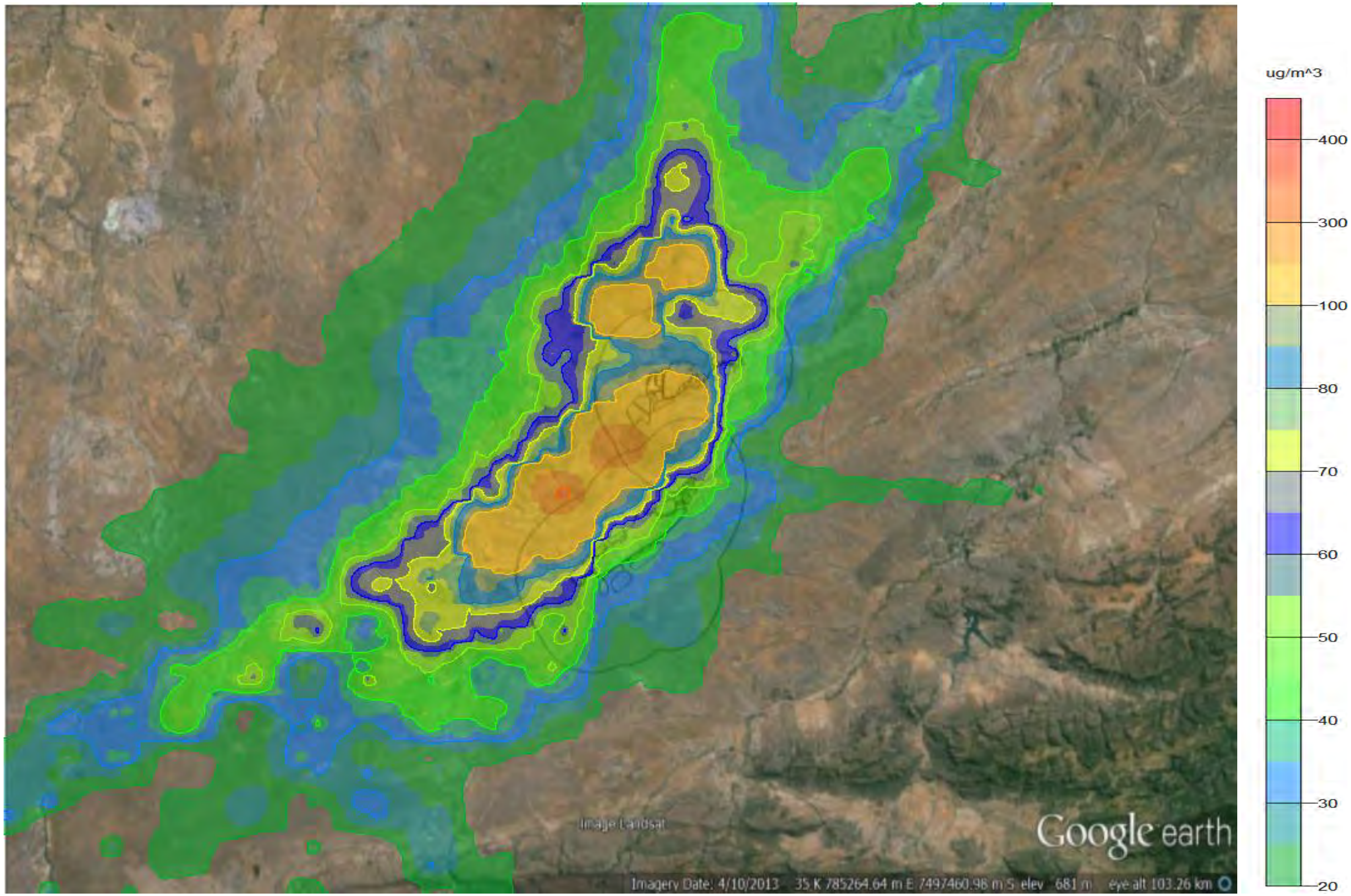


Figure 88: Maximum predicted hourly concentration (µg/m^3) of particulate matter from Blasting Activities

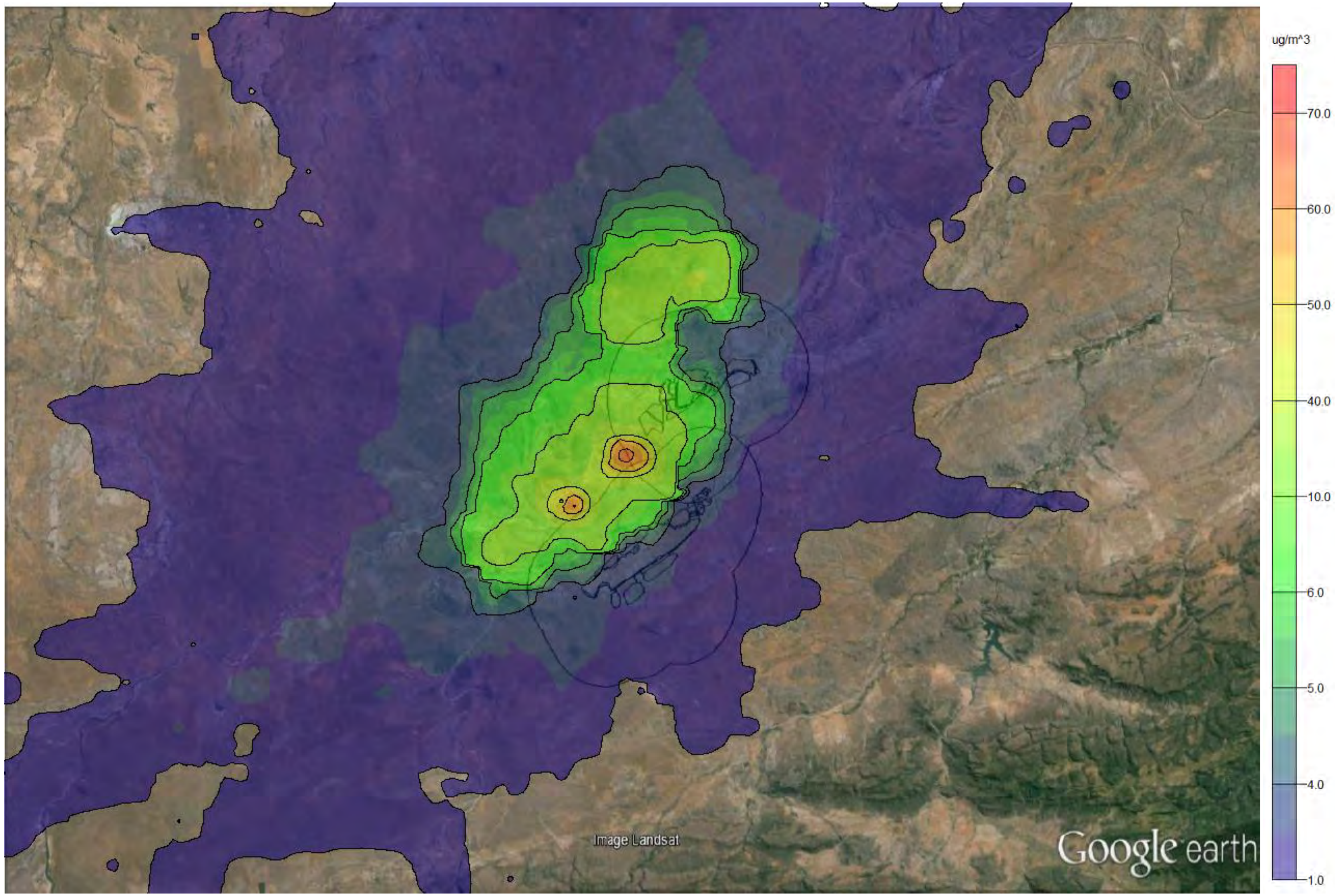


Figure 89: Maximum predicted daily concentration (µg/m^3) of particulate matter from blasting activities

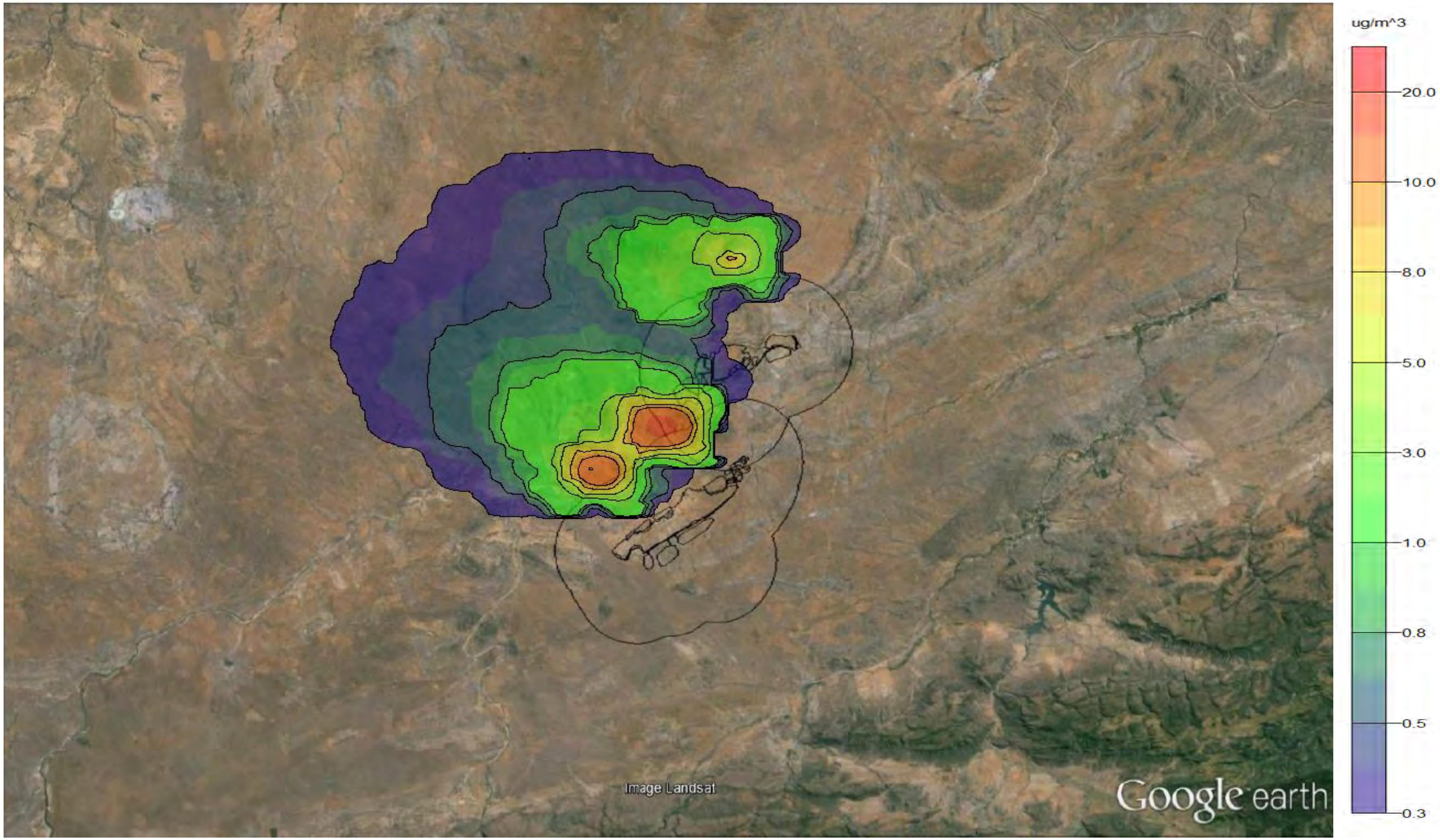


Figure 90: Maximum predicted annual concentration (µg/m^3) of particulate matter from blasting activities

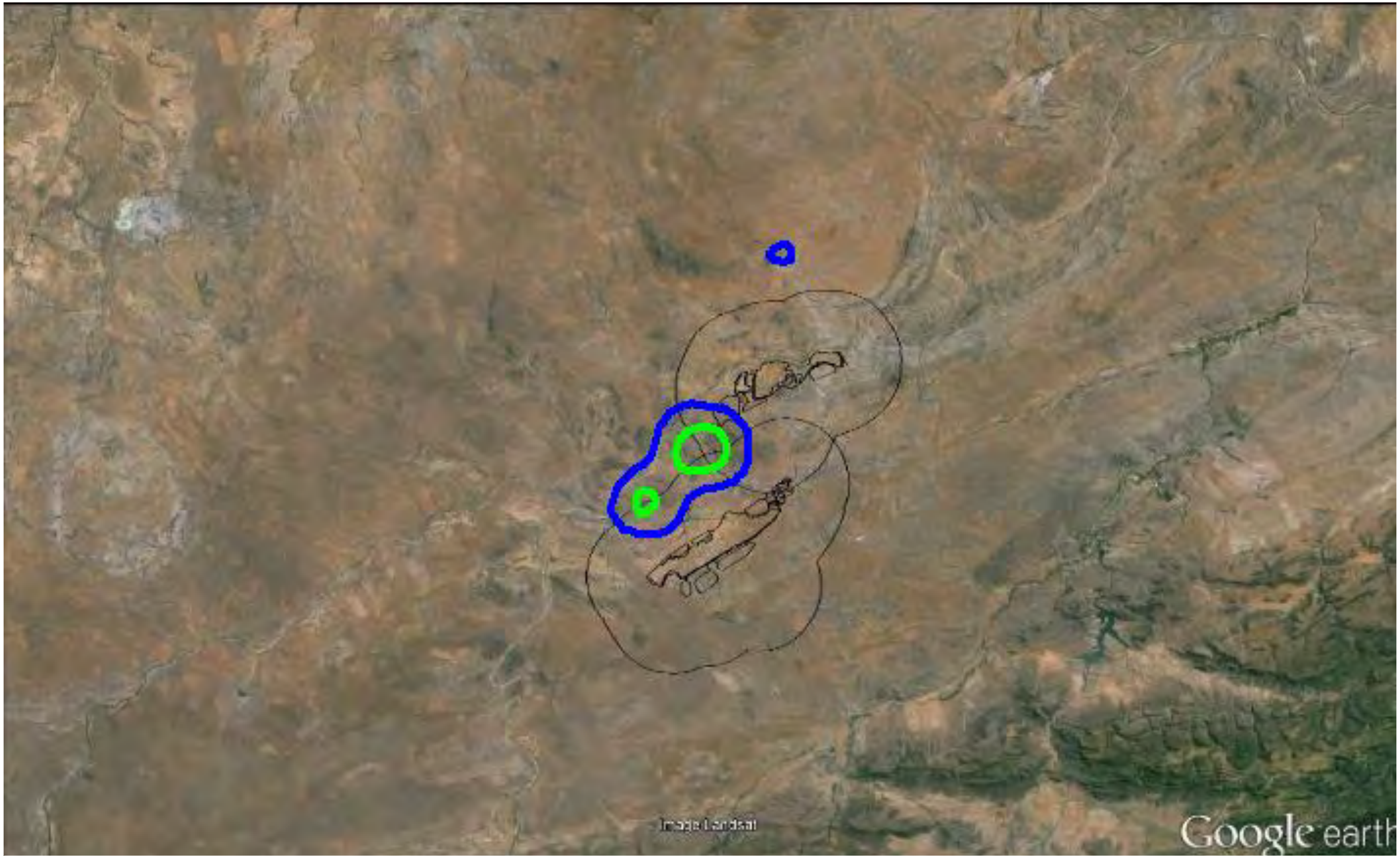


Figure 91: Dust fallout impacts recorded during the Operational phases of the Mopane Project

{Green = 600 mg/m^2/day, blue = 300 mg/m^2/day}

Exposed soil is often prone to erosion by water. The erodability of soil depends on the amount of rainfall and its intensity, soil type and structure, slope of the terrain and the amount of vegetation cover (Brady, 1974). Revegetation of exposed areas for long-term dust and water erosion control is commonly used and is the most cost-effective option. Plant roots bind the soil, and vegetation cover breaks the impact of falling raindrops, thus preventing wind and water erosion. Plants used for revegetation should be indigenous to the area, hardy, fast-growing, nitrogen-fixing, provide high plant cover, be adapted to growing on exposed and disturbed soil (pioneer plants) and should easily be propagated by seed or cuttings.

The impacts from dust fallout and Particulate matter can be reduced by implementing dust control measures. The highest intensity of the construction work should be carried out during the summer months and not over the harsh winter months as can result in increased dispersion of fugitive dust. The Mopane mine should ensure that unpaved roads are continuously watered and treated with dust-a-side products to reduce the volume of fugitive dust emitted from unpaved roads. The use of wind screens on open ground surfaces during periods of extreme windy conditions.

Overall the impacts arising from the mining activities at both the Jutland and Voorburg Sections are within the ambient air quality standards.

5.1.1.4 Methane Emissions

Methane is formed in coal during coalification. The quality and the quantity of methane created depend on the composition of the organic matter. Methane is retained within the coal bed and surrounding strata. As long as the gas remains under pressure and assuming there is no geological processes to influence the reservoir, mining activities releases the pressure and methane escapes. In area where miners are working, methane level are required to be at 0.5%, this can be achieved by continuous ventilation. Methane in general is not toxic to humans but it is of concern in terms of its explosive potential and its impact on the global climate. The most common accepted flammability range for methane in air mixtures are given as 5.3% to 14%. The flammability range becomes slightly extended to 5.0% - 15% when mixtures of methane in air are retained. Methane is one of the most significant greenhouse gases (21 times stronger than carbon dioxide).

5.1.2 AMBIENT NOISE

5.1.2.1 Construction Phase

Construction activities highly depend on the final mining plan and schedule. The mining plan as received from the client was reviewed and potential locations where noisy activities may take place identified. A layout as conceptualised and modelled is presented in Figure 92.

As can be seen from this conceptual scenario a number of different activities could take place, at a number of locations, each with a specific impact on the closest potentially noise-sensitive developments. Because of the various potential activities that could take place during the construction phase, a conceptual worse-case scenario was considered including:

- Preparation of box-cut area – Bulldozer clearing vegetation and topsoil
- Excavator loading topsoil/softs on LHD trucks for removal to stockpiles
- Drilling of the interburden
- LHD trucks idling near excavation activities
- LHD truck offloading softs at a number of stockpiles
- General noise for a number of construction activities
- Diesel generator operating in vicinity of general construction activities
- General noise in areas where the plant, offices and workshops are to be constructed
- TLB digging foundations for the conveyor belt
- 12 light and 12 heavy vehicles traveling between the various activities at an average speed of 60 km/h.
- All equipment is operating under full load and all activities taking place simultaneously at a number of locations close to the community (worst case scenario).
- The potential shielding that other buildings may provide is not considered.
- Atmospheric conditions would be ideal for sound propagation (50% humidity and 25o C) with a slight south south-easterly wind.
- Ambient sound levels were assumed to be 30 dBA (quiet rural area).

The noise contours associated with the construction phase are illustrated in Figure 95.

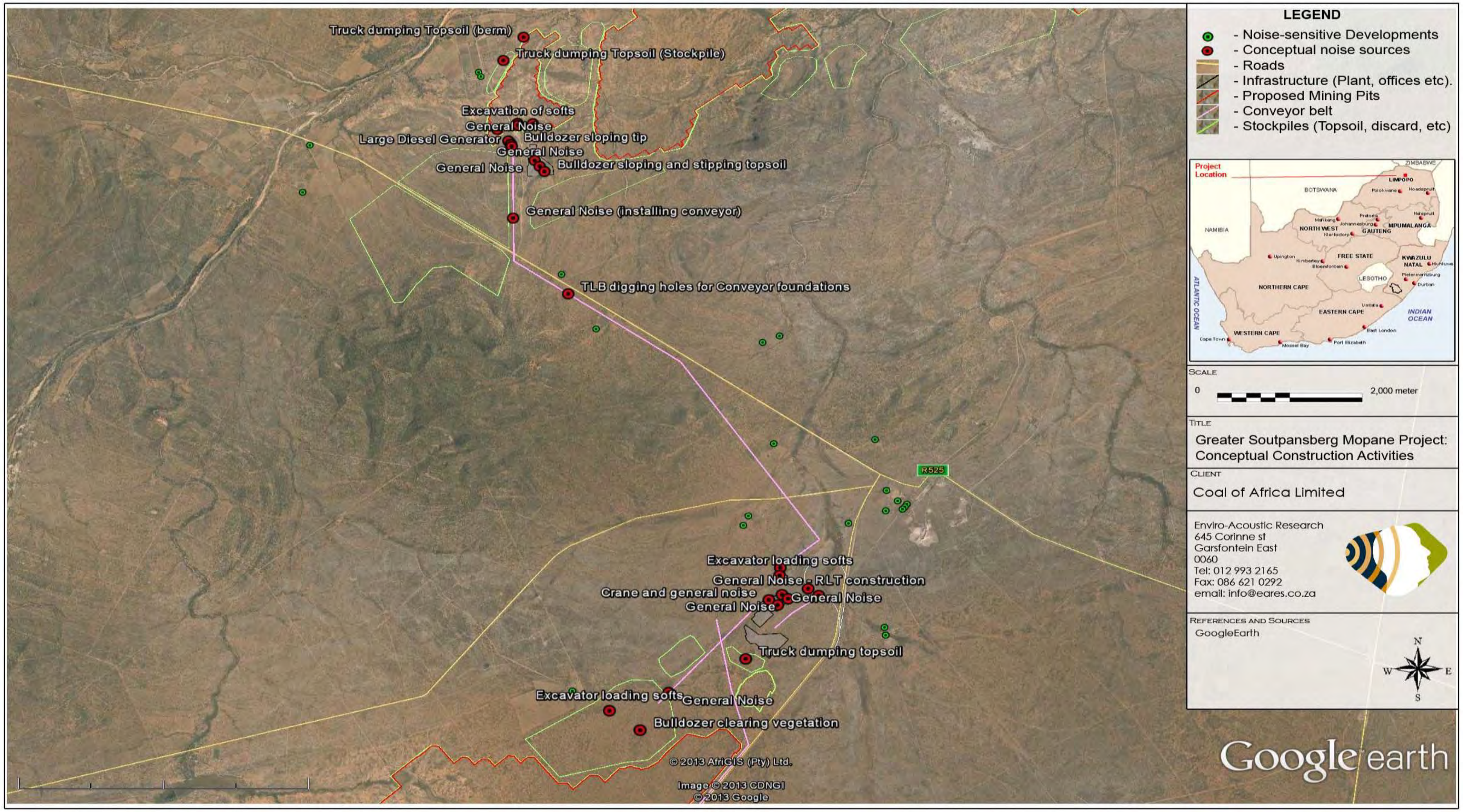


Figure 92: Conceptualised locations of noisy construction activities – larger site

Due to the inter-dependence on the construction requirements it is unlikely that all construction activities would be taking place simultaneously, but it is definite that a number of different construction activities would be taking place at the same time. The potential impact of three noise sources operating at one location (108 dBA sound power emission level for a bulldozer) was modelled to allow for the identification of potential issues. The modelled noise level (for 3 bulldozers operating) was plotted over distance (see Figure 93) together with the noise levels as calculated for the conceptual scenario. Noise due to linear activities (roads) were also evaluated and plotted as illustrated in Figure 94.

Based on Figure 93, if these noisy activities take place within approximately:

- 200 meters from a noise-sensitive receptor the noise level will exceed the daytime rating levels for an urban area;
- 300 meters from a noise-sensitive receptor the noise level will exceed the daytime rating levels for a sub-urban area;
- 500 meters from a noise-sensitive receptor the noise level will exceed the daytime rating levels for a rural area or the night-time (if there are night-time construction activities) rating level for an urban area;
- 800 meters from a noise-sensitive receptor the noise level will exceed the night-time (if there are night-time construction activities) rating level for an sub-urban area;
- 1 200 meters from a noise-sensitive receptor the noise level will exceed the night-time (if there are night-time construction activities) rating level for an rural area.

In reality, cumulative effects from a number of noisy activities taking place simultaneously could double these distances.

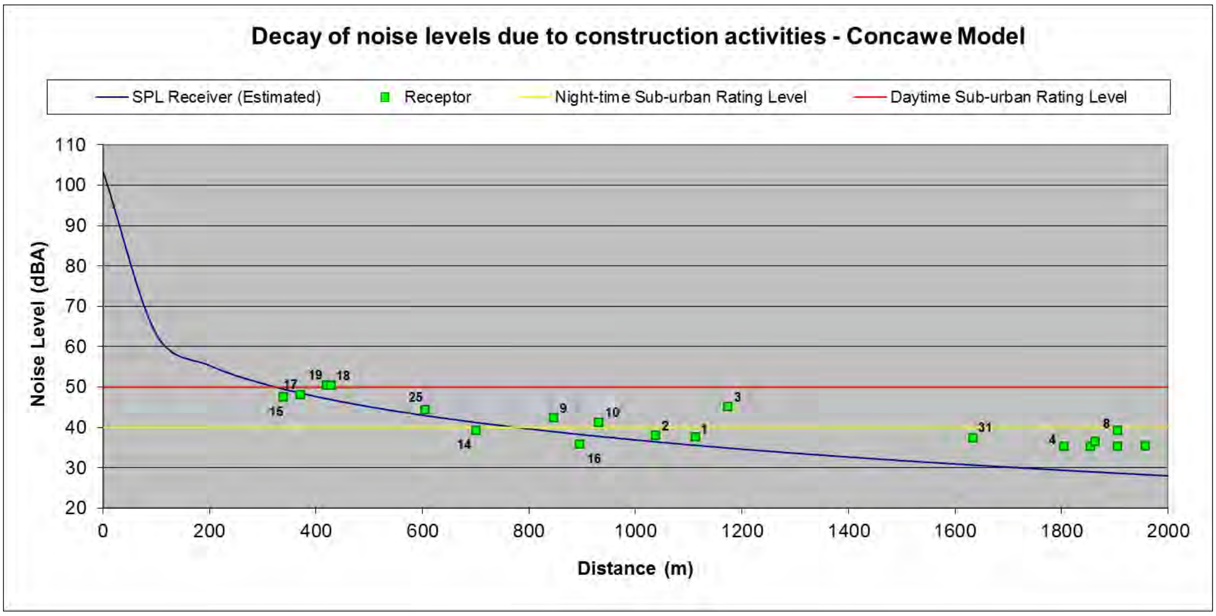


Figure 93: Construction noise: Projected Construction Noise Levels as distances increase between NSDs and locations where construction can take place – illustrative scenario

Similarly, considering Figure 94, if there are a noise-sensitive receptor within approximately:

- 8 meters from a road the noise level will exceed the daytime rating levels for an urban area;
- 40 meters from a road the noise level will exceed the daytime rating levels for a sub-urban area;
- 70 meters from a road the noise level will exceed the daytime rating levels for a rural area or the night-time (if there are night-time construction activities with the projected traffic volume) rating level for a urban area;
- 100 meters from a road the noise level the will exceed the night-time (if there are night-time construction activities) rating level for a sub-urban area;
- 230 meters from a road the noise level the will exceed the night-time (if there are night-time construction activities) rating level for a rural area.

More importantly are the prevailing ambient sound levels surrounding this receptor. A receptor used to ambient sound levels less than 30 dBA (very quiet) could experience noise levels of approximately 40 dBA (2 000 meters downwind from such noisy activities) due to the addition of the noisy activities. This is more than 7 dB higher than the prevailing ambient sound level, it will be highly detectable and the receptor may find this noise disturbing and complain. However, a receptor staying only 500 meters from such a noisy activity may be used to higher noise levels (due to other sources such as animals, road traffic, etc), e.g. 50 dBA. The addition of the new noise sources may in such a case not even be detected by this receptor. The attitude of a receptor with regards to the developer is a significant determinant on their acceptance levels with increased noise levels.

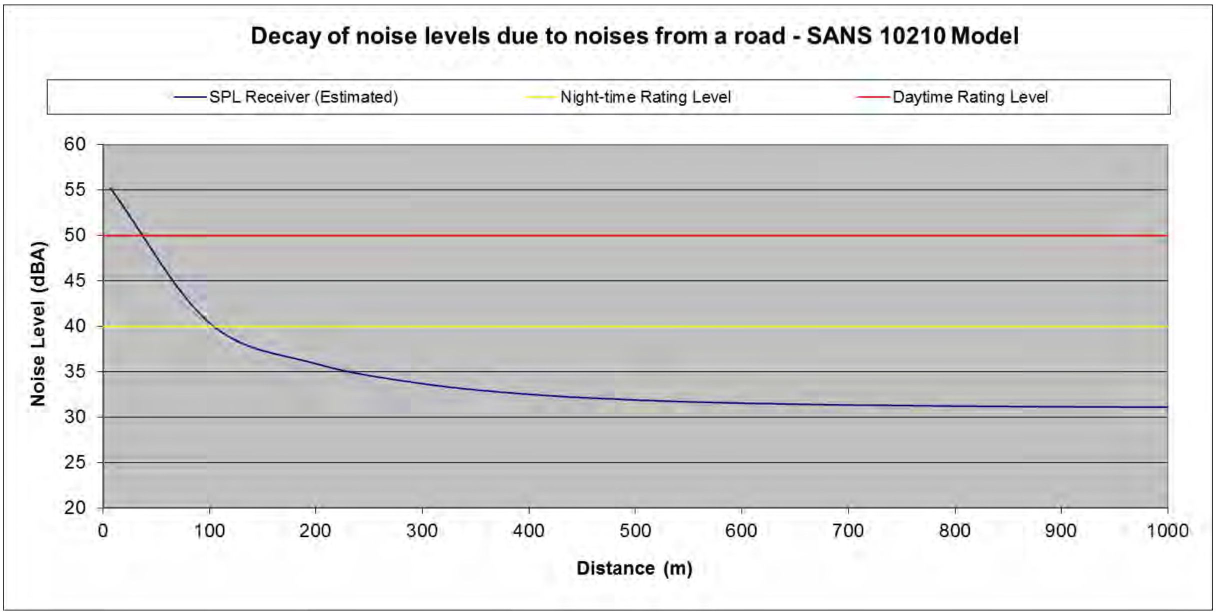


Figure 94: Construction noise: Projected Road Traffic Noise Levels as distances increase between a conceptual NSD and road (carrying 12 light and 12 heavy vehicles per hour travelling at 60 km/hr on a gravel road)

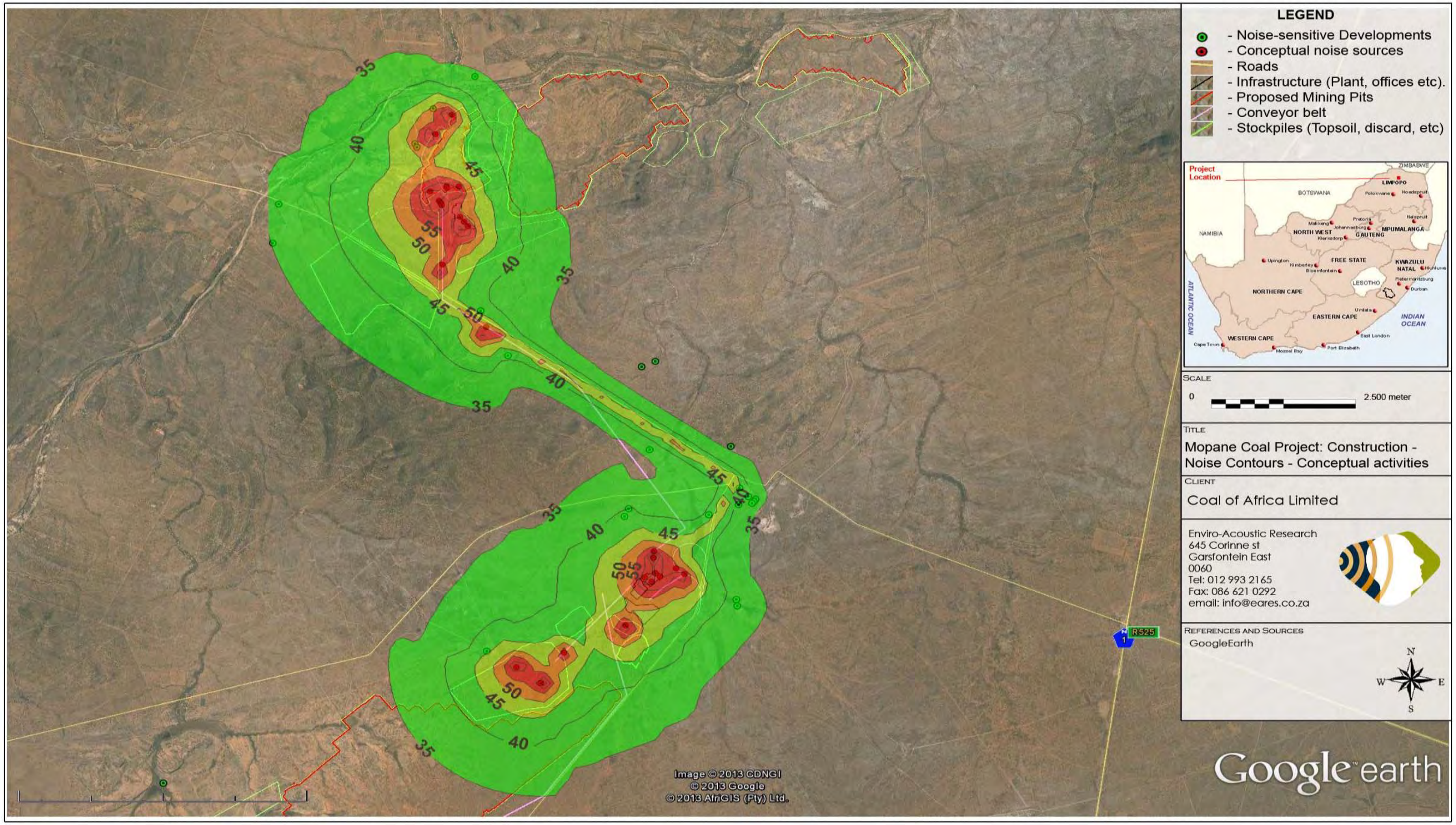


Figure 95: Projected Construction Noise Levels in contours of equal sound levels

In summary:

Daytime noise impact – Based on the preceding figures, if construction activities are taking place closer than 500 meters (300 meters for sub-urban and 500 for rural district) from the potential noise-sensitive receptor noise levels could exceed the respective daytime rating levels. Equivalent daytime ambient sound levels were measured around between 43 – 64 dBA, ranging between 22 and 75 dBA (10-minute measurements) and the projected noise levels could change ambient sound levels with more than 7 dBA within 500 meters from the noisy activities at times.

Night-time noise impact – Based on the preceding figures, if construction activities are taking place closer than 1 200 meters (800 meters for sub-urban and 1 200 for rural district) from the potential noise-sensitive receptor noise levels could exceed the respective night-time rating levels. Equivalent night-time ambient sound levels were measured around between 33 – 64 dBA, ranging between 19 and 75 dBA (10-minute measurements) and the projected noise levels could change ambient sound levels with more than 7 dBA within 1 500 meters from the noisy activities at times.

5.1.2.2 Results: Operational Phase

Two distinctive phases will be discussed in this section, namely:

- The operation of the opencast section (just after the construction phase, year 2019 – mining activities at Voorburg and plant activities at Jutland) – this is the worst-case scenario as future mining activities actually moves away from the receptors; and
- The operation of the opencast section (year 2030 – mining activities at both Voorburg and Jutland as well as plant activities at Jutland).

As the ambient sound levels are generally lower at night, increased noises coupled with more stable atmospheric conditions creates situations where noise can be heard over long distances. This, coupled with the lower rating level, makes the night-time period ideal to evaluate the potential noise impact.

5.1.2.2.1 Operation of the Opencast – year 2019

Layout as conceptualised and modelled is presented in Figure 96.

Because of the various potential activities that could take place during the operational phase, a conceptual worse-case scenario was considered including:

- Various mining activities (Excavation and loading of coal, interburden and overburden;
- Drilling activities – at Voorburg Section only)
- Tipping activities at material tip (tipping; crushing; material handling);
- Material handling – hauling of waste rock to stockpiles;
- Transfer of coal via conveyor belt system to the plant at Jutland;
- Various plant activities at the Jutland Section (material handling; feed screens; beneficiation [high gravity, low gravity and fines]; material handling);
- Activities at the RLT (diesel locomotive idling; material handling).

Night-time noise impact:

Considering the noise contours illustrated in Figure 97 (mitigation effect due to stockpiles acting as barriers included) an area up to 700 meters can be impacted (downwind from mining activities, behind barrier) as mining activities can raise noise levels to exceed a night-time rating level of 40 dBA.

Night-time rating levels of 40 dBA can also be impacted by increased noises approximately 2 000 meters from the material tip (areas with a direct line of sight to the material tip [no barriers, downwind]. Similarly, an area up to 1 700 meters downwind from the plant may be influenced.

Night-time equivalent ambient sound levels were measured between 33 and 64 dBA, with 10-minutes measurements ranging between less than 20 to 73 dBA. Because of the relationship between change in ambient sound levels and the prevailing ambient sound level it is difficult to accurately estimate the potential extent of this noise impact. Based on ambient sound levels of 35 dBA (typical for a quiet rural area) the projected noise levels could change ambient sound levels with more than 7 dBA within approximately 1 600 meters from the noisy activities (no noise mitigation such as a berm or stockpile).

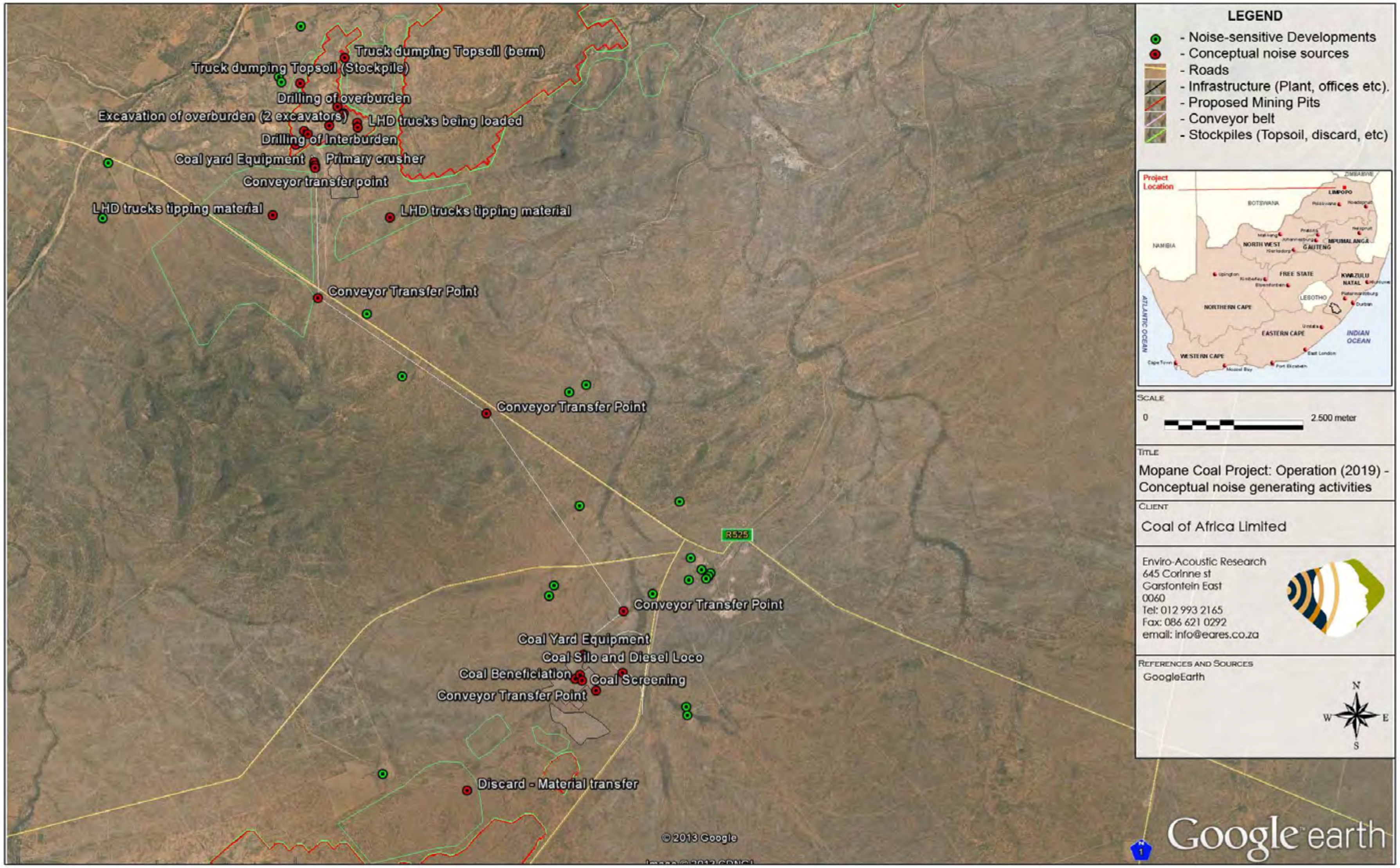


Figure 96: Operational phase – First year of operation, conceptual activities: Overview

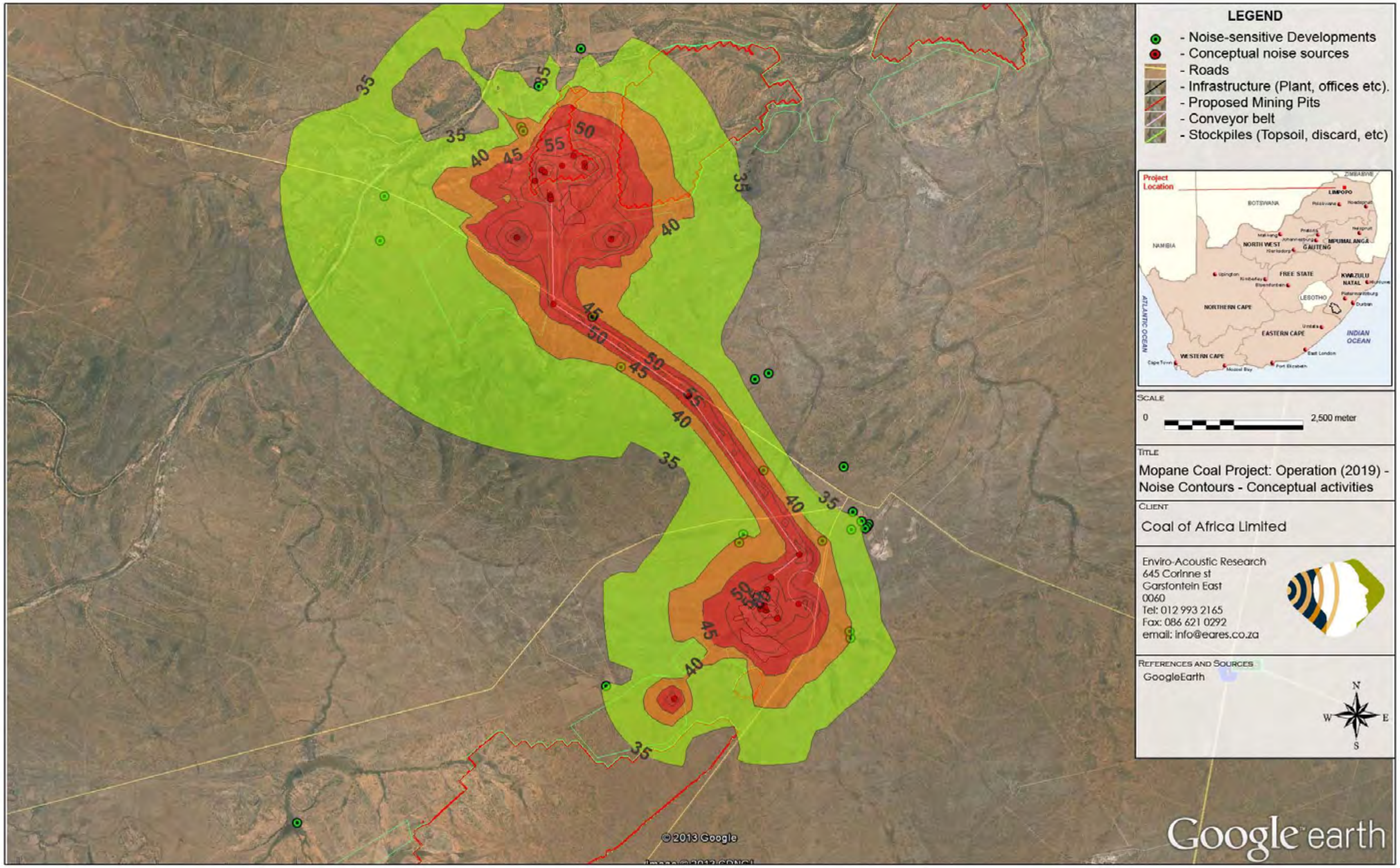


Figure 97: Night-time operations: Projected noise contours – Start of mining operations

5.1.2.2.2 Operation of the Opencast - 2030 (mining at Voorburg and Jutland Sections)

Layout as conceptualised and modelled is presented in Figure 98.

Because of the various potential activities that could take place during the operational phase, a conceptual worse-case scenario was considered including:

- Various mining activities (Excavation and loading of coal, interburden and overburden; Drilling activities – at Voorburg Section);
- Various mining activities (Excavation and loading of coal, interburden and overburden; Drilling activities – at Jutland Section);
- Tipping activities at material tip (tipping; crushing; material handling);
- Material handling – hauling of overburden/interburden to old mining area;
- Transfer of coal via conveyor belt system to the plant at Jutland;
- Various plant activities at the Jutland Section (material handling; feed screens; beneficiation [high gravity, low gravity and fines]; discard disposal; material handling [Front End Loader]);
- Activities at the RLT (diesel locomotive idling; material handling).

Night-time noise impact:

Considering the noise contours illustrated in Figure 99 (mitigation effect due to stockpiles acting as barriers included) an area up to 1 100 meters can be impacted (downwind from mining activities, behind barrier) as mining activities can result in noise levels exceeding a night-time rating level of 40 dBA.

Night-time rating levels of 40 dBA can be exceeded by increased noises approximately 1 900 meters from the material tip (areas with a direct line of sight to the material tip [no barriers, downwind]). Similarly, an area up to 2 000 meters downwind from the plant may be influenced (no barriers, downwind).

Night-time equivalent ambient sound levels were measured between 33 and 64 dBA, with 10-minutes measurements ranging between less than 20 to 73 dBA. Because of the relationship between change in ambient sound levels and the prevailing ambient sound level it is difficult to accurately estimate the potential extent of this noise impact. Based on ambient sound levels of 35 dBA (typical for a quiet rural area) the projected noise levels could change ambient sound levels with more than 7 dBA within approximately 1 600 meters from the noisy activities (with no noise mitigation such as a berm or stockpile).

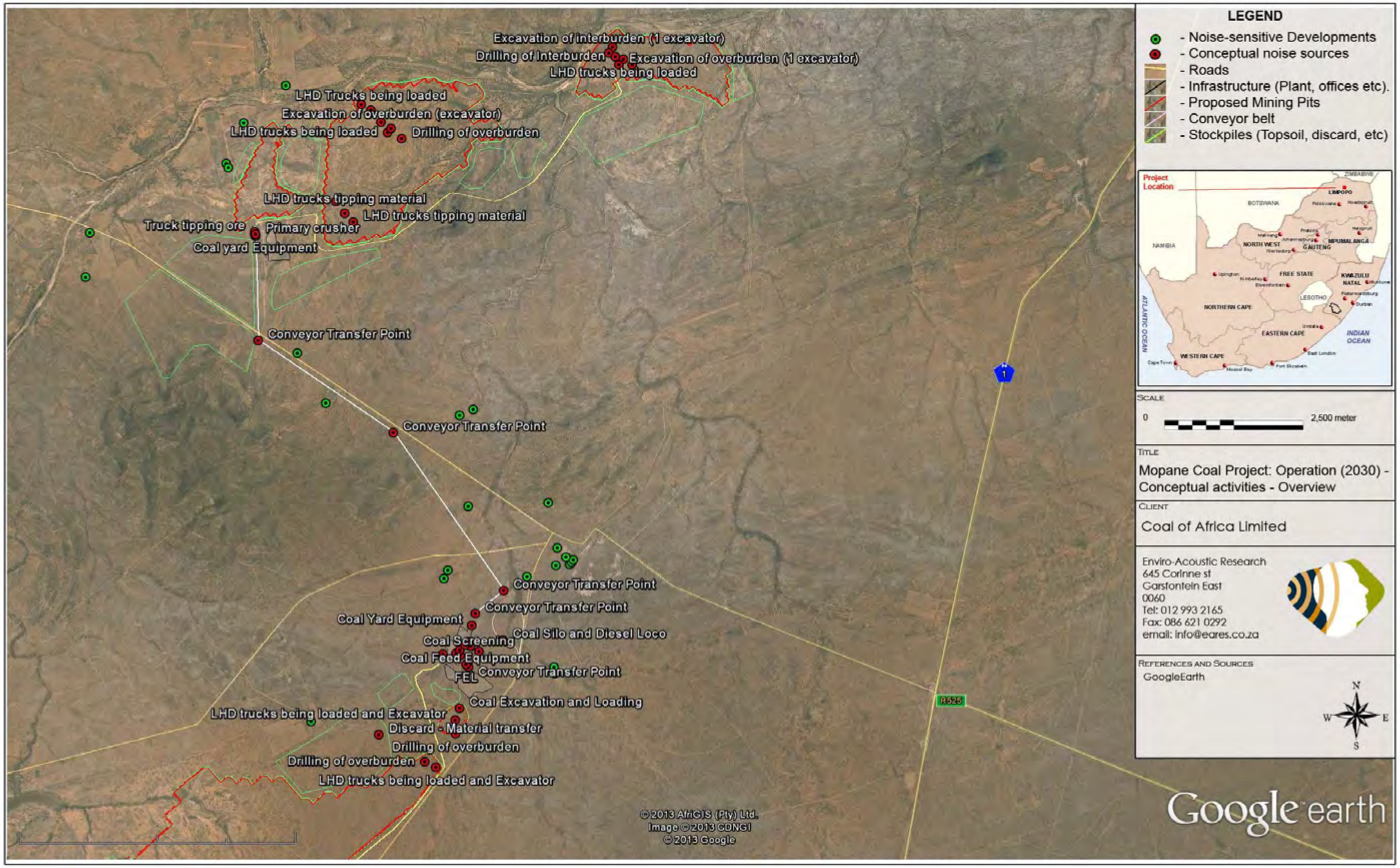


Figure 98: Operational phase – Year 2030, conceptual activities: Overview

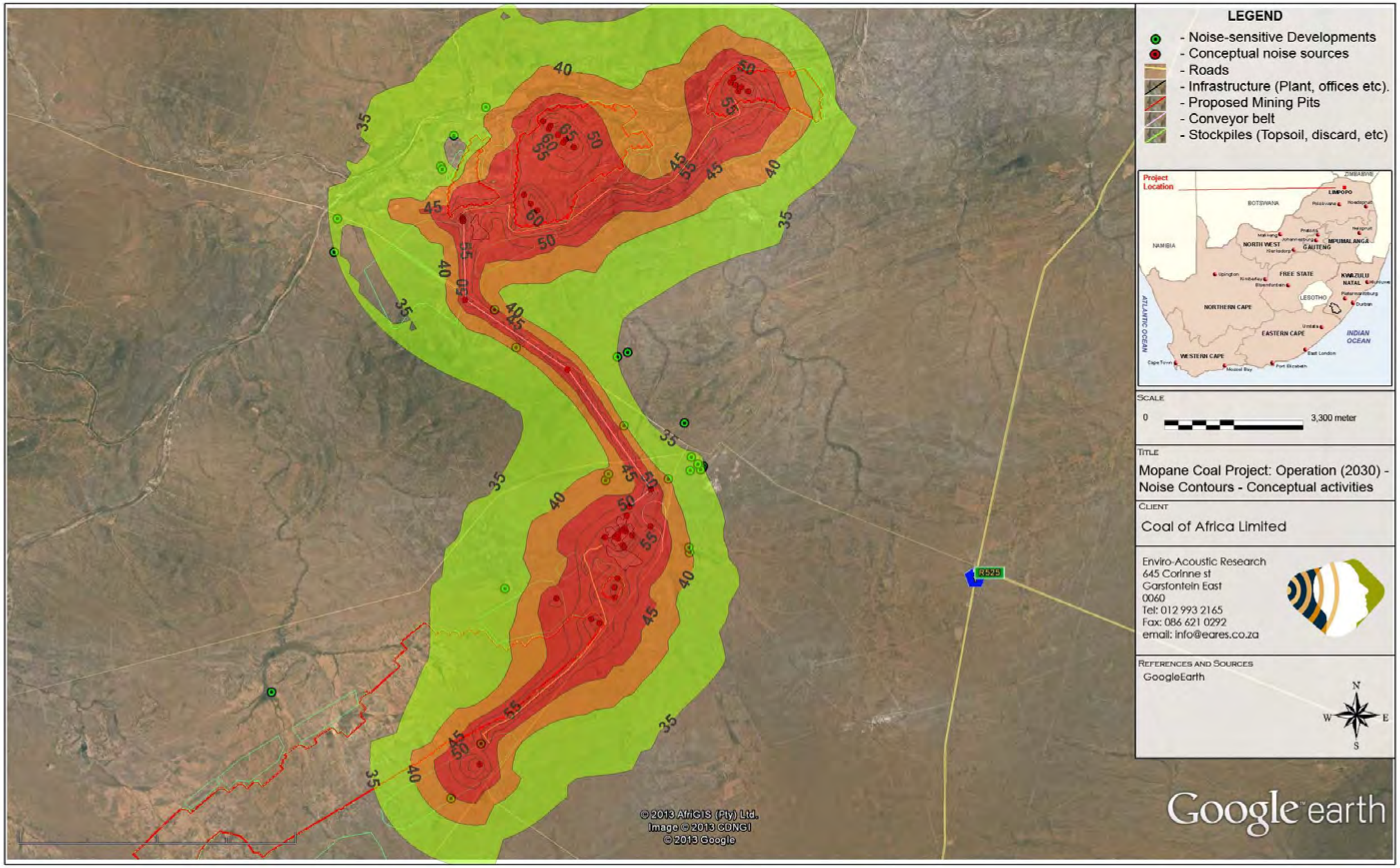


Figure 99: Night-time operations: Projected noise contours – Year 2030 mining operations

5.1.3 VISUAL AND AESTHETIC IMPACT

The aim of the visual assessment is to identify systematically all the potential landscape and visual impacts associated with the mine development to predict and estimate their magnitude. The assessment will cover landscape impacts, which amount to changes in the fabric and character of the landscape and visual impacts, for example, changes in available views of the landscape and the effect the changes will have on sensitive receptors in the area.

The total extent of the mining operations will span approximately 10 km by 4 km for the Voorburg Section and approximately 13 km by 5 km for the Jutland Section. The proposed operations are large and include various open pits and associated dumps and stockpiles, a conveyors system linking the Voorburg Section with the Jutland Section, a coal beneficiation plant on the Jutland Section, haul roads, etc. The development will affect the immediate sense of place and will result in a total transformation of the landscape.

The main concerns in this regard are the following:

- The change of the topography by large scale (footprint and height) of the opencast areas, stockpiles and the coal beneficiation plant and related infrastructure;
- The dumping and exposure of calcareous materials, the color of which is in sharp contrast with the environment;
- The introduction of industrial activity with associated light and dust pollution; and
- The introduction of additional transport and delivery vehicles on local roads at a high rate of recurrence.

5.1.3.1 Visual Exposure

A preliminary viewshed analysis was conducted for the Mopane Project area, based on two observations points located within the mining areas as shown in Figure 100. This reveals that the limited ridges and outcrops provide a degree of shielding. However, the structure will be visible for a radius reaching as far as 20 km.

A full impact assessment will provide a clearer picture of the impacted areas and sensitive receptors that will be impacted on by the development; however it is anticipated that tall structures such as stockpiles and parts of the coal beneficiation plant will be highly visible. Due to the rural and peaceful nature of the area, visibility of the mine is expected to have an extremely negative visual impact if not mitigated.

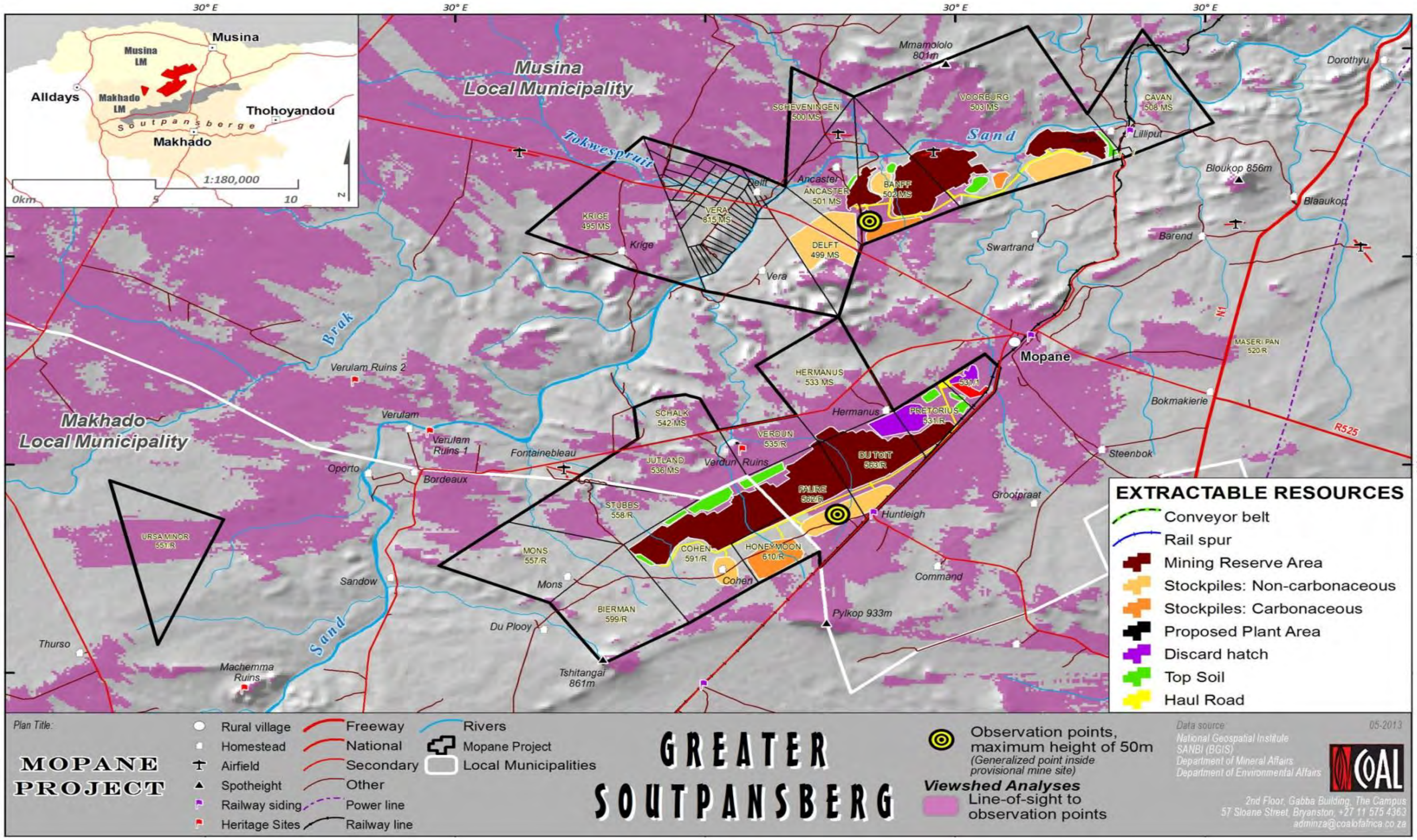


Figure 100: Viewshed analysis for the Mopane Project area

5.1.3.2 Factors impacting on the Sense of Place

Apart from visibility of static mine components such as stockpiles and infrastructure, the following secondary effects of mining operations adversely affect the quality of the landscape and the sense of place on a wider scale:

Product Transport: The conveyor system between the Voorburg and Jutland Sections, the RLT and rail loop (siding), and the increase in rail traffic will increase the ambient noise levels which will impact on the sense of place and negatively influence sensitive receptors.

Road traffic: Additional transport on the roads in the vicinity of the mine. Apart from the N1, these roads only carry local traffic. The type of vehicles, which may be regarded as abnormal, invoke extremely negative perceptions from residents and other road users, especially where these are considered to be causing road deterioration, accidents, traffic congestion and dust pollution.

Lighting: It is expected that lighting associated with mining operations will introduce a large degree of light pollution, especially since no other activities of this nature exist in the area. This is of particular concern for game farm and lodge owners who host tourists in close proximity to the mine area.

Dust: Dust is an inevitable result of open cast mining and the transportation of coal. Although mitigation measures can be put in place to minimize this, it must still be considered as a possibility which might negatively influence sensitive viewers.

5.1.4 SOCIAL IMPACTS

The anticipated socio-economic impacts of the proposed project are detailed in the SEIA (ANNEX-9) and are summarized below in table format.

Environmental (Social) Aspect	Potential Impact
Demographic and Population Impacts	Influx of work seekers into the area
	Influx of construction labour with pressure on services and social structures
	Influx of operational workforce with pressure on services and social structures
	Influx of people and the development of spontaneous settlements near project facilities, in the Mopane Town and surrounding areas
	Conflicts arising at the end of construction due to the termination of job opportunities for contractors
Health and Social Wellbeing	Increased chances of the spread of communicable diseases such as HIV/AIDS and STDs linked to influx of predominantly male job-seekers and workers
	Safety and Risk Exposure through an increase in crime
	Safety and Risk Exposure due to an increase in poaching on neighbouring game farming properties
Quality of Living Environment	Change in “sense of place”
	Disruption of Social Networks and decrease in Social Capital
	Perceptions of and Feelings in relation to the project
Family and Community Impacts	Impacts on land owner and labourers
	Change processes and impacts related to daily movement patterns

Environmental (Social) Aspect	Potential Impact
	Conversion of land use
Institutional/Legal/Political/Equity Impacts	Challenge to local government capacity
	Participation and Consultation in process
	Impact equity
Socio-economic Wellbeing	Increase in South African GDP and Trade Balance
	Increase in provincial and local GDP
	Increase in government revenue
	Increase in employment, income and skills development
	Impact on existing businesses in surrounding areas
	Change in property values
	Decrease of visitors, tourists and hunting parties
	Equity Participation of the Local Communities
	Participation of local business in procurement opportunities
	Decline in South African GDP and Trade Balance at Decommissioning
	Decline in provincial and local GDP at decommissioning
	Decline in government revenue at Decommissioning
	Decline in employment, income and skills development at decommissioning
Vulnerable Group Impacts	Gendered Division of labour
	Potential Infringements on Historically Disadvantaged People's Human Rights

The results of the SEIA indicate that the recommended mitigation measures are expected to reduce the significance of negative impacts to acceptable levels, while positive impacts will on average be significantly enhanced to maximise benefits to surrounding communities.

The main conclusion arising from the assessment of cumulative impacts is that the planned Mopane Colliery and its ancillary infrastructure will add to the socio-economic impact of the mining operations in the area in a negative sense. Firstly the proposed development might stimulate an additional influx of people into the area, thereby adding to congestion and pressure on local infrastructure and services. Secondly the project may add to the mining operations' existing and future impact on the area's sense of place, this in turn may cause a decline in tourism and hunting related activities in the surrounding area. However, the project will also add to the positive impacts associated with these other developments (in terms of job creation, stimulating the local economy, etc.).

5.2 CULTURAL AND HERITAGE

The nature and scale of impacts of the proposed mining on heritage are summarised in the following table:

	ACTIVITY	POTENTIAL IMPACTS
1	Mineral extraction	Stripping of top soil and mineral extraction opencast methods will represent the most extensive excavation of the area and earthmoving. Total destruction of heritage sites.
2	Non-carbonaceous material dumps	Overlaying (and destruction) of heritage sites. Possible graves in the proposed.
3	Carbonaceous dump	Overlaying (and destruction) of heritage sites.
4	Stockpiles (topsoil & discards)	Overlaying (and destruction) of heritage sites.
5	Mine infrastructure/plant	Total destruction of heritage resources. Visuals impacts on cultural landscapes.
6	Main access road, conveyor belt	Total destruction and visual impacts.
7	Emulsion and explosion areas	Destruction, vibration, pollution.

5.2.1 NATIONAL AND PROVINCIAL HERITAGE SITES (MONUMENTS)

Site No#	Farm	Threats
95	Verdun	The Mining area on Verdun Farm is a small portion on its south-eastern corner of the farm (boundary with Faure and Hermanus. The Verdun Ruins are therefore considered to be out of physical danger, although pollutive mine dust can reach the ruins.

#Refer to Catalogue of heritage sites (Annexure II of the HIA)

There are no proclaimed Grade 1 sites in the Mopane Project Area. The Verdun Ruins (Site No 95 in the Catalogue) on Verdun Farm were proclaimed a National Monument in 1938 under the now repealed National Monument Commission/ Council (NMC) Act. It thus became ranked Grade 2 Provincial Heritage Site under the National Heritage Resources Act, (No 25: 1999). Verdun Ruins was an early Venda chiefly settlement, situated approximately 10km west of the small town of Mopane. According to legend, the ruins are the remains of the home of the Venda Chief Matshokotike, dating to the early eighteenth century. The strong walls of the Khoro, or council-chamber, have a typical chief's chair. Behind the chair on the opposite side of the walls is a short piece of wall with check patterns. These ruins, like the Machema (in the Chapudi Project Area) and Dzata Ruins in Sibasa Communal area, form an important architectural continuum with Mapungubwe. They are however built much later than Mapungubwe associated with southward movements of later Venda groups across the Limpopo River (DEA, 2004).

According to the South African Heritage Resources Agency (SAHRA) the largest Baobab Tree in the Vhembe District which is located near Tshipise, southeast of Musina has been proclaimed a National Monument (Grade 1) under the NHRA, 25 of 1999: South African Heritage Resource Agency Identification (SAHRA ID) 9/2/240/0003. There are many Baobab trees in the Project Area as the fieldwork results attest. Only a few baobabs have been selected and illustrated in the catalogue to highlight their heritage significance (e.g. Site Nos 4, 16, 85).

5.2.2 GRAVES AND BURIAL GROUNDS

Forty burial sites have been recorded, of which a number will be directly affected by the proposed mining and infrastructure footprint. A distinction may be made between graves with inscriptions and those which are "anonymous". The pattern is also consistent that those graves with inscription tend to be properly built and finished either cement or polished granite dressing and inscribed headstones, while those without bio-data tend to be marked by stone cairns. Headstones are also placed on some of the roughly marked graves. All graves of farm owners and their family members are in the first category, while those which appear to be of farm workers are mostly marked by stone cairns.

Site No#	Farm	Threat
2	Faure	Many burials will be directly affected by the development. Development imperatives often make it practically impossible to protect and preserve all graves in their original positions, i.e. *in situ*- . Legislation, allow exhumation but advises a cautious approach and consultation with communities who might have strong feelings for protection in original positions. Section 36 of the NHRA provides for Graves and Burial Grounds of victims of conflict. It also implies that development projects may warrant exhumations and relocation of burials.
33	Du Toit	
8, 11	Ancaster	
27	Delft	
73, 78	Pretorius 1	
79, 80, 85, 87	Pretorius 2	
112	Vrienden	
118	Kitchener	
124	Hermanus	
140	Cohen	
160	Voorburg	

#Refer to Catalogue of heritage sites (Annexure II of the HIA)

5.2.3 HERITAGE SITES

In total approximately 130 heritage sites will be affected by the mining development.

Farm	Number of Heritage sites affected	Farm	Number of Heritage sites affected
Voorburg	18	Faure	6
Banff	10	Cohen	18
Ancaster	8	Honeymoon	3
Delft	14	Kitchener	5
Pretorius 1	10	Hermanus	7
Pretorius 2	12	Verdun	6
Du Toit	7	Vrienden	6

5.3 QUANTIFICATION OF IMPACT ON DIRECTLY AFFECTED PERSONS

This will be affected by the final mining schedule and infrastructure layout plans to be developed during the Feasibility Phase, in line with the numerous recommendations made by the EIA specialists. The final quantification in monetary terms will only be undertaken after completion of the Feasibility Phase.

6 ASSESSMENT AND EVALUATION OF POTENTIAL IMPACTS

Risk is a combination of the probability, or frequency of occurrence of a hazard and the magnitude of the consequence of the occurrence (Nel, 2002). Risk estimation (RE) is concerned with the outcome, or consequences of an intention, taking account of the probability of occurrence and can be expressed as P (probability) x S (severity) = RE. Risk evaluation is concerned with determining significance of the estimated risks and also includes the element of risk perception. Risk assessment combines risk estimation and risk evaluation (Nel, 2002).

The positive and negative impacts were assessed on the basis of issues identified through the public participation process, interviews with key stakeholders and specialist opinion. Identified impacts were categorised in terms of the phase of the proposed project that is expected to give rise to the impacts.

The following steps were followed in the assessment of the potential risks:

- Issues that may arise as a result of the proposed development, through planning, construction, operation and decommissioning phases.
- Potential impacts will be identified for each issue and assessed by considering criteria as outlined in the table below.
- Where the potential impacts are perceived as having a high risk or significance, alternatives, preventative and mitigation measures will be recommended.
- The significance of each impact will be determined "without mitigation" and "with mitigation", taking into consideration alternatives, preventative and mitigation measures.

Table 45: Impact Rating methodology

RISK IMPACT METHODOLOGY		
DURATION		
Short term	6 months	1
Construction	36 months	2
Life of project	50 years	3
Post Closure	Post closure or during decommissioning and downscaling	4
Residual	Beyond the project life	5
EXTENT		
Site specific	Site of the proposed development	1
Local	Farm and surrounding farms	2
District	Musina Local Municipality	3
Regional	Vhembe District Municipality	4
Provincial	Limpopo Province	5
National	Republic of South Africa	6
International	Beyond RSA borders	7
PROBABILITY		
Almost Certain	100% probability of occurrence – is expected to occur	5
Likely	99% - 60% probability of occurrence – will probably occur in most circumstances	4
Possible	59% - 16% chance of occurrence – might occur at some time	3
Unlikely	15% - 6% probability of occurrence – could occur at some time	2
Rare	<5% probability of occurrence – may occur in exceptional circumstances	1
SEVERITY		
Critical	Total change in area of direct impact, avoidance or replacement not an option, detrimental effects, huge financial loss	5
Major (High)	> 50% change in area of direct impact, relocation required and possible, extensive injuries, long	4

RISK IMPACT METHODOLOGY		
	term loss in capabilities, off-site release with no detrimental effects, major financial implications	
Moderate (medium)	20 – 49% change, medium term loss in capabilities, rehabilitation / restoration / treatment required, on-site release with outside assistance, high financial impact	3
Minor	10 – 19% change, short term impact that can be absorbed, on-site release, immediate contained, medium financial implications	2
Insignificant (low)	< 10 % change in the area of impact, low financial implications, localised impact, a small percentage of population	1

RISK ESTIMATION (Nel 2002)

RE (Risk Estimation) = P (Probability) X S (Severity)

	SEVERITY				
PROBABILITY	**Insignificant (1)**	**Minor (2)**	**Moderate (3)**	**Major (4)**	**Critical (5)**
Almost certain (5)	L 5	M 10	H 15	VH 20	VH 25
Likely (4)	L 4	M 8	H 12	H 16	VH 20
Possible (3)	L 3	M 6	M 9	H 12	H 15
Unlikely (2)	VL 2	L 4	M 6	M 8	M 10
Rare (1)	VL 1	VL 2	L 3	L 4	L 5

VH	Very High – immediate action required, Countermeasures and management actions to mitigate risk must be implemented immediately, alternatives to be considered	20 – 25
H	High risk – specific management plans required, determine if risk can be reduced by design and management in planning process, if cannot, alternatives to be considered, senior management responsibility	12 – 16
M	Moderate risk – management and monitoring plans required with responsibilities outlined for implementation, middle management responsibility	6 – 10
L	Low risk – management as part of routine requirements	3 – 5
VL	Very Low risk – no management required	1 - 2

Mitigation - The impacts that are generated by the development can be minimised if measures are put in place to reduce them. These measures are mitigation measures to ensure that the development takes into consideration the environment and the impacts that are predicted so that development can co-exist with the environment as a basis for planning.

Determination of Significance; without mitigation - Significance is determined through a synthesis of impact characteristics as described in the above paragraphs. It provides an indication of the importance of the impact in terms of both tangible and intangible characteristics. The significance of the impact "without mitigation" is the prime determinant of the nature and degree of mitigation required.

IMPACT SIGNIFICANCE

IS (Impact Significance) = D (Duration) + E (Extent) + S (Severity) X P (Probability)

Insignificant	The impact is non-existent or insubstantial, is of no or little importance to any stakeholder and can be ignored.
Low	The impact is limited in extent, even if the intensity is major; whatever its probability of occurrence, the impact will not have a significant impact considered in relation to the bigger picture; no major material effect on decisions and is unlikely to require management intervention bearing significant costs.
Moderate	The impact is significant to one or more stakeholders, and its intensity will be medium or high; therefore, the impact may materially affect the decision, and management intervention will be required.
High	The impact could render development options controversial or the entire project unacceptable if it cannot be reduced to acceptable levels; and/or the cost of management intervention will be a significant factor in project decision-making.
Very high	Usually applies to potential benefits arising from projects.

Determination of Significance; with mitigation - Determination of significance refers to the foreseeable significance of the impact after the successful implementation of the necessary mitigation measures.

Table 46: Environmental Impact Risk Matrix

#ID Abbreviations: A – All activities, OC – Opencast mining, P – Processing plant / infrastructure areas (incl RLT / siding), ON – On-site conveyance of ROM and product, MR – Mine residue stockpiles, OF – Off-site conveyance of ROM (conveyor between Voorburg & Jutland), EM – Off-site conveyance of product by truck (in emergencies)

ID#	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map (Without mitigation)	Impact Significance (Without mitigation)	Proposed Mitigation measures	Risk Map (With mitigation)	Impact Significance (With mitigation)
A1	Biodiversity / Land Use & Capability	Surface disturbance of approximately 3,500 hectares for the purpose of mining and infrastructure development over the LOM will lead to impacts on the soil, land use and land capability, natural vegetation and fauna	Negative	High Risk	Moderate Significance	• Development and implementation of a detailed Mine Rehabilitation and Reclamation Plan during the Feasibility Phase. • Concurrent rehabilitation and levelling of opencast pits in line with the Mine Rehabilitation and Reclamation Plan. • Monitoring, auditing and regular review (if required) of the Mine Rehabilitation and Reclamation Plan. • Rehabilitation of infrastructure and other disturbed areas post-mining. • Implementation of Flora Rescue and Relocation Plan prior to any surface disturbances. • Develop species rescue, relocation and re-introduction plan (fauna) with the assistance of specialists in this field. • Develop and implement Biodiversity Action Plan, including avifaunal plan. • Fencing of designated mining and infrastructure areas. • Implementation of biodiversity monitoring. • Close collaboration with the Vhembe Biosphere Reserve in respect of final end land use and sustainable mining.	Moderate Risk	Moderate Significance
A2	Biodiversity / Land Use & Capability	Increased poaching in region as a result of influx	Negative	Moderate Risk	Moderate Significance	• Establishment of an anti-poaching unit in conjunction with adjacent landowners and communities. • Implement an Environmental Awareness Programme within the surrounding communities.	Moderate Risk	Low Significance
A3	Waste Management	Poor waste management could lead to environmental impacts	Negative	Moderate Risk	Low Significance	• Implementation and regular review of Waste Management Procedure. • Appoint an approved, registered waste contractor to manage the waste generation and safe disposal thereof. • No waste will be disposed of or buried on site, or in any other location that is not a licensed waste disposal site.	Low Risk	Low Significance
A4	Waste Management	Poor sewage management could impact on water resources	Negative	Moderate Risk	Moderate Significance	• Sewage effluent will be treated to General Standards and pumped to the Infrastructure Area storage dams for re-use in the process. No effluent will be discharged to the environment.	Low Risk	Low Significance

ID#	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map (Without mitigation)	Impact Significance (Without mitigation)	Proposed Mitigation measures	Risk Map (With mitigation)	Impact Significance (With mitigation)
A5	Bulk Water	Impact on water stressed catchment - fully allocated	Negative	Very High Risk	Moderate Significance	• The bulk water source will be determined during the Feasibility Phase, followed by a detail EIA for the selected option. • Design closed system to ensure optimal recycling of water and minimise water requirements for the mine. • Installation of filter presses to increase water recovery in the process plant.	High Risk	Moderate Significance
A6	Bulk Electricity	Further impact on over-allocated electricity reticulation system	Negative	High Risk	Moderate Significance	• Energy efficient designs such as: o High efficiency motors in plant and workshops o Power Factor Correction o Use VSDs o Use solar power where possible o Install solar geysers at change houses\Optimal building design to make use of ambient light • Energy Policy must govern energy efficient designs such as: power factor correction; lighting designs; cooking and heating - avoid electricity use gas; process efficiency; high efficiency motors; low loss transformers; green building designs; use of solar and heat pumps for water heating. • Implement Energy Management Plan. • Monitor and record energy usage on site. Ongoing improvement in energy consumption should form part of the mine's KPIs.	Moderate Risk	Moderate Significance
A7	Heritage Resources	Destruction of heritage & cultural resources as a result of mining and associated infrastructure (including linear activities)	Negative	Very High Risk	Moderate Significance	• A detail Heritage Management Action Plan will be developed during the Feasibility Phase once the mining and infrastructure has been finalised. • Implementation of Heritage Management Action Plan dealing with the Phase 1B&2 assessment as well as grave relocation. • National Heritage and Cultural issues will be included in the environmental awareness programme. • Regular monitoring of off-site heritage resources of importance.	Moderate Risk	Low Significance
A8	Sense of Place	Impact on conservation value of the region	Negative	High Risk	Moderate Significance	• Identify and implement biodiversity offset programmes in conjunction with the IAPs and authorities, including the Vhembe Biosphere Reserve. • Implementation of environmental monitoring programme. • Develop environmental awareness & educational programmes. • Environmental auditing and reporting.	Moderate Risk	Moderate Significance

ID[#]	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
				Without mitigation			With mitigation	
OC1	Soils / Land Use & Capability	Potential hard setting of soils post reclamation	Negative	Moderate Risk	Moderate Significance	• Soil analyses and amelioration during reclamation.	Low Risk	Low Significance
OC2	Soils / Land Use & Capability	Subsidence of rehabilitated areas	Negative	Moderate Risk	Low Significance	• Free-draining profile (as far as practically possible) for rehabilitated areas and ongoing monitoring.	Low Risk	Low Significance
OC3	Surface Water	Impact on non-perennial streams cutting through mining areas leading to decrease in runoff	Negative	High Risk	Moderate Significance	• Optimisation of the storm water management plan and positioning of mining pits during the Feasibility Phase. • Diversion of non-perennial streams around opencast areas to minimise decrease in surface runoff • Rehabilitation concurrent to mining – limit dirty footprint.	Moderate Risk	Moderate Significance
OC4	Surface Water	Impact on wetland areas and aquatic ecosystems associated with non-perennial streams	Negative	High Risk	Moderate Significance	• Aquatic monitoring. • Create small impoundments at head of stream diversions to limit erosion. This could potentially become artificial wetlands over time. • Identify and implement biodiversity offset programmes (including wetland offsets) in conjunction with the IAPs and authorities, including the Vhembe Biosphere Reserve.	Moderate Risk	Moderate Significance
OC5	Surface Water	Impact on 1:100 year flood-line of the Sand River	Negative	High Risk	Moderate Significance	• Revise mining footprint during Feasibility Phase to avoid 1:100 flood-lines of the Sand River, plus a 100m buffer zone.	Moderate Risk	Low Significance
OC6	Surface Water	Increased sedimentation into Sand River due to uncontrolled surface run-off	Negative	High Risk	Moderate Significance	• Design and install appropriate outlet structures to retard flow velocity. • Construction of energy dissipating structures along steep slopes. • Side slopes of earth berms / canals to be designed to 1:3 and protected & vegetated to prevent erosion.	Moderate Risk	Moderate Significance
OC7	Surface Water	Potential impact on in-stream habitat and riverine vegetation as a result of decrease in runoff	Negative	Moderate Risk	Low Significance	• Implementation of monitoring programme for early detection of impacts (plant moisture stress monitoring). • Diversion of clean storm water runoff around opencast areas to minimise impact of flow within the Sand River.	Moderate Risk	Low Significance
OC8	Surface Water	Impact of long-term decant on water quality	Negative	High Risk	High Significance	• Investigate appropriate management measures over the LOM.	High Risk	High Significance

ID#	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
				Without mitigation			With mitigation	
OC9	Groundwater	Dewatering of aquifer as a result of mining	Negative	Very High Risk	High Significance	• The mining schedules will be revised during the Feasibility Phase in line with the recommendation of the specialist EIAs. Once this has been completed, the groundwater impact model will be revised to determine the impact of the revised mining design. • Implementation of baseline monitoring programme on farms that are potentially impacted once the mining and infrastructure feasibility studies have been completed. • Provide alternative water sources where appropriate. • Compensation mechanisms need to be developed and agreed with impacted landowners to compensate those who are impacted upon.	High Risk	High Significance
OC10	Groundwater	Impact on surrounding vegetation as a result of dewatering and subsequent recovery	Negative	Moderate Risk	Moderate Significance	• Implementation of monitoring programme for early detection of impacts (plant moisture stress monitoring). • Diversion of clean storm water runoff around opencast areas to minimise impact of flow within the Sand River.	Moderate Risk	Moderate Significance
OC11	Groundwater	Decrease in regional water quality due to seepage from rehabilitated pits	Negative	Moderate Risk	Low Significance	• Potential acid generating horizons will be placed at bottom of pit and submerged below the water table, thereby preventing oxidation. • Rehabilitation will be concurrent with mining, minimising the potential for oxidation of sulphide bearing rocks and controlling the migration of high sulphate leachate. • Exposed residue material will be minimised by direct placement of overburden and topsoil. • Vegetation will be re-established as soon as possible after topsoiling to minimise infiltration of water through residue material. • Implementation of baseline monitoring programme to detect any seepage. • Compensation mechanism to compensate landowners who are impacted upon.	Moderate Risk	Low Significance
OC12	Groundwater	Migration of pollution plume after full recovery of groundwater levels (prior to decant)	Negative	High Risk	Moderate Significance	• Investigate appropriate management measures over the LOM. • Groundwater and geochemical models must be updated on a regular basis (every 5 years) to verify potential for decant.	High Risk	Moderate Significance
OC13	Air Quality	Dust impact caused by vehicle movement	Negative	High Risk	Moderate Significance	• Application of dust suppression measures (surface surfactants) such as Dustex. • Reduce vehicle speed on unpaved roads to limit dust creation.	Low Risk	Low Significance

ID#	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map (Without mitigation)	Impact Significance (Without mitigation)	Proposed Mitigation measures	Risk Map (With mitigation)	Impact Significance (With mitigation)
OC14	Air Quality	Dust impact caused by blasting activities	Negative	High Risk	Moderate Significance	• Develop Blasting Procedure to minimise impacts.	Moderate Risk	Low Significance
OC15	Air Quality	Dust impact caused by materials handling	Negative	High Risk	Moderate Significance	• Reduction of drop height to reduce the dispersion of materials being transferred, and increase in moisture content (water sprays). • Creation of wind breaks in close proximity to storage piles to reduce the potential erosive forces of the wind.	Low Risk	Low Significance
OC16	Air Quality	Methane emissions leading to air quality impacts	Negative	Low Risk	Low Significance	• Ongoing methane monitoring if required.	Low Risk	Low Significance
OC17	Noise	Elevated noise levels caused by mining operation, dewatering (pumping) and blasting activities	Negative	High Risk	Moderate Significance	• Noise attenuation berms (topsoil) on footprint of opencast areas. • Noise suppression devices on heavy vehicles and all noisy plant. • Alternative reverse hooting systems will be implemented to reduce the noise levels. • Low noise generator sets will be used in pit. • Develop air blast control measures. • Blasting limited on regular times, restricted to 08:00-18:00. • All plant, equipment and vehicles to be kept in good repair. • Employees / contractors working in areas where the 8-hour ambient noise levels exceed 85dBA shall wear ear protection equipment.	Moderate Risk	Moderate Significance
OC18	Visual / Aesthetics	The mining will have a negative on the aesthetics / sense of place	Negative	High Risk	Moderate Significance	• Berms on footprint of opencast areas to be protected and vegetated to reduce the visual impact. • Avoid the unnecessary removal of vegetation during the operational phase. • Rehabilitation and revegetation will be performed concurrent to mining. • Introduce trees to the landscape at strategic locations (sensitive receptors) to break full exposure of the mine. Further analyses and stakeholder engagement will be required for this commitment.	Moderate Risk	Moderate Significance
OC19	Socio-economic	Impact on the communities and sensitive receptors as a result of blasting	Negative	High Risk	Moderate Significance	• Develop and implement Blasting Procedure as well as an Evacuation Procedure.	Moderate Risk	Low Significance
P1	Soils / Land Use & Capability	Soil impacts as a result of poor hydrocarbon management and spillages	Negative	Moderate Risk	Low Significance	• Develop and implement hydrocarbon management procedure. • Reclamation of soils in the event of accidental spillages.	Low Risk	Low Significance

ID[#]	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
				Without mitigation			With mitigation	
P2	Soils / Land Use & Capability	Surface disturbance caused by infrastructure	Negative	High Risk	Moderate Significance	• Dismantling of infrastructure. • Final rehabilitation of disturbed areas. • Rehabilitation of dams and storm water drainage.	Moderate Risk	Low Significance
P3	Surface Water	Water quantity impact due to decreased surface runoff	Negative	Moderate Risk	Moderate Significance	• Optimisation of the storm water management plan and positioning of infrastructure during the Feasibility Phase. • Separation of clean and dirty water systems (stream diversions) to minimise impact on runoff.	Low Risk	Low Significance
P4	Surface Water	Water quality impact on Sand River	Negative	Moderate Risk	Moderate Significance	• Directing and containment of dirty water runoff in dirty water dams and providing silt traps. • Recycling (reuse) of dirty water in process. • The dirty water dam will be designed for the 1:50 year flood-event and HDPE lined to prevent discharges / seepage into the surface water resources.	Low Risk	Low Significance
P5	Surface Water	Water quality impacts as a result of poor hydrocarbon management and spillages	Negative	Moderate Risk	Moderate Significance	• Develop and implement hydrocarbon management procedure. • Bulk facilities to be concrete lined and bunded to capacity of 110%.	Low Risk	Low Significance
P6	Groundwater	Water quality impacts due to infiltration of dirty water from the plant and infrastructure areas	Negative	High Risk	Moderate Significance	• Dirty water dams to be plastic lined to prevent groundwater contamination. • Carbonaceous plant stockpile areas to be appropriately lined with dedicated dirty water drainage from the stockpile to prevent groundwater contamination. • Dirty water canals in the Infrastructure Area to be concrete lined to prevent groundwater contamination.	Moderate Risk	Low Significance
P7	Air Quality	Air quality impacts associated with processing activities and movement of vehicles	Negative	Moderate Risk	Low Significance	• Reduction of drop height to reduce the dispersion of materials being transferred, and increase in moisture content (water sprays). • Plant and access roads to be surfaced or treated with dust palliatives such as Dustex.	Low Risk	Low Significance
P8	Air Quality	Dust impact caused by crushing and screening operations	Negative	Moderate Risk	Moderate Significance	• Introduce dust suppression systems, either in the form of water sprays or cladding in order to reduce the potential emissions. • Reduce vehicle speed on unpaved roads to limit dust creation.	Low Risk	Low Significance

ID#	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
				Without mitigation			With mitigation	
P9	Noise	Elevated noise levels caused by crushing and processing activities	Negative	Moderate Risk	Moderate Significance	• Rubber vulcanised belt – less noisy / vibration. • Cladding of crushing and screening plants and noisy equipment – encapsulation in buildings, acoustic covers, screens or sheds. • Noise suppression devices on heavy vehicles / crushing equipment. • Low noise generator sets will be used in plant. • Employees / contractors working in areas where the 8-hour ambient noise levels exceed 85dBA shall wear ear protection equipment.	Moderate Risk	Low Significance
P10	Visual / Aesthetics	Processing plant will have a visual impact as a result of high buildings	Negative	High Risk	Moderate Significance	• Avoid the use of highly reflective material in construction. • Metal surfaces should be painted in natural soft colours (Aloe Green) that would blend in with the environment.	Moderate Risk	Moderate Significance
P11	Lighting	Sky glow effect will have an impact on the sense of place at night	Negative	High Risk	Moderate Significance	• Use specifically designed lighting equipment that minimises the upward spread of light near to and above the horizontal. Care should be taken when selecting luminaries to ensure that appropriate units are chosen and that their location will reduce spill light and glare to a minimum. • Keep glare to a minimum by ensuring that the main beam angle of all lights directed towards any potential observer is not more than 70°. Higher mounting heights allow lower main beam angles, which can assist in reducing glare. In areas with low ambient lighting levels, glare can be very obtrusive and extra care should be taken when positioning and aiming lighting equipment. • Covering of high lighting masts to reduce the glow. • Suppress dust forming to minimise the effect of sky glow during night.	Moderate Risk	Moderate Significance
P12	Lighting	Impact on invertebrates	Negative	Moderate Risk	Moderate Significance	• Long-wavelength light sources should be used, e.g. low-pressure sodium vapour lights.	Moderate Risk	Low Significance
ON1	Air Quality	On-site conveyance will increase the ambient air quality	Negative	Moderate Risk	Moderate Significance	• Application of dust suppression (Dustex) on internal haul roads. • Surfacing of access road and main haul roads. • Water sprays at stockpiles and transfer points. • Water misters will be installed at strategic points at the transfer points along the conveyor in order to abate dust emission. • Vehicle speed on unpaved roads limited to prevent dust creation. • Conveyor design to include 'dogsheeting' on top and along the prevailing wind direction sides to minimise dust generation. • Use of appropriate plant operation and material handling techniques, good maintenance and housekeeping. Therefore the implement	Low Risk	Low Significance

ID#	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map (Without mitigation)	Impact Significance (Without mitigation)	Proposed Mitigation measures	Risk Map (With mitigation)	Impact Significance (With mitigation)
						measures to minimise the generation and dispersion of dust and surface disturbances. • Employ latest technology to reduce vehicle exhaust gas emissions.		
ON2	Surface Water	Stream crossings (road and conveyor) could potentially impact on the stream flow and lead to stream flow reductions downstream	Negative	Moderate Risk	Moderate Significance	• Design crossings for 1:20 year flood to minimise effect of damming of water upstream. No permanent retention of water in river at crossings.	Low Risk	Low Significance
ON3	Surface Water	Spillages along conveyors/roads could impact on water quality	Negative	Moderate Risk	Moderate Significance	• Regular inspections will be implemented for early detection of spillages. Cleaning up of any spillages that may have occurred. • All conveyors to be fully enclosed for zero spillage over all stream crossings. • Conveyors covered to deflect rain water away from conveyor belt. • Installation of primary and secondary scrapers ensures that there is continuous contact between the scrapers and the belt which will prevent spillages on the return belt.	Moderate Risk	Low Significance
ON4	Noise	Elevated noise levels caused by trucking and conveying activities	Negative	High Risk	Moderate Significance	• Rubber vulcanised belt – less noisy / vibration. • Maintenance of vehicles. • All equipment selection to fall in line with permissible noise dBA. • During the selection of the main components and equipment of the proposed undertaking as a whole, installation of alternative low-noise generating makes and models will be considered. • Noise suppression devices on heavy vehicles / conveying equipment.	Moderate Risk	Moderate Significance
ON5	Soils / Land Use & Capability	Surface disturbance caused by infrastructure	Negative	Low Risk	Low Significance	• Dismantling of infrastructure. • Final rehabilitation of disturbed areas and storm water drainage.	Low Risk	Low Significance
MR1	Groundwater	Impact of carbonaceous stockpiles on groundwater resources	Negative	High Risk	Moderate Significance	• Carbonaceous stockpiles to be appropriately lined with a sub-surface drainage system. • Stockpiles to be compacted, properly capped and revegetated to reduce recharge. • Stockpiles slopes to be designed such to increase runoff whilst preventing erosion. • Carbonaceous stockpiles to be disposed in-pit as far as possible at closure to minimise final footprint of surface carbonaceous stockpiles.	Moderate Risk	Low Significance

ID[#]	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
				Without mitigation			With mitigation	
MR2	Surface Water	Impact on non-perennial streams cutting through mining areas leading to decrease in runoff	Negative	Moderate Risk	Moderate Significance	• Optimisation of the storm water management plan and re-positioning of stockpiles during the Feasibility Phase. • Diversion of non-perennial streams around stockpile areas to minimise decrease in surface runoff.	Low Risk	Low Significance
MR3	Surface Water	Increased sedimentation in Sand River due to uncontrolled surface run-off and erosion	Negative	Moderate Risk	Moderate Significance	• Side slopes of stockpiles to be protected and vegetated to prevent erosion. • Construction of energy dissipating structures along steep slopes.	Low Risk	Low Significance
MR4	Surface Water	Water quality impacts as a result of dirty water runoff / seepage from carbonaceous stockpiles	Negative	High Risk	Moderate Significance	• Dirty water / seepage to be collected in lined facility and recycled to dirty water dams for use in process.	Moderate Risk	Moderate Significance
MR5	Visual / Aesthetics	Large stockpiles will impact on the landscape	Negative	High Risk	Moderate Significance	• In-pit disposal as far as possible. • Stockpiles to be protected and vegetated to reduce visual impact. • Landscaping of stockpiles to minimise impact – avoid straight lines and design contoured stockpiles that represent the natural lines of the existing topography.	Moderate Risk	Moderate Significance
MR6	Air Quality	Increase dust emissions as a result of stockpiles	Negative	Moderate Risk	Moderate Significance	• Compaction by heavy vehicles used for stockpile operations. • Stockpiles to be vegetated to reduce dust emissions.	Moderate Risk	Low Significance
MR7	Noise	Noise from stockpile construction leading to the main contributing factors to the noise at the sensitive receptors, especially at night-time	Negative	High Risk	Moderate Significance	• Noise suppression devices on heavy vehicles / crushing equipment. • Alternative reverse hooting systems will be implemented to reduce the noise levels.	Moderate Risk	Moderate Significance
OF1	Safety	Road / conveyor crossings could lead to safety risks to road users	Negative	Moderate Risk	Moderate Significance	• Appropriate crossings (under or over-passes) will be designed to eliminate the safety risks. • The conveyor route will be fenced off to prevent people and animals from going onto or across the conveyor.	Moderate Risk	Low Significance
OF2	Surface Water	Stream crossings where culverts may concentrate flow, leading to enhanced flow velocities and associated erosion problems	Negative	Low Risk	Moderate Significance	• Design crossings for 1:20 year flood to minimise effect of damming of water upstream. No permanent retention of water in river at crossings. • Construct the necessary erosion control measures at these crossings to reduce the impact.	Low Risk	Low Significance

ID#	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
				Without mitigation			With mitigation	
OF3	Surface Water	Potential for water quality impacts due to dirty runoff and spillages along the conveyor	Negative	Moderate Risk	Moderate Significance	• Regular inspections will be implemented for early detection of spillages. Cleaning up of any spillages that may have occurred. • All conveyors to be fully enclosed for zero spillage over all stream crossings. • Conveyors covered to deflect rain water away from conveyor belt. • Installation of primary and secondary scrapers ensures that there is continuous contact between the scrapers and the belt which will prevent spillages on the return belt.	Moderate Risk	Moderate Significance
OF4	Noise	Increase of ambient noise levels along the conveyor route	Negative	Moderate Risk	Moderate Significance	• Cladding of conveyor drives and other noisy equipment – encapsulation in buildings, acoustic covers, screens or sheds. • Rubber vulcanised belt – less noisy / vibration. • Noise suppression devices on conveying equipment.	Moderate Risk	Low Significance
OF5	Air Quality	Increase of dust emissions along the conveyor route	Negative	Moderate Risk	Moderate Significance	• Dust fallout monitoring points will be established along the conveyor route to detect an increase in emissions. • Regular inspections will be done along the conveyor route to detect and clean any spillages from the conveyor.	Moderate Risk	Moderate Significance
OF6	Biodiversity	Land units will be divided into smaller units which may not be ecologically viable	Negative	High Risk	Moderate Significance	• Re-route conveyor to align with existing disturbed corridors, i.e. roads, railway line. This will be finalised during the Feasibility Phase. • Animal crossings (underpasses) will be created along the conveyor for animals and domestic livestock, if the route cannot feasibly be re-routed.	Low Risk	Low Significance
OF7	Biodiversity	Potential impact on protected flora species identified along the route	Negative	Moderate Risk	Low Significance	• The conveyor route will be diverted to prevent impact to specific protected species, e.g. baobabs, impala lilies. • Where possible, the species that cannot be avoided will be rescued and relocated as per the Rescue & Relocation Plan.	Low Risk	Low Significance
OF8	Biodiversity	Creation of additional corridors which could lead to increased poaching	Negative	Moderate Risk	Low Significance	• Establishment of an anti-poaching unit in conjunction with adjacent landowners and communities. • Fencing (game fence) of the conveyor for safety and access control.	Moderate Risk	Low Significance
OF9	Biodiversity	Killing of animals crossing the conveyor	Negative	Moderate Risk	Moderate Significance	• The conveyor will be fenced off to prevent animals from going onto the conveyor system.	Low Risk	Low Significance

ID#	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
				Without mitigation			With mitigation	
EM1	Safety	Road transport of product will impact on the traffic along the route, safety risk to road users	Negative	High Risk	Moderate Significance	• Implementation of Community Safety and Traffic Management Procedure, including: o Upgrading of road intersections. o Other traffic calming measures identified during the LOM. o Maintaining vehicle speeds. o Covering of vehicles when in motion, both for loaded and unloaded vehicles. o Switching on head lights of trucks. • Due notification to the surrounding landowners and communities in the event of emergency trucking. • Implement a Traffic Awareness Programme within the surrounding communities.	Moderate Risk	Moderate Significance
EM2	Biodiversity	Killing of animals and avifauna on the roads, especially nocturnal animals/birds	Negative	Moderate Risk	Moderate Significance	• Maintaining vehicle speeds. • Trucking during daylight hours only. • Implement an Environmental Awareness Programme for trucking contractor.	Moderate Risk	Moderate Significance
EM3	Surface Water	Potential for water quality impacts due to spillages and dirty runoff into the streams	Negative	Moderate Risk	Moderate Significance	• Regular inspections will be done along the route to detect and clean any spillages from the trucks. • Emergency procedure to be developed and implemented in the event of any spillage / accident along the route. • Covering of vehicles when in motion, both for loaded and unloaded vehicles.	Moderate Risk	Moderate Significance
EM4	Air Quality	Material and product loss from trucks	Negative	Moderate Risk	Moderate Significance	• Gravel roads to be surfaced or treated with dust palliatives such as Dustex. • Covering of vehicles when in motion, both for loaded and unloaded vehicles. • Regular inspections will be done along the route to detect and clean any spillages from the trucks.	Low Risk	Low Significance
EM5	Noise	Increase of ambient noise levels along the route	Negative	Low Risk	Low Significance	• Noise suppression devices on transport trucks. • Trucking during daylight hours only.	Low Risk	Low Significance

Table 47: Social Impact Risk Matrix

ID	Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
				Without mitigation			With mitigation	
DP1	Demographic and Population Impacts	Influx of work seekers into the area	Negative	Moderate Risk	Moderate Significance	• Optimise the use of local labour as far as possible. • Establishing early on skills development programmes in the local area will support to possibility of finding skilled people locally. • Development and Implementation of an Influx and Land use Management Plan. • Develop a code of conduct with which contractors and their employees must comply. The code should deal with the interaction with local communities and substance abuse among other things. • Develop a Stakeholder Engagement Plan (SEP) which clarifies the principles of engagement with community and other stakeholders, sets in place appropriate liaison forums (a community forum is recommended), and describes the grievance management procedure to be adopted by the Mopane Project. Establishment of a local labour recruitment committee to monitor recruitment procedures and results • Communicate through media the recruitment procedures and priorities to discourage work seekers from outside the area.	Low Risk	Low Significance

ID	Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
				Without mitigation			With mitigation	
DP2	Demographic and Population Impacts	Influx of construction labour with pressure on services and social structures	Negative	Moderate Risk	Moderate Significance	• Facilitate the provision of housing and associated infrastructure. • Establishment of a construction accommodation camp to house those employees that cannot be sourced from the local community due to a lack of skills. • Optimise the use of local labour as far as possible. Establishing early on skills development programmes in the local area will support to possibility of finding skilled people locally. • Development and Implementation of an Influx and Land use Management Plan. • Develop a code of conduct with which contractors and their employees must comply. The code should deal with the interaction with local communities and substance abuse among other things. • Develop a Stakeholder Engagement Plan (SEP) which clarifies the principles of engagement with community and other stakeholders, sets in place appropriate liaison forums (a community forum is recommended), and describes the grievance management procedure to be adopted by the Mopane Project. Establishment of a local labour recruitment committee to monitor recruitment procedures and results. • Develop and communicate a clear and concise employment and recruitment policy to prevent opportunistic job seekers from settling in the area. • Implementation of a programme of STD and HIV/AIDS screening, counselling and (where possible) treatment.	Low Risk	Low Significance

ID	Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
				Without mitigation			With mitigation	
DP3	Demographic and Population Impacts	Influx of operational workforce with pressure on services and social structures	Negative	Moderate Risk	Moderate Significance	• Contribution towards the provision of housing, infrastructure and services for operational staff. • The establishment of partnerships with other private sector stakeholders, government authorities and civil society organisations to integrate planning around the provision of services and infrastructure, and to ensure that Mine inputs in this context compliment initiatives led by other players, especially the local and district municipality. • Development and Implementation of an Influx and Land use Management Plan. • Optimise the use of local labour as far as possible. Establishing early on skills development programmes in the local area will support to possibility of finding skilled people locally. • Induction of contractors and workforce with regard to their code of conduct in the local communities. • Develop and communicate a clear and concise employment and recruitment policy to prevent opportunistic job seekers from settling in the area. • Implementation of a programme of STD and HIV/AIDS screening, counselling and (where possible) treatment. • Continuous assessment and monitoring of infrastructure and services capacity in focal points (assessment every 5 years). • Determine scale of assistance required at focal points and enter into an agreement with the municipality. • Establish a development, infrastructure and service monitoring forum with the municipality to continuously assess and monitor capacity, determine assistance required and oversee implementation.	Low Risk	Low Significance

ID	Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
				Without mitigation			With mitigation	
DP4	Demographic and Population Impacts	Influx of people and the development of spontaneous settlements near project facilities, in the Mopane Town and surrounding areas	Negative	High Risk	Moderate Significance	• Develop a Community Development Plan which addresses issues relating to provision of housing for the workforce through on-going communication and engagement between the mine and local authorities for implementation of this plan. • Develop and adoption of an Influx Management Plan in consultation with the local government that outlines proactive management measures to discourage and manage influx, outlines and refines relevant stakeholders and their roles and responsibilities and the way in which each role-player intends to manage influx and spontaneous settlements. • Support the compilation of a development master plan, in cooperation with relevant local and regional authorities for the Musina and Makhado areas, whereby new development areas for workers' and new arrivals' accommodation will be catered for and duly planned. • Support local government capacity for integrated development planning. • Develop and communicate a clear and concise employment and recruitment policy to prevent opportunistic job seekers from settling in the area. • Continuous assessment and monitoring of infrastructure and services capacity in focal points (assessment every 5 years). • Determine scale of assistance required at focal points and enter into an agreement with the municipality. • Establish a development, infrastructure and service monitoring forum with the municipality to continuously assess and monitor capacity, determine assistance required and oversee implementation.	Moderate Risk	Low Significance

ID	Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
				Without mitigation			With mitigation	
DP5	Demographic and Population Impacts	Conflicts arising at the end of construction due to the termination of job opportunities for contractors	Negative	High Risk	Moderate Significance	• Investigate the possibility of transferring labour from one operation to another – depending on the phasing of the projects. • Develop the MbeuYashu grievance procedure to capture and address grievances arising due to retrenchments and downscaling. • Ensure compliance with all applicable Labour Regulations of South Africa. • Consider compliance with Best Practice , i.e. IFC's Performance Standard 2 "Labour and Working Conditions". • Monitoring of all contractors and sub-contractors for compliance with the above standards, with contractually-established financial sanctions for observed non-compliances. • Communicate the termination conditions to the communication structure established. • Communicate the termination conditions to all employees – including contractors and sub-contractors.	Moderate Risk	Low Significance
HSW1	Health and Social Wellbeing	Increased chances of the spread of communicable diseases such as HIV/AIDS and STDs linked to influx of predominantly male job-seekers and workers	Negative	High Risk	Moderate Significance	• Develop a comprehensive HIV/AIDS and STD program to employees through employee wellness programmes which should include prevention, voluntary counselling for HIV testing, as well as anti-retroviral treatment for employees. • Develop a Community Health Action Plan which focuses on HIV/AIDS, tuberculosis. • Repeated awareness campaigns that is focused beyond employees, and includes contractors and the communities near project facilities.	Moderate Risk	Moderate Significance

ID	Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
				Without mitigation			With mitigation	
HSW2	Health and Social Wellbeing	Safety and Risk Exposure through an increase in crime	Negative	Moderate Risk	Low Significance	• Increased security on mine premises. • Construction and permanent workers are identified and marked with clear identifiable clothing. • Code of Conduct to form part of induction of new workers with a clear statement and procedure regarding access, conduct and identification. • All construction workers should wear clothing marked (and reflective vests) with the logo of the construction firm/contractor or sub-contractor as well as identification cards that cannot be easily forged, so that they can be easily recognized as being legitimate. • Workers to be screened including criminal background checks. • Properly constructed and secured fences can control access to construction sites. Implementing strict access control of the project site and specifically the contractors workforce camp. • Workers should be urged to recognize and report suspicious activity and signs of burglary and be informed of crime prevention measures that they themselves can take. • Employment of local people on the mine to improve the poverty levels in the host and neighbouring communities. • MbeuYashu to liaise with existing community policing forums and project security to properly secure the project area and surrounding area. • Investigate the implementation of an anti-poaching unit in collaboration with local stakeholders, policing forums and police.	Low Risk	Low Significance

ID	Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
				Without mitigation			With mitigation	
HSW3	Health and Social Wellbeing	Safety and Risk Exposure due to an increase in poaching on neighbouring game farming properties	Negative	Moderate Risk	Low Significance	• Establishment of an anti-poaching unit available to adjacent land owners, and establishing a security forum in collaboration with these land owners. Land owners are to be actively involved in the selection of the contracting company employed to conduct anti-poaching in the area. • Increased security measures (fencing, access control and monitoring) on mine premises. Properly constructed and secured fences can control access to construction sites. Implementing strict access control of the project site and the contractors workforce camp. • Construction workers accommodated on mine are identified and marked with clear identifiable clothing. • Code of Conduct to form part of induction of new workers with a clear statement and procedure regarding access, conduct and identification. All construction workers should wear clothing marked (and reflective vests) with the logo of the construction firm/contractor or sub-contractor as well as identification cards that cannot be easily forged, so that they can be easily recognized as being legitimate. • Workers to be screened including criminal background checks. • Employment of local people on the mine to improve the poverty levels in the local communities.	Low Risk	Low Significance

ID	Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
				Without mitigation			With mitigation	
QL1	Quality of Living Environment	Change in "sense of place"	Negative	High Risk	Moderate Significance	• Regular and effective engagement with stakeholders through the SEP. • An effective grievance management procedure managed within the framework of the SEP. Grievance mechanisms must be in place throughout the life of the mine, including for a determined period post-closure, to address any impact for affected communities. • Implementation of traffic management measures Implementation of mitigation measures for noise. • Implementation of visual barriers and other mitigation measures as recommended in the visual study. • Colour schemes must complement the local environment. • Minimising disturbance to vegetated areas outside the critical development areas where possible. • Revegetation/rehabilitation of disturbed sites in parallel with development. • Successful mitigation interventions can reduce the intensity of the impact to at least moderate and ultimately moderate-low levels. If grievances are addressed adequately, and communication and engagement is effective affected communities may be able to adjust more easily to the changes.	Moderate Risk	Low Significance
QL2	Quality of Living Environment	Disruption of Social Networks and decrease in Social Capital	Negative	Moderate Risk	Low Significance	• Employment of local people already part of the community. • Code of conduct to form part of induction for all new workers. • Grievance Procedure within the local communities.	Low Risk	Low Significance
QL3	Quality of Living Environment	Perceptions of and Feelings in relation to the project	Negative	High Risk	Moderate Significance	• Establish on-going Consultative Forums with concerned groups to air concerns, find possible mitigation measures for their perceived impacts, solutions to co-existence and monitor implementation and effectiveness of mitigation measures. • Continuous communication with all stakeholders providing information on anticipated impacts and planned mitigation measures.	Moderate Risk	Low Significance

ID	Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
				Without mitigation			With mitigation	
FC1	Family and Community Impacts	Impacts on landowner and labourers	Negative	Very High Risk	Moderate Significance	• Development of a land acquisition or lease policy defining the negotiation process to minimize the feelings of uncertainty. • Financial compensation of affected property owners/tenants, employees and their families in terms of the relevant legislation. • Displacement of workers and their dependents requires an equitable policy, principles, financial guidelines and clarification of operational approaches. • Land acquisition, lease and compensation agreements reached with affected landowners that include arrangements and measures for labour tenants.	Moderate Risk	Low Significance
FC2	Family and Community Impacts	Change processes and impacts related to daily movement patterns	Negative	Moderate Risk	Moderate Significance	• The project description defines that no hauling will take place along existing farm roads or regional / national roads. It is planned that the run-of-mine (ROM) coal will be transported for short distances by truck, on the in-pit haul roads to the crushing and screening facilities. The crushed and screened ROM product will be transported to the coal beneficiation plant at the Infrastructure Hub via conveyor. It is further planned that the product will be loaded directly onto trains at the Rail Load-out Terminal situated at the Infrastructure Hub which links up with the existing Musina-Makhado railway line. • Therefore only supplier light-vehicles and employee busses will disrupt movement patterns, these will stabilize once the mine is fully operational.	Low Risk	Low Significance
FC3	Family and Community Impacts	Conversion of land use	Negative	High Risk	Moderate Significance	• Acquisition and/or leasing of directly impacted land. • Fair compensation negotiated and agreed with land owners that will lose agricultural land. • Continuous consultation with landowners discussing co-existence and feasibility. • Educate landowners in terms of their rights and responsibilities prior to the construction phase. • Assist landowners in identifying ways to adapt their land uses, to the benefit of both the landowner and MbeuYashu. • Implement a consultation programme with regional stakeholders in the development of a closure plan and rehabilitation programme. • Determine the regional needs and characteristics to ensure post mining use of land enhances the regional characteristics.	Moderate Risk	Low Significance

ID	Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
				Without mitigation			With mitigation	
I1	Institutional/Legal /Political/Equity Impacts	Challenge to local government capacity	Negative	Moderate Risk	Low Significance	• Intensive engagement between MbeuYashu / CoAL and the municipality well in advance of construction. In this context the responsibilities of local government should be well understood, and potential problems defined and addressed as early as possible. • Establishment of a limited and time-bound municipal support function. MbeuYashu / CoAL should contribute funding and appropriate technical resources. The participation of other major mines and industries in the area should be promoted by both MbeuYashu / CoAL and the local municipality.	Low Risk	Low Significance
I2	Institutional/Legal /Political/Equity Impacts	Participation and Consultation in process	Negative	Moderate Risk	Low Significance	• Either provide transport or reimbursement to the Historical Disadvantaged Communities. • During the Operational phase, the structures established for participation should have a proper constitution that addresses reimbursement of costs. • Arrangement of meetings in proximity to the mine or in affected communities to minimize the distance of directly affected parties to travel. • Cluster meetings together on the same day or over 2 days to minimize disruption of personal schedules.	Low Risk	Low Significance
I3	Institutional/Legal /Political/Equity Impacts	Impact equity	Negative	High Risk	Moderate Significance	• Tax and Profit benefits must be ploughed back into the Local Municipal areas and immediate communities. • Employment should be prioritized to local communities. • Local beneficiation programmes to be investigated and implemented.	Moderate Risk	Low Significance
E1	Socio-economic Wellbeing	Increase in South African GDP and Trade Balance	Positive	High Positive	Moderate Significance	• Procure goods and services from South African suppliers as far as possible. • Procure ancillary services for goods procured abroad, such as installation, customisation and maintenance, from South African companies as far as possible.	Very High Positive	High Significance

ID	Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
				Without mitigation			With mitigation	
E2	Socio-economic Wellbeing	Increase in provincial and local GDP	Positive	High Positive	Moderate Significance	• Procure goods and services from local or provincial suppliers as far as possible. • Procure ancillary services for goods purchased from outside of the Limpopo Province, such as installation, customisation and maintenance, from local or provincial companies as far as possible.	Very High Positive	High Significance
E3	Socio-economic Wellbeing	Increase in government revenue	Positive	High Positive	Moderate Significance	• None	High Positive	Moderate Significance
E4	Socio-economic Wellbeing	Increase in employment, income and skills development	Positive	High Positive	Moderate Significance	• Aim to use local workers as far as possible and formalise this policy in contracts. • Consider implementing labour-intensive rather than capital-intensive work methods wherever possible. • Procure resources from local sources wherever possible. • Establish a database of local people with information on qualifications and skills, utilize this database to develop skills plans and recruit local people. • Implement early on skills development programmes in the areas where most job opportunities will be created, i.e. operators and drivers. • Include training for general life skills such as financial management and health. • Implement portable skills development programmes. • Design and implement economic development programmes that will assist people being retrenched in sustaining their livelihoods. • Establish a future forum with representation from the workforce to discuss potential difficulties and solutions. • Implementation of programmes to minimize and mitigate the impact of downscaling and retrenchment.	Very High Risk	Moderate Significance

ID	Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
				Without mitigation			With mitigation	
E5	Socio-economic Wellbeing	Impact on existing businesses in surrounding areas	Negative	High Risk	Moderate Significance	• Devise a compensation plan for direct impacts of mining on adjacent farms, such as loss or pollution of land. • Screen mining activities from the adjacent farms and the main access road to minimize the impact on the general sense of place and tourists. • Identification of employees that may lose their employment and enrol in skills programme.	Moderate Risk	Low Significance
E6	Socio-economic Wellbeing	Change in property values	Negative	High Risk	Moderate Significance	• Attempt to minimize impacts through implementation of mitigation strategies focusing on aspects that may affect tourism characteristics including traffic, noise, and visual aspects such as screening mining activities from the adjacent farms and the main access road to minimize the impact on the general sense of place. • Establish a baseline of property values by conducting baseline valuations on representative properties and providing such to landowners, thereafter conducting monitoring valuations in periods of 5 years or as may be agreed with landowners. • Establish a communication channel with direct adjacent land owners to address impacts and grievances. • Adopting principles of good corporate citizenship focused on conservation of natural resources such as water, biodiversity, etc. Inclusion of these principles and actions into information disseminated in the local area ("how mining can be done differently").	Moderate Risk	Low Significance
E7	Socio-economic Wellbeing	Decrease of visitors, tourists and hunting parties	Negative	High Risk	Moderate Significance	• Attempt to minimize impacts through implementation of mitigation strategies focusing on aspects that may affect tourism characteristics including traffic, noise, and visual aspects such as screening mining activities from the adjacent farms and the main access road to minimize the impact on the general sense of place. • Collaborate with local stakeholders in terms of regional planning to ensure certain areas are protected for tourism and hunting activities. • Adopting principles of good corporate citizenship focused on conservation of natural resources such as water, biodiversity, etc. Inclusion of these principles and actions into information disseminated in the local area ("how mining can be done differently").	Moderate Risk	Low Significance

ID	Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
				Without mitigation			With mitigation	
E8	Socio-economic Wellbeing	Equity Participation of the Local Communities	Positive	Moderate Risk	Moderate Significance	• Ensure communities are fully involved and properly represented in the structures. • Ensure capacity is built at an early stage for communities to understand how equity and dividends work. • Place protective measures in place that will shield the communities from any business risk or liabilities.	High Positive	Moderate Significance
E9	Socio-economic Wellbeing	Participation of local business in procurement opportunities	Positive	High Positive	Moderate Significance	• Ensure communities are fully involved and understand the local procurement policy and procedure. • Ensure capacity is built at an early stage through enterprise development to enable local business to participate in opportunities. • Identify local only opportunities that is reserved for local business.	High Positive	Moderate Significance
E10	Socio-economic Wellbeing	Decline in South African GDP and Trade Balance at Decommissioning	Negative	Moderate Risk	Moderate Significance	• None	Low Risk	Moderate Significance
E11	Socio-economic Wellbeing	Decline in provincial and local GDP at decommissioning	Negative	High Risk	Moderate Significance	• Actively promote the development of different economic sectors from an early stage, e.g. through incentivising other industries to locate in the area, providing adequate infrastructure and promoting an increase and diversity of skills in the local population. • Actively engage with a range of stakeholders throughout the life-of-mine to discuss potential consequences of mine closure and possible mitigation. • Incorporate measures to retrain workers in the Social and Labour Plan.	Moderate Risk	Moderate Significance
E12	Socio-economic Wellbeing	Decline in government revenue at Decommissioning	Negative	High Risk	Moderate Significance	• None	Moderate Risk	Moderate Significance

ID	Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
				Without mitigation			With mitigation	
E13	Socio-economic Wellbeing	Decline in employment, income and skills development at decommissioning	Negative	High Risk	Moderate Significance	• Aim to use local workers as far as possible and formalise this policy in contracts. • Consider implementing labour-intensive rather than capital-intensive work methods wherever possible. • Purchase resources from local sources wherever possible. • Institute training programmes for local workers to raise skills levels. • Include training for general life skills such as financial management and health.	Moderate Risk	Moderate Significance
VG1	Vulnerable Group Impacts	Gendered Division of labour	Negative	Moderate Risk	Low Significance	• Women must have equal employment opportunities. • Training and skills development for women. • Salaries of women must be equal to that of men. • Establish opportunities that are suitable for women employment. • Implement measures to enable working environment for women. • Establishing gender-sensitive policy positions, such as for cultural heritage, employment and business development. • Mainstreaming gender into project planning, particularly for community development. • Using gender-sensitive indicators, such as employment data disaggregated by gender. • Consultation with national women’s organizations.	Low Risk	Low Significance
VG2	Vulnerable Group Impacts	Potential Infringements on Historically Disadvantaged People’s Human Rights	Negative	Moderate Risk	Low Significance	• Focusing local benefits on those communities previously disadvantaged to ensure upliftment. • Enter into agreements with local communities to address post closure land use and sustainability. • Optimization of local employment to minimize impacts of external or migrant workers on the local communities.	Low Risk	Low Significance

7 COMPARATIVE ASSESSMENT OF LAND USE AND DEVELOPMENT ALTERNATIVES

7.1 CURRENT LOCAL ECONOMIC ACTIVITIES

The current land uses / economic activities in the region include:

- Live Stock Farming
  - Commercial Cattle
- Game Farming
  - Live Sales
  - Hunting, subdivided in "Trophy" and "Biltong"
    - Trophy hunting including the services of professional hunter, skinner, tracker, etc.
    - Biltong hunting including tracker, skinner, etc.
  - Hunting Accommodation
- Eco Tourism, visitors to the lodges without any hunting motivation.
- Cultivation (crop production): Irrigation and dry-land.

Mosaka Economic Consultants was appointed to perform a Macro and Micro-Economic Impact Analysis for the Mopane Project – refer to ANNEX-10 for the full report.

For analytical purposes the project area was divided into three farming areas, the so-called Category 1 representing roughly 1 472 hectares and the Category 2 farms roughly 20 169 hectares together with the Category 3 farms of roughly 3 539 hectares.

The following give an indication of the makeup of the different categories – refer to Figure 101. A detailed explanation is provided in the main report (ANNEX-10).

- Category 1 land use: The following farming practices were included in this group:
  - Cultivation of irrigation crops as the main source of income; and/or
  - Cattle only; and/or
  - Cattle farms together with irrigation crops.
- Category 2 land use. The following farming practices were included in this group:
  - Game farming with lodge/chalet accommodation facilities for both trophy and biltong hunters; and/or
  - Game farms with accommodation and irrigation crops; and/or
  - Game farms with accommodation and cattle; and/or
  - Game farms with accommodation with both cattle and irrigation crops.
- Category 3 land use. The following farming practices were included in this group:
  - Farms with game but without accommodation facilities for either trophy/biltong hunters; and/or
  - Farms with game but without accommodation facilities for either trophy/biltong hunters but also stocking cattle; and/or
  - Farms without accommodation facilities for either trophy/biltong hunters with irrigation crop production.

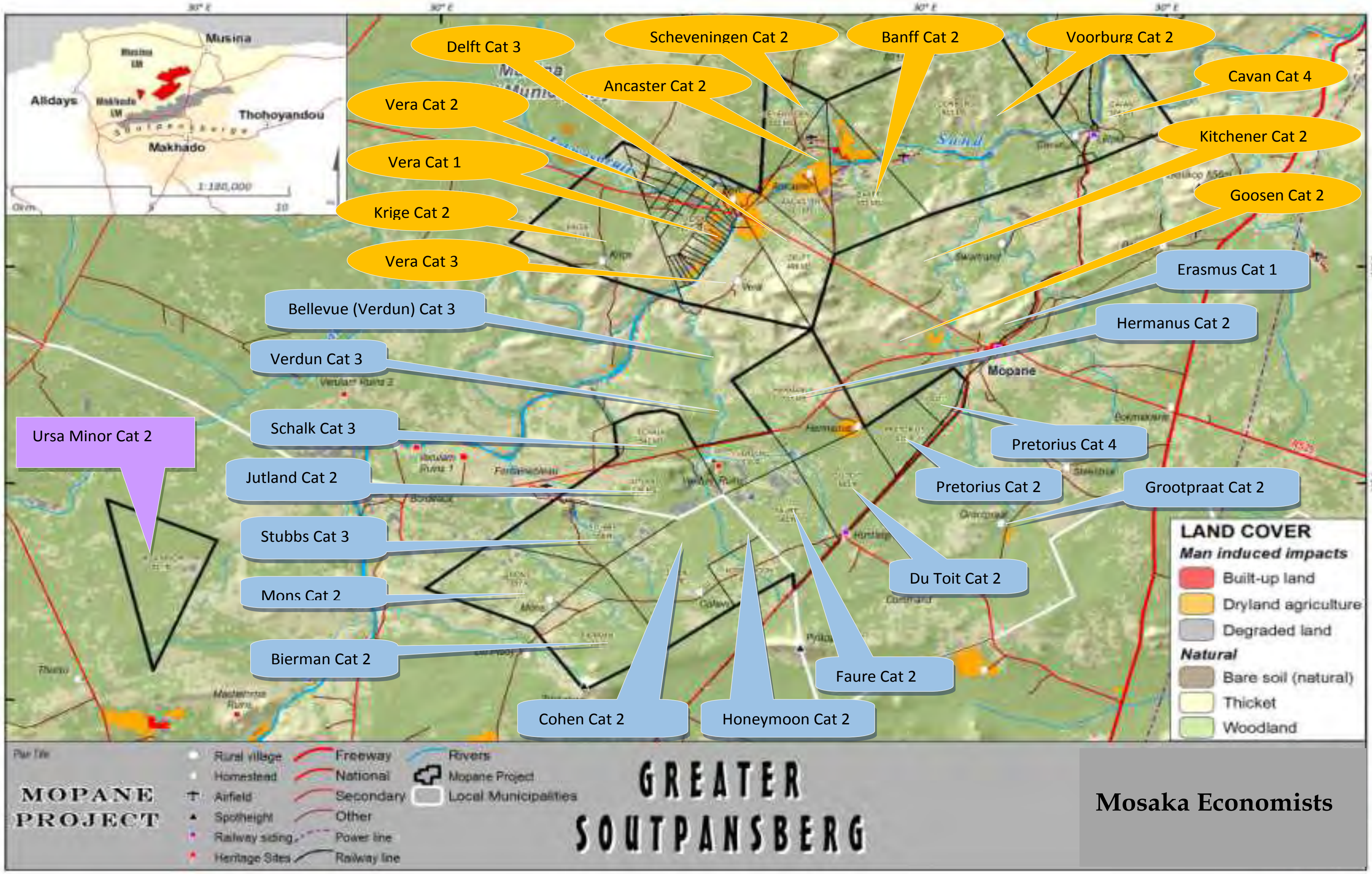


Figure 101: Farm categories for macro-economic analyses

The following table presents a summary of the current land use in the project area. Please take note that the irrigation figures below represents crop hectares and not physical hectares to make provision for double cropping.

	Cattle hectares	Game hectares	Irrigation Crop hectares	Total hectares
Category 1 Farms	1 047	53	60	1 160
Category 2 Farms	470	20 748	80	21 298
Category 3 Farms	234	3 215	46	3 495
Total	**1 751**	**24 015**	**186**	**25 953**

The following table gives an indication of the magnitude of the current activities in the project area.

	Annual Income	Annual Income	Annual Income	Annual Income
	Rand Million	Rand Million	Rand Million	Rand Million
	Category 1	Category 2	Category 3	Total
Beef Farming	0.32	0.57	0.05	0.93
Game Farming - Animals(Turn Over)	**0.07**	**5.32**	**0.18**	**5.57**
- *Game Sales*	0.07	0.52	-	0.59
- *Trophy Hunting*	0.00	2.86	0.09	2.94
- *Biltong Hunting*	0.00	1.94	0.10	2.04
Hunting				
- Professional Hunting Services (including game catching)	0.00	6.42	0.03	6.45
- *Taxidermy*	0.00	1.91	0.58	2.49
- *Accommodation*	0.00	15.47	-	15.47
Total	**0.00**	**23.79**	**0.61**	**24.40**
Eco-Tourism	0.00	7.74	0	7.74
Irrigation	3.16	5.55	6.85	15.56
Grand Total	**3.55**	**42.96**	**7.69**	**54.21**

The table shows that game farming and the related activities such as accommodation are by far the largest income generators in the area, representing 57.4% of the total annual turnover, expressed in 2013 prices.

In the following table the total economic activities for the three farming areas identified and analysed are expressed in terms of GDP and employment opportunities.

The impact on GDP reflects the magnitude of the values added to the coal mining industry from activities within the industry. Value added is made up of three elements, namely:

- Remuneration of employees;
- Gross operating surplus (which includes profit and depreciation); and
- Net indirect taxes.

It is important to keep in mind that GDP excludes any income taxes and interest payments on loans.

	Gross Domestic Product			Employment		
	Direct R mil.	Indirect/ Induced R mil.	Total R mil.	Direct Number	Indirect/ Induced Number	Total Number
Irrigation	8.33	8.64	16.98	122	42	164
Beef Farming	0.41	0.22	0.63	2	2	4
Game Farming	2.36	3.33	5.69	20	33	53
Hunting	3.13	3.06	6.20	17	13	30
Taxidermy, Game catching, etc.	4.93	4.97	9.90	27	19	46
Accomodation	10.53	12.29	22.82	70	51	121
Total	**29.70**	**32.52**	**62.22**	**257**	**160**	**417**

The table shows that the activities support 257 full time direct employment opportunities with another 160 indirect and induced opportunities and in total 417. It generates a total of R62.22 million in GDP of which R29.70 million is direct, expressed in 2013 prices. It is necessary that the direct GDP be evaluated in terms of its per hectare value, which is only about R1 150 per hectare per annum expressed in 2013 prices.

The following table presents the estimated incremental negative impact of the mine in the study area expressed in macro-economic parameters for the rail transport option; the coal will be loaded at the mining site then railed to the selected railway siding. In total the impact of all the areas identified are reflected in the table below.

	Gross Domestic Product			Employment		
	Direct R mil.	Indirect/ Induced R mil.	Total R mil.	Direct Number	Indirect/ Induced Number	Total Number
Irrigation	-3.50	-3.61	-7.11	-52	-18	-70
Beef Farming	-0.14	-0.08	-0.22	-1	-1	-2
Game Farming	-0.27	-1.21	-1.47	-8	-13	-21
Hunting	-1.96	-1.92	-3.88	-10	-8	-18
Taxidermy, Game catching, etc.	-2.96	-2.98	-5.94	-16	-11	-27
Accomodation	-6.27	-7.31	-13.57	-41	-30	-71
Total	**-15.09**	**-17.10**	**-32.19**	**-128**	**-81**	**-209**

The table shows that as many as 128 direct employment opportunities can be lost in the project area and a total of 209overall. The projected direct GDP loss is R15.09 million with a total of R32.19 million.

7.2 PROPERTY VALUES

The estimated property values depend on a number of issues and are normally valuated using a number of different fixed capital improvements. The *economic* values, not market values, differ from R1 503 per hectare for a beef producing unit, R2 344 basic game producing unit without any value added improvements to R12 204 for the units catering for the luxury market.

It is accepted that some of the property owners will probably not only suffer losses as far as income is concerned but also face the possibility that their property value will be devaluated, especially farms with accommodation facilities. It must be kept in mind that the major contributing factor to a possible devaluation in property values is the negative experience of "sense of place" for a specific property by a number of visitors. The two main issues affecting the formation of these perceptions are noise and visual intrusions.

7.3 COST BENEFIT ANALYSIS – ECONOMIC VIABILITY

A detailed Economic Cost Benefit Analysis was performed for the mining activity and the coal rail transport option to the identified siding in current financial prices using 6% inflation and constant economic prices. The CBA analysis incorporated the negative impacts on current local activities as a cost item over the mining period, environmental and loss of biodiversity costs and identified social costs.

In the following table the differences between a private sector financial CBA and a public sector economic CBA is presented.

Attributes	Public Sector Economic CBA	Private Sector Financial CBA
Perspective	The broader community.	Project shareholders/capital providers.
Goal	The most effective application of scarce resources.	Maximization of net value.
Discount Rate	Social discount rate.	Market determined weighted cost of capital.
Unit of Valuation	Opportunity costs.	Market prices.
Scope	All aspects necessary for a rational, economic decision.	Limited to aspects that affect profits.
Benefits	Additional goods, services, income and/or cost saving.	Profit and financial return on capital employed.
Costs	Opportunity costs of goods and services foregone.	Financial payments and depreciation calculated according to generally accepted accounting principles.
Income Tax	Income tax is not part of the calculations.	Very often income tax is included in the calculations

The benefits associated with the project are the revenue resulting from the sale of the coking coal and Eskom quality coal.

Approximately 25.6 million tons of coking coal is expected to be produced over the LOM. The 2011 price of coking coal was at an all-time high, the Australian coking coal varied from July 2010 to June 2011 from US$225 to US$328 per ton FOB. Currently, September 2013 the price is varying around US$147 per ton FOB. As the coking coal from the proposed mine will have to compete with the imported variety, the determination of the price will be an important aspect and the exchange rate also plays a vital role.

Determining the Free-on-Board (FOB) price was therefore complex and it is necessary to discuss some of the parameters used in the calculations:

- The 2011 situation
  - FOR price expressed in US$ - $207 ton/coking coal, the average 2010 price,
  - Exchange rate – R7 per 1US$,
  - Providing a FOR price of R1449 per ton.
- Current 2013 situation
  - Average 2013 FOB price expressed in US$ - $147 per ton1,
  - Exchange Rate –R9.50 per 1 US$,
  - Providing a FOB price of R1 396person.

Although the price has dropped in US$ terms by 8%, expressed in terms of Rands the reduction is only 3.7%.

MbeuYashu had a separate coking coal market study done by Wood Mackenzie; the report forecasted the following price scenario for the next number of years based on the different coking quality coal.

	2012	2013	2014	2015	2020	2025	2030
SSCC[2] benchmark (NSW)	147.16	117.69	119.85	125.12	145.50	171.75	178.60

The table shows that they expect the price over time will increase in constant terms; we accepted these figures for the base scenario as they are in line with other predictions found on the internet.

The second issue is the possible movement of the South African Rand exchange rate, we accepted for the base scenario an annual weakening of 1.67% against the US dollar as forecasted in the Manuel for Cost Benefit Analysis[3].

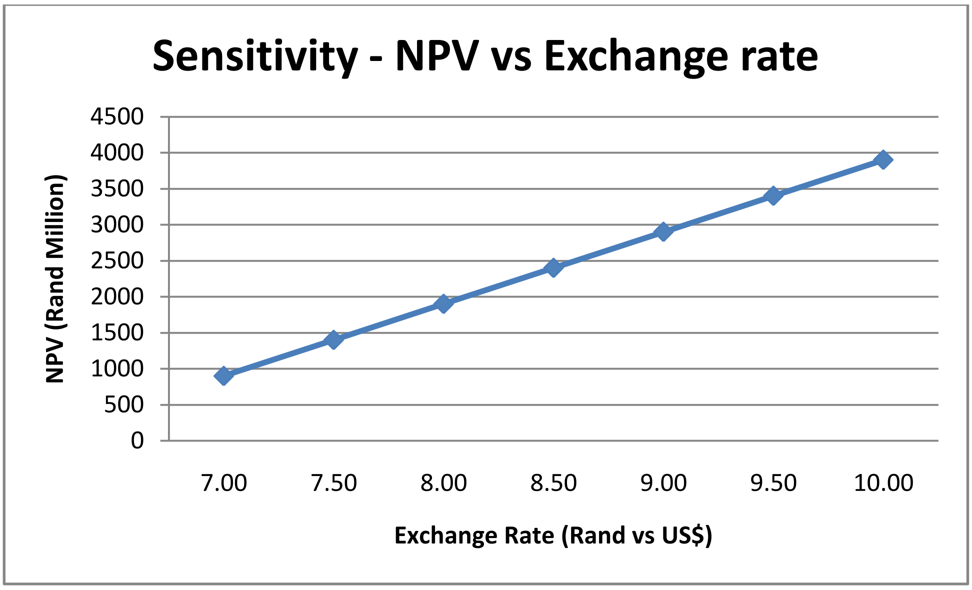
The Eskom destined coal is priced according to the average 2012 price of R349 per ton FOR with a 10% annual escalation for the first number of years as announced by Eskom and then a constant price.

The following graph shows the impact of different exchange rates on the Net Present Value for the $147.16 per ton, the average 2011 price.

[1]Wood Mackenzie - Market Study for CoAL - 2012

[2] SSCC – Semi – soft coking coal

[3]WRC Report No. TT 305/07 – A Manuel for Cost Benefit Analysis in South Africa with specific reference to Water Resource Development - August 2007.



The graph shows that a linear relationship exists between the exchange rate and economic viability of the project. Currently the exchange rate is very volatile with dramatic movements up and down, however a consensus opinion is that the lower limit would be R9 to the US$, although no guarantee exists that this would be the lower limit.

The following table presents the results of the financial and economic price CBA models developed by Mosaka Economic Consultants and based on the interpretation of the economic assumptions as detailed above.

	Financial CBA	Economic CBA
Net Present Value (NPV) (Rand million)	R 4 656.01	R 2 272.79
Benefit Cost Ratio (BCR)	1.89	1.64
Internal Rate of Return (IRR)	18.9%	14.3%

The results show that the project is economically viable when the inflation adapted financial prices have positive parameters for all three the price scenarios as well as the economic CBA in constant economic prices.

7.4 MACRO-ECONOMIC IMPACT ANALYSIS

The macro-economic impact analysis also shows a positive picture for both the economic impacts on the Limpopo Province as well as the South African economy. In the following table a summary of the Construction Phase annual impact results [R millions, 2012/2013 Prices] is presented.

In the following table the total macro-economic impacts on the RSA and the Limpopo Province is presented.

Summary of the Construction Phase Results [R millions, 2010/2011 Prices]

	National - RSA Economy	Provincial - Limpopo Economy
Impact on Total GDP (R millions)	**1 196**	**270**
Impact on Total Employment[4] [numbers]:	**4 834**	**1 987**
Impact on Households (R millions):	**809**	**143**
Low Income Households (R millions)	126	46
Medium Income Households (R millions)	156	24
High Income Households (R millions)	527	74
Fiscal Impact (R million):	**364**	**60**

The above table shows that the construction phase will have a positive impact on the National as well as the Limpopo Provincial economy for the duration of the construction phase. It is interesting to observe that out of a total 4 834 employment opportunities created, 1 987 will be in the Limpopo Province.

In the following table a summary of the annual total Operational Phase results [R millions, 2011/2012 Prices] is presented.

Summary of the Operational Phase Results showing the impact on the National and Limpopo Province economies [R millions, 2011/2012 Prices]. The Limpopo results are included in the National results.

	National - RSA Economy	Provincial - Limpopo Economy
Impact on GDP (R millions)	**6 580**	**2 073**
Impact on Total Employment[5] [numbers]:	**12 093**	**2 741**
Impact on Households (R millions):	**4 601**	**1 083**
Low Income Households (R millions)	765	325
Medium Income Households (R millions)	1 890	213
High Income Households (R millions)	2 213	545
Fiscal Impact (R million):	**1 808**	**417**
Balance of Payments (R million)	**2 813**	

The table shows that the operational phase of the proposed mine will have a very positive impact on the economy of the Province and that as much as 2 741 employment opportunities can be created of which over 917 will be direct employment opportunities on the mine itself.

The mine will, at full production, pay various taxes amounting to R1 808 million annually and have a positive contribution to the "Balance of Payments" of R2 813 million per annum if expressed in 2013 prices and values.

[4] Total Employment – Direct, Indirect and Induced Employment Opportunities

[5] Provincial and National numbers differ because of number of issues including transport and applications by Eskom

7.5 CONCLUSION

Comparison of the Local Economic Activities Baseline and estimated Negative Impact with the estimated impact of the proposed mine (2012 prices).

<table>
<tr><th colspan="8">Baseline Local Economic Activities and Impact of Mining</th></tr>
<tr><th colspan="8">Mining Operational Phase – Annual Impact Current Activities</th></tr>
<tr><th colspan="2"></th><th>Baseline</th><th>Impact</th><th colspan="2"></th><th>Base Line</th><th>Impact</th></tr>
<tr><td rowspan="3">Gross Domestic Product Rand million</td><td>Direct</td><td>29.70</td><td>-15.09</td><td rowspan="3">Employment</td><td>Direct</td><td>257</td><td>-128</td></tr>
<tr><td>Indirect/Induced</td><td>32.52</td><td>-17.10</td><td>Indirect/Induced</td><td>160</td><td>-81</td></tr>
<tr><td>Total</td><td>62.22</td><td>-32.19</td><td>Total</td><td>417</td><td>-209</td></tr>
<tr><th colspan="8">Mining Operational Phase – Annual Impact Limpopo Province</th></tr>
<tr><td rowspan="3">Gross Domestic Product Rand million</td><td>Direct</td><td colspan="2">1 518</td><td rowspan="3">Employment</td><td>Direct</td><td colspan="2">917</td></tr>
<tr><td>Indirect/Induced</td><td colspan="2">555</td><td>Indirect/Induced</td><td colspan="2">1 824</td></tr>
<tr><td>Total</td><td colspan="2">2 073</td><td>Total</td><td colspan="2">2 741</td></tr>
</table>

From the above table it appears that the current local economic activities in the defined project area contribute R62.22 million in total GDP and sustain 417 total employment opportunities of which 257 are direct. The mine activity will cost the local economic activities R32.19 million in GDP and 209 employment opportunities, of which 128 will be direct, in the project area.

The mine will offer 917 direct employment opportunities compensating for the loss 135 jobs in the project area. It is however in the rest of the Limpopo province where the mine will create many more jobs than the current activities namely 1 824 versus 160.

From the above and the rest of the analysis it appears that the proposed mining project will be an economic viable entity which will add value to the Limpopo Province. This will take place at the expense of the local economic activities, especially the game with ecology included, however, proper mitigation and even compensation must be part of the final solution. The investment the owner has made to a property can be negatively impacted if the hunting and accommodation facilities on the property are not fully utilised because of a down turn in visitors resulting from the mining activities.

Probably the two most important benefits to the national economy are:

- The annual impact on the "Fiscus" with an annual tax contribution of R1 808 million expressed in 2013 prices.
- The second impact is the favourable annual impact on the "Balance of Payments "amounting to R2 813 million, if expressed in 2013 prices.

From the above and the rest of the analysis it appears that the proposed mining project will be an economic viable entity which will add value to the Limpopo province. However, it will take place at the expense of some of the current local economic activities, specifically those in the irrigation, the game and ecology sectors and proper mitigation and even compensation might be part of the final solution. The investment the owner has made to the property can be negatively impacted if the hunting and accommodation facilities on the property is not fully utilised because of a down turn in visitors resulting. As stated, this will be a permanent impact and it will be necessary for the mining company to negotiate a proper mitigation programme.

8 LIST OF SIGNIFICANT IMPACTS AND PROPOSED MITIGATORY MEASURES

The lists of significant environmental and socio-economic impacts are provided in Table 48 and Table 49 respectively, together with the proposed mitigation measures to prevent and/or reduce these impacts.

8.1 CONSIDERATION OF CONCERNS RAISED BY STAKEHOLDERS

The main comments raised by the stakeholders included the following aspects:

- Water scarcity / availability for mining
- Surface & groundwater impacts (quantity & quality)
- Wetlands & springs (fountains)
- Ecological impact (destruction)
- Biodiversity and Sensitive Areas, Protected areas, Conservation value and initiatives of the area, Sand River Riparian Biodiversity
- Cumulative impacts
- Heritage and Cultural Resources, Graves & Verdun ruins
- Noise & dust pollution
- Visual and aesthetic value of the area, Sense of place
- Impact on existing land use, eco-tourism and employment
- Land value, compensation, Impact on Property Values
- Sustainability of land use options in the short and long term
- Potential changes in social structure and character of the area, due to the influx of work-seekers and illegal immigrants to the area
- Labour and accommodation (squatting)
- Job creation, procurement opportunities
- Equity / Community ownership in project
- Safety and Security

These concerns were addressed as far as possible in the specialist studies and included in this report. In addition, the following alternative options were proposed by stakeholders during the various engagement sessions and will be investigated further during the Feasibility Phase of the project:

- Relocation of the Mopane Infrastructure Hub to either the farm Van Der Bijl 528 MS or the farm Vriendin 589 MS.
- Re-alignment of the overland conveyor from the Voorburg Section to the Infrastructure Hub, aligning it along the Nieuwelust road and then along the Musina-Makhado railway line, rather than cutting through undisturbed areas on the farm Goosen 580 MS.

Table 48: List of significant environmental impacts identified during the EIA, together with proposed mitigation measures

Activity	Environmental Aspect	Potential Impact	Mitigation Measures
All activities	**Biodiversity / Land Use & Capability**	Surface disturbance of approximately 3,500 hectares for the purpose of mining and infrastructure development over the LOM will lead to impacts on the soil, land use and land capability, natural vegetation and fauna	• Development and implementation of a detailed Mine Rehabilitation and Reclamation Plan during the Feasibility Phase. • Concurrent rehabilitation and levelling of opencast pits in line with the Mine Rehabilitation and Reclamation Plan. • Monitoring, auditing and regular review (if required) of the Mine Rehabilitation and Reclamation Plan. • Rehabilitation of infrastructure and other disturbed areas post-mining. • Implementation of Flora Rescue and Relocation Plan prior to any surface disturbances. • Develop species rescue, relocation and re-introduction plan (fauna) with the assistance of specialists in this field. • Develop and implement Biodiversity Action Plan, including avifaunal plan. • Fencing of designated mining and infrastructure areas. • Implementation of biodiversity monitoring. • Close collaboration with the Vhembe Biosphere Reserve in respect of final end land use and sustainable mining.
		Increased poaching in region as a result of influx	• Establishment of an anti-poaching unit in conjunction with adjacent landowners and communities. • Implement an Environmental Awareness Programme within the surrounding communities.
All activities	**Waste management**	Poor waste management could lead to environmental impacts	• Implementation and regular review of Waste Management Procedure. • Appoint an approved, registered waste contractor to manage the waste generation and safe disposal thereof. • No waste will be disposed of or buried on site, or in any other location that is not a licensed waste disposal site.
		Poor sewage management could impact on water resources	• Sewage effluent will be treated to General Standards and pumped to the Infrastructure Area storage dams for re-use in the process. No effluent will be discharged to the environment.
All activities	**Bulk water**	Impact on water stressed catchment - fully allocated	• The bulk water source will be determined during the Feasibility Phase, followed by a detail EIA for the selected option. • Design closed system to ensure optimal recycling of water and minimise water requirements for the mine. • Installation of filter presses to increase water recovery in the process plant.

Activity	Environmental Aspect	Potential Impact	Mitigation Measures

All activities	**Bulk electricity**	Further impact on over-allocated electricity reticulation system	• Energy efficient designs such as:
			  ○ High efficiency motors in plant and workshops
			  ○ Power Factor Correction
			  ○ Use VSDs
			  ○ Use solar power where possible
			  ○ Install solar geysers at change houses\Optimal building design to make use of ambient light
			• Energy Policy must govern energy efficient designs such as: power factor correction; lighting designs; cooking and heating - avoid electricity use gas; process efficiency; high efficiency motors; low loss transformers; green building designs; use of solar and heat pumps for water heating.
			• Implement Energy Management Plan.
			• Monitor and record energy usage on site. Ongoing improvement in energy consumption should form part of the mine's KPIs.

All activities	**Heritage resources**	Destruction of heritage & cultural resources as a result of mining and associated infrastructure (including linear activities)	• A detail Heritage Management Action Plan will be developed during the Feasibility Phase once the mining and infrastructure has been finalised. • Implementation of Heritage Management Action Plan dealing with the Phase 1B&2 assessment as well as grave relocation. • National Heritage and Cultural issues will be included in the environmental awareness programme. • Regular monitoring of off-site heritage resources of importance.
All activities	**Sense of place**	Impact on conservation value of the region	• Identify and implement biodiversity offset programmes in conjunction with the IAPs and authorities, including the Vhembe Biosphere Reserve. • Implementation of environmental monitoring programme. • Develop environmental awareness & educational programmes. • Environmental auditing and reporting.
Opencast mining	**Soils / Land Use & Capability**	Potential hard setting of soils post-reclamation	• Soil analyses and amelioration during reclamation.
		Subsidence of rehabilitated areas	• Free-draining profile for rehabilitated areas (as far as practically possible) and ongoing monitoring.
Opencast mining	**Surface water**	Impact on non-perennial streams cutting through mining areas leading to decrease in runoff	• Optimisation of the storm water management plan and positioning of mining pits during the Feasibility Phase. • Diversion of non-perennial streams around opencast areas to minimise decrease in surface runoff. • Rehabilitation concurrent to mining – limit dirty footprint.

Activity	Environmental Aspect	Potential Impact	Mitigation Measures
		Impact on wetland areas and aquatic ecosystems associated with non-perennial streams	• Aquatic monitoring. • Create small impoundments at head of stream diversions to limit erosion. This could potentially become artificial wetlands over time. • Identify and implement biodiversity offset programmes (including wetland offsets) in conjunction with the IAPs and authorities, including the Vhembe Biosphere Reserve.
		Impact on 1:100 year flood-line of the Sand River	• Revise mining footprint during Feasibility Phase to avoid 1:100 flood-lines of the Sand River, plus a 100m buffer zone.
		Increased sedimentation into Sand River due to uncontrolled surface run-off	• Design and install appropriate outlet structures to retard flow velocity. • Construction of energy dissipating structures along steep slopes. • Side slopes of earth berms / canals to be designed to 1:3 and protected & vegetated to prevent erosion.
		Potential impact on in-stream habitat and riverine vegetation as a result of decrease in runoff	• Implementation of monitoring programme for early detection of impacts (plant moisture stress monitoring). • Diversion of clean storm water runoff around opencast areas to minimise impact of flow within the Sand River.
		Impact of long-term decant on water quality	• Investigate appropriate management measures over the LOM.
Opencast mining	**Groundwater**	Dewatering of aquifer as a result of mining	• The mining schedules will be revised during the Feasibility Phase in line with the recommendation of the specialist EIAs. Once this has been completed, the groundwater impact model will be revised to determine the impact of the revised mining design. • Implementation of baseline monitoring programme on farms that are potentially impacted once the mining and infrastructure feasibility studies have been completed. • Provide alternative water sources where appropriate. • Compensation mechanisms need to be developed and agreed with impacted landowners to compensate those who are impacted upon.
		Impact on surrounding vegetation as a result of dewatering and subsequent recovery	• Implementation of monitoring programme for early detection of impacts (plant moisture stress monitoring). • Diversion of clean storm water runoff around opencast areas to minimise impact of flow within the Sand River.

Activity	Environmental Aspect	Potential Impact	Mitigation Measures
		Decrease in regional water quality due to seepage from rehabilitated pits	• Potential acid generating horizons will be placed at bottom of pit and submerged below the water table, thereby preventing oxidation. • Rehabilitation will be concurrent with mining, minimising the potential for oxidation of sulphide bearing rocks and controlling the migration of high sulphate leachate. • Exposed residue material will be minimised by direct placement of overburden and topsoil. • Vegetation will be re-established as soon as possible after topsoiling to minimise infiltration of water through residue material. • Implementation of baseline monitoring programme to detect any seepage. • Compensation mechanism to compensate landowners who are impacted upon.
		Migration of pollution plume after full recovery of groundwater levels (prior to decant	• Investigate appropriate management measures over the LOM. • Groundwater and geochemical models must be updated on a regular basis (every 5 years) to verify potential for decant.
Opencast mining	**Air Quality**	Dust impact caused by vehicle movement	• Application of dust suppression measures (surface surfactants) such as Dustex. • Reduce vehicle speed on unpaved roads to limit dust creation.
		Dust impact caused by blasting activities	• Develop Blasting Procedure to minimise impacts.
		Dust impact caused by materials handling	• Reduction of drop height to reduce the dispersion of materials being transferred, and increase in moisture content (water sprays). • Creation of wind breaks in close proximity to storage piles to reduce the potential erosive forces of the wind.
		Methane emissions leading to air quality impacts	• Ongoing methane monitoring if required.
Opencast mining	**Noise**	Elevated noise levels caused by mining operation, dewatering (pumping) and blasting activities	• Noise attenuation berms (topsoil) on footprint of opencast areas. • Noise suppression devices on heavy vehicles and all noisy plant. • Alternative reverse hooting systems will be implemented to reduce the noise levels. • Low noise generator sets will be used in pit. • Develop air blast control measures. • Blasting limited on regular times, restricted to 08:00-18:00. • All plant, equipment and vehicles to be kept in good repair. • Employees / contractors working in areas where the 8-hour ambient noise levels exceed 85dBA shall wear ear protection equipment.

Activity	Environmental Aspect	Potential Impact	Mitigation Measures
Opencast mining	**Visual / Aesthetics**	The mining will have a negative on the aesthetics / sense of place	• Berms on footprint of opencast areas to be protected and vegetated to reduce the visual impact. • Avoid the unnecessary removal of vegetation during the operational phase. • Rehabilitation and revegetation will be performed concurrent to mining. • Introduce trees to the landscape at strategic locations (sensitive receptors) to break full exposure of the mine. Further analyses and stakeholder engagement will be required for this commitment.
Opencast mining	**Socio-economic**	Impact on the communities and sensitive receptors as a result of blasting	• Develop and implement Blasting Procedure as well as an Evacuation Procedure.
Processing plant / infrastructure areas (including RLT & siding)	**Soils / Land Use & Capability**	Soil impacts as a result of poor hydrocarbon management and spillages	• Develop and implement hydrocarbon management procedure. • Reclamation of soils in the event of accidental spillages.
		Surface disturbance caused by infrastructure	• Dismantling of infrastructure. • Final rehabilitation of disturbed areas. • Rehabilitation of dams and storm water drainage.
Processing plant / infrastructure areas (including RLT & siding)	**Surface water**	Water quantity impact due to decreased surface runoff	• Optimisation of the storm water management plan and positioning of infrastructure during the Feasibility Phase. • Separation of clean and dirty water systems (stream diversions) to minimise impact on runoff.
		Water quality impact on Sand River	• Directing and containment of dirty water runoff in dirty water dams and providing silt traps. • Recycling (reuse) of dirty water in process. • The dirty water dam will be designed for the 1:50 year flood-event and HDPE lined to prevent discharges / seepage into the surface water resources.
		Water quality impacts as a result of poor hydrocarbon management and spillages	• Develop and implement hydrocarbon management procedure. • Bulk facilities to be concrete lined and bunded to capacity of 110%.
Processing plant / infrastructure areas (including RLT & siding)	**Groundwater**	Water quality impacts due to infiltration of dirty water from the plant and infrastructure areas	• Dirty water dams to be plastic lined to prevent groundwater contamination. • Carbonaceous plant stockpile areas to be appropriately lined with dedicated dirty water drainage from the stockpile to prevent groundwater contamination. • Dirty water canals in the Infrastructure Area to be concrete lined to prevent groundwater contamination.

Activity	Environmental Aspect	Potential Impact	Mitigation Measures
Processing plant / infrastructure areas (including RLT & siding)	**Air quality**	Air quality impacts associated with processing activities and movement of vehicles	• Reduction of drop height to reduce the dispersion of materials being transferred, and increase in moisture content (water sprays). • Plant and access roads to be surfaced or treated with dust palliatives such as Dustex.
		Dust impact caused by crushing and screening operations	• Introduce dust suppression systems, either in the form of water sprays or cladding in order to reduce the potential emissions. • Reduce vehicle speed on unpaved roads to limit dust creation.
Processing plant / infrastructure areas (including RLT & siding)	**Noise**	Elevated noise levels caused by crushing and processing activities	• Rubber vulcanised belt – less noisy / vibration. • Cladding of crushing and screening plants and noisy equipment – encapsulation in buildings, acoustic covers, screens or sheds. • Noise suppression devices on heavy vehicles / crushing equipment. • Low noise generator sets will be used in plant. • Employees / contractors working in areas where the 8-hour ambient noise levels exceed 85dBA shall wear ear protection equipment.
Processing plant / infrastructure areas (including RLT & siding)	**Visual / aesthetics**	Processing plant will have a visual impact as a result of high buildings	• Avoid the use of highly reflective material in construction. • Metal surfaces should be painted in natural soft colours (Aloe Green) that would blend in with the environment.
Processing plant / infrastructure areas (including RLT & siding)	**Lighting**	Sky glow effect will have an impact on the sense of place at night	• Use specifically designed lighting equipment that minimises the upward spread of light near to and above the horizontal. Care should be taken when selecting luminaries to ensure that appropriate units are chosen and that their location will reduce spill light and glare to a minimum. • Keep glare to a minimum by ensuring that the main beam angle of all lights directed towards any potential observer is not more than 70°. Higher mounting heights allow lower main beam angles, which can assist in reducing glare. In areas with low ambient lighting levels, glare can be very obtrusive and extra care should be taken when positioning and aiming lighting equipment. • Covering of high lighting masts to reduce the glow. • Suppress dust forming to minimise the effect of sky glow during night.
		Impact on invertebrates	• Long-wavelength light sources should be used, e.g. low-pressure sodium vapour lights.

Activity	Environmental Aspect	Potential Impact	Mitigation Measures
On-site conveyance of ROM and product	**Air Quality**	On-site conveyance will increase the ambient air quality	• Application of dust suppression (Dustex) on internal haul roads. • Surfacing of access road and main haul roads. • Water sprays at stockpiles and transfer points. • Water misters will be installed at strategic points at the transfer points along the conveyor in order to abate dust emission. • Vehicle speed on unpaved roads limited to prevent dust creation. • Conveyor design to include 'dogsheeting' on top and along the prevailing wind direction sides to minimise dust generation. • Use of appropriate plant operation and material handling techniques, good maintenance and housekeeping. Therefore the implement measures to minimise the generation and dispersion of dust and surface disturbances. • Employ latest technology to reduce vehicle exhaust gas emissions.
On-site conveyance of ROM and product	**Surface water**	Stream crossings (road and conveyor) could potentially impact on the stream flow and lead to stream flow reductions downstream	• Design crossings for 1:20 year flood to minimise effect of damming of water upstream. No permanent retention of water in river at crossings.
		Spillages along conveyors/roads could impact on water quality	• Regular inspections will be implemented for early detection of spillages. Cleaning up of any spillages that may have occurred. • All conveyors to be fully enclosed for zero spillage over all stream crossings. • Conveyors covered to deflect rain water away from conveyor belt. • Installation of primary and secondary scrapers ensures that there is continuous contact between the scrapers and the belt which will prevent spillages on the return belt.
On-site conveyance of ROM and product	**Noise**	Elevated noise levels caused by trucking and conveying activities	• Rubber vulcanised belt – less noisy / vibration. • Maintenance of vehicles. • All equipment selection to fall in line with permissible noise dBA. • During the selection of the main components and equipment of the proposed undertaking as a whole, installation of alternative low-noise generating makes and models will be considered. • Noise suppression devices on heavy vehicles / conveying equipment.
On-site conveyance of ROM and product	**Soils / Land Use & Capability**	Surface disturbance caused by infrastructure	• Dismantling of infrastructure. • Final rehabilitation of disturbed areas and storm water drainage.

Activity	Environmental Aspect	Potential Impact	Mitigation Measures
Mine residue stockpiles	**Groundwater**	Impact of carbonaceous stockpiles on groundwater resources	• Carbonaceous stockpiles to be appropriately lined with a sub-surface drainage system. • Stockpiles to be compacted, properly capped and revegetated to reduce recharge. • Stockpiles slopes to be designed such to increase runoff whilst preventing erosion. • Carbonaceous stockpiles to be disposed in-pit as far as possible at closure to minimise final footprint of surface carbonaceous stockpiles.
Mine residue stockpiles	**Surface water**	Impact on non-perennial streams cutting through mining areas leading to decrease in runoff	• Optimisation of the storm water management plan and re-positioning of stockpiles during the Feasibility Phase. • Diversion of non-perennial streams around stockpile areas to minimise decrease in surface runoff.
		Increased sedimentation in Sand River due to uncontrolled surface run-off and erosion	• Side slopes of stockpiles to be protected and vegetated to prevent erosion. • Construction of energy dissipating structures along steep slopes.
		Water quality impacts as a result of dirty water runoff / seepage from carbonaceous stockpiles	• Dirty water / seepage to be collected in lined facility and recycled to dirty water dams for use in process.
Mine residue stockpiles	**Visual / Aesthetics**	Large stockpiles will impact on the landscape	• In-pit disposal as far as possible. • Stockpiles to be protected and vegetated to reduce visual impact. • Landscaping of stockpiles to minimise impact – avoid straight lines and design contoured stockpiles that represent the natural lines of the existing topography.
Mine residue stockpiles	**Air quality**	Increase dust emissions as a result of stockpiles	• Compaction by heavy vehicles used for stockpile operations. • Stockpiles to be vegetated to reduce dust emissions.
Mine residue stockpiles	**Noise**	Noise from stockpile construction leading to the main contributing factors to the noise at the sensitive receptors, especially at night-time	• Noise suppression devices on heavy vehicles / crushing equipment. • Alternative reverse hooting systems will be implemented to reduce the noise levels.
Off-site conveyance of ROM - conveyor between Voorburg & Jutland	**Safety**	Road / conveyor crossings could lead to safety risks to road users	• Appropriate crossings (under or over-passes) will be designed to eliminate the safety risks. • The conveyor route will be fenced off to prevent people and animals from going onto or across the conveyor.
Off-site conveyance of ROM - conveyor between Voorburg & Jutland	**Surface water**	Stream crossings where culverts may concentrate flow, leading to enhanced flow velocities and associated erosion problems	• Design crossings for 1:20 year flood to minimise effect of damming of water upstream. No permanent retention of water in river at crossings. • Construct the necessary erosion control measures at these crossings to reduce the impact.

Activity	Environmental Aspect	Potential Impact	Mitigation Measures
Off-site conveyance of ROM - conveyor between Voorburg & Jutland	**Surface water**	Potential for water quality impacts due to dirty runoff and spillages along the conveyor	• Regular inspections will be implemented for early detection of spillages. Cleaning up of any spillages that may have occurred. • All conveyors to be fully enclosed for zero spillage over all stream crossings. • Conveyors covered to deflect rain water away from conveyor belt. • Installation of primary and secondary scrapers ensures that there is continuous contact between the scrapers and the belt which will prevent spillages on the return belt.
Off-site conveyance of ROM - conveyor between Voorburg & Jutland	**Noise**	Increase of ambient noise levels along the conveyor route	• Cladding of conveyor drives and other noisy equipment – encapsulation in buildings, acoustic covers, screens or sheds. • Rubber vulcanised belt – less noisy / vibration. • Noise suppression devices on conveying equipment.
Off-site conveyance of ROM - conveyor between Voorburg & Jutland	**Air quality**	Increase of dust emissions along the conveyor route	• Dust fallout monitoring points will be established along the conveyor route to detect an increase in emissions. • Regular inspections will be done along the conveyor route to detect and clean any spillages from the conveyor.
Off-site conveyance of ROM - conveyor between Voorburg & Jutland	**Biodiversity**	Land units will be divided into smaller units which may not be ecologically viable	• Re-route conveyor to align with existing disturbed corridors, i.e. roads, railway line. This will be finalised during the Feasibility Phase. • Animal crossings (underpasses) will be created along the conveyor for animals and domestic livestock, if the route cannot feasibly be re-routed.
		Potential impact on protected flora species identified along the route	• The conveyor route will be diverted to prevent impact to specific protected species, e.g. baobabs, impala lilies. • Where possible, the species that cannot be avoided will be rescued and relocated as per the Rescue & Relocation Plan.
		Creation of additional corridors which could lead to increased poaching	• Establishment of an anti-poaching unit in conjunction with adjacent landowners and communities. • Fencing (game fence) of the conveyor for safety and access control.
		Killing of animals crossing the conveyor	• The conveyor will be fenced off to prevent animals from going onto the conveyor system.
Off-site conveyance of product by truck (in emergencies)	**Safety**	Road transport of product will impact on the traffic along the route, safety risk to road users	• Implementation of Community Safety and Traffic Management Procedure, including: o Upgrading of road intersections. o Other traffic calming measures identified during the LOM. o Maintaining vehicle speeds. o Covering of vehicles when in motion, both for loaded and unloaded

Activity	Environmental Aspect	Potential Impact	Mitigation Measures
			vehicles. o Switching on head lights of trucks. • Due notification to the surrounding landowners and communities in the event of emergency trucking. • Implement a Traffic Awareness Programme within the surrounding communities.
Off-site conveyance of product by truck (in emergencies)	**Biodiversity**	Killing of animals and avifauna on the roads, especially nocturnal animals/birds	• Maintaining vehicle speeds. • Trucking during daylight hours only. • Implement an Environmental Awareness Programme for trucking contractor.
Off-site conveyance of product by truck (in emergencies)	**Surface water**	Potential for water quality impacts due to spillages and dirty runoff into the streams	• Regular inspections will be done along the route to detect and clean any spillages from the trucks. • Emergency procedure to be developed and implemented in the event of any spillage / accident along the route. • Covering of vehicles when in motion, both for loaded and unloaded vehicles.
Off-site conveyance of product by truck (in emergencies)	**Air quality**	Material and product loss from trucks	• Gravel roads to be surfaced or treated with dust palliatives such as Dustex. • Covering of vehicles when in motion, both for loaded and unloaded vehicles. • Regular inspections will be done along the route to detect and clean any spillages from the trucks.
Off-site conveyance of product by truck (in emergencies)	**Noise**	Increase of ambient noise levels along the route	• Noise suppression devices on transport trucks. • Trucking during daylight hours only.

Table 49: List of significant environmental impacts identified during the SEIA, together with proposed mitigation measures

Social Aspect	Potential Impact	Proposed Mitigation measures
Demographic and Population Impacts	Influx of work seekers into the area	• Optimise the use of local labour as far as possible. Establishing early on skills development programmes in the local area will support to possibility of finding skilled people locally. • Development and Implementation of an Influx and Land use Management Plan. • Develop a code of conduct with which contractors and their employees must comply. The code should deal with the interaction with local communities and substance abuse among other things. • Develop a Stakeholder Engagement Plan (SEP) which clarifies the principles of engagement with community and other stakeholders, sets in place appropriate liaison forums (a community forum is recommended), and describes the grievance management procedure to be adopted by the Mopane Project. Establishment of a local labour recruitment committee to monitor recruitment procedures and results. • Communicate through media the recruitment procedures and priorities to discourage work seekers from outside the area.
Demographic and Population Impacts	Influx of construction labour with pressure on services and social structures	• Facilitate the provision of housing and associated infrastructure. • Establishment of a construction accommodation camp to house those employees that cannot be sourced from the local community due to a lack of skills. • Optimise the use of local labour as far as possible. Establishing early on skills development programmes in the local area will support to possibility of finding skilled people locally. • Development and Implementation of an Influx and Land use Management Plan. • Develop a code of conduct with which contractors and their employees must comply. The code should deal with the interaction with local communities and substance abuse among other things. • Develop a Stakeholder Engagement Plan (SEP) which clarifies the principles of engagement with community and other stakeholders, sets in place appropriate liaison forums (a community forum is recommended), and describes the grievance management procedure to be adopted by the Mopane Project. • Establishment of a local labour recruitment committee to monitor recruitment procedures and results. • Develop and communicate a clear and concise employment and recruitment policy to prevent opportunistic job seekers from settling in the area. • Implementation of a programme of STD and HIV/AIDS screening, counselling and (where possible) treatment.

Social Aspect	Potential Impact	Proposed Mitigation measures
Demographic and Population Impacts	Influx of operational workforce with pressure on services and social structures	• Contribution towards the provision of housing, infrastructure and services for operational staff. • The establishment of partnerships with other private sector stakeholders, government authorities and civil society organisations to integrate planning around the provision of services and infrastructure, and to ensure that Mine inputs in this context compliment initiatives led by other players, especially the local and district municipality. • Development and Implementation of an Influx and Land use Management Plan. • Optimise the use of local labour as far as possible. Establishing early on skills development programmes in the local area will support to possibility of finding skilled people locally. • Induction of contractors and workforce with regard to their code of conduct in the local communities. • Develop and communicate a clear and concise employment and recruitment policy to prevent opportunistic job seekers from settling in the area. • Implementation of a programme of STD and HIV/AIDS screening, counselling and (where possible) treatment. • Continuous assessment and monitoring of infrastructure and services capacity in focal points (assessment every 5 years). • Determine scale of assistance required at focal points and enter into an agreement with the municipality. • Establish a development, infrastructure and service monitoring forum with the municipality to continuously assess and monitor capacity, determine assistance required and oversee implementation.

Social Aspect	Potential Impact	Proposed Mitigation measures
Demographic and Population Impacts	Influx of people and the development of spontaneous settlements near project facilities, in the Mopane Town and surrounding areas	• Develop a Community Development Plan which addresses issues relating to provision of housing for the workforce through on-going communication and engagement between the mine and local authorities for implementation of this plan. • Develop and adoption of an Influx Management Plan in consultation with the local government that outlines proactive management measures to discourage and manage influx, outlines and refines relevant stakeholders and their roles and responsibilities and the way in which each role-player intends to manage influx and spontaneous settlements. • Support the compilation of a development master plan, in cooperation with relevant local and regional authorities for the Musina and Makhado areas, whereby new development areas for workers' and new arrivals' accommodation will be catered for and duly planned • Support local government capacity for integrated development planning. • Develop and communicate a clear and concise employment and recruitment policy to prevent opportunistic job seekers from settling in the area. • Continuous assessment and monitoring of infrastructure and services capacity in focal points (assessment every 5 years). • Determine scale of assistance required at focal points and enter into an agreement with the municipality. • Establish a development, infrastructure and service monitoring forum with the municipality to continuously assess and monitor capacity, determine assistance required and oversee implementation.
Demographic and Population Impacts	Conflicts arising at the end of construction due to the termination of job opportunities for contractors	• Investigate the possibility of transferring labour from one operation to another – depending on the phasing of the projects. • Develop the MbeuYashu grievance procedure to capture and address grievances arising due to retrenchments and downscaling. • Ensure compliance with all applicable Labour Regulations of South Africa. • Consider compliance with Best Practice , i.e. IFC's Performance Standard 2 "Labour and Working Conditions". • Monitoring of all contractors and sub-contractors for compliance with the above standards, with contractually-established financial sanctions for observed non-compliances. • Communicate the termination conditions to the communication structure established. • Communicate the termination conditions to all employees – including contractors and sub-contractors.

Social Aspect	Potential Impact	Proposed Mitigation measures
Health and Social Wellbeing	Increased chances of the spread of communicable diseases such as HIV/AIDS and STDs linked to influx of predominantly male job-seekers and workers	• Develop a comprehensive HIV/AIDS and STD program to employees through employee wellness programmes which should include prevention, voluntary counselling for HIV testing, as well as anti-retroviral treatment for employees. • Develop a Community Health Action Plan which focuses on HIV/AIDS, tuberculosis. • Repeated awareness campaigns that is focused beyond employees, and includes contractors and the communities near project facilities.
Health and Social Wellbeing	Safety and Risk Exposure through an increase in crime	• Increased security on mine premises. • Construction and permanent workers are identified and marked with clear identifiable clothing. • Code of Conduct to form part of induction of new workers with a clear statement and procedure regarding access, conduct and identification. All construction workers should wear clothing marked (and reflective vests) with the logo of the construction firm/contractor or sub-contractor as well as identification cards that cannot be easily forged, so that they can be easily recognized as being legitimate. • Workers to be screened including criminal background checks. • Properly constructed and secured fences can control access to construction sites. Implementing strict access control of the project site and specifically the contractors accommodation camp. • Workers should be urged to recognize and report suspicious activity and signs of burglary and be informed of crime prevention measures that they themselves can take. • Employment of local people on the mine to improve the poverty levels in the host and neighbouring communities. • MbeuYashu to liaise with existing community policing forums and project security to properly secure the project area and surrounding area. • Investigate the implementation of an anti-poaching unit in collaboration with local stakeholders, policing forums and police.

Social Aspect	Potential Impact	Proposed Mitigation measures
Health and Social Wellbeing	Safety and Risk Exposure due to an increase in poaching on neighbouring game farming properties	• Establishment of an anti-poaching unit available to adjacent landowners, and establishing a security forum in collaboration with these land owners. Landowners are to be actively involved in the selection of the contracting company employed to conduct anti-poaching in the area. • Increased security measures (fencing, access control and monitoring) on mine premises. • Properly constructed and secured fences can control access to construction sites. • Implementing strict access control of the project site and the contractors workforce camp. • Construction workers accommodated on mine are identified and marked with clear identifiable clothing. • Code of Conduct to form part of induction of new workers with a clear statement and procedure regarding access, conduct and identification. All construction workers should wear clothing marked (and reflective vests) with the logo of the construction firm/contractor or sub-contractor as well as identification cards that cannot be easily forged, so that they can be easily recognized as being legitimate. • Workers to be screened including criminal background checks. • Employment of local people on the mine to improve the poverty levels in the local communities.
Quality of Living Environment	Change in "sense of place"	• Regular and effective engagement with stakeholders through the SEP. • An effective grievance management procedure managed within the framework of the SEP. Grievance mechanisms must be in place throughout the life of the mine, including for a determined period post-closure, to address any impact for affected communities. • Implementation of traffic management measures. • Implementation of mitigation measures for noise. • Implementation of visual barriers. • Colour schemes must complement the local environment. • Minimising disturbance to vegetated areas outside the critical development areas where possible. • Revegetation/rehabilitation of disturbed sites in parallel with development. • Successful mitigation interventions can reduce the intensity of the impact to at least moderate and ultimately moderate-low levels. If grievances are addressed adequately, and communication and engagement is effective affected communities may be able to adjust more easily to the changes.
Quality of Living Environment	Disruption of Social Networks and decrease in Social Capital	• Employment of local people already part of the community. • Code of conduct to form part of induction for all new workers. • Grievance Procedure within the local communities.

Social Aspect	Potential Impact	Proposed Mitigation measures
Quality of Living Environment	Perceptions of and Feelings in relation to the project	• Establish on-going Consultative Forums with concerned groups to air concerns, find possible mitigation measures for their perceived impacts, solutions to co-existence and monitor implementation and effectiveness of mitigation measures. • Continuous communication with all stakeholders providing information on anticipated impacts and planned mitigation measures.
Family and Community Impacts	Impacts on landowner and labourers	• Development of a land acquisition or lease policy defining the negotiation process to minimize the feelings of uncertainty. • Financial compensation of affected property owners/tenants, employees and their families in terms of the relevant legislation. • Displacement of workers and their dependents requires an equitable policy, principles, financial guidelines and clarification of operational approaches. • Land acquisition, lease and compensation agreements reached with affected landowners that include arrangements and measures for labour tenants.
Family and Community Impacts	Change processes and impacts related to daily movement patterns	• The project description defines that no hauling will take place along existing farm roads or regional / national roads. It is planned that the run-of-mine (ROM) coal will be transported for short distances by truck, on the in-pit haul roads to the crushing and screening facilities. The crushed and screened ROM product will be transported to the coal beneficiation plant at the Infrastructure Hub via conveyor. It is further planned that the product will be loaded directly onto trains at the Rail Load-out Terminal situated at the Infrastructure Hub which links up with the existing Musina-Makhado railway line.
Family and Community Impacts	Conversion of land use	• Acquisition and/or leasing of directly impacted land. • Fair compensation negotiated and agreed with land owners that will lose agricultural land. • Continuous consultation with landowners discussing co-existence and feasibility. • Educate landowners in terms of their rights and responsibilities prior to the construction phase. • Assist landowners in identifying ways to adapt their land uses, to the benefit of both the landowner and MbeuYashu. • Implement a consultation programme with regional stakeholders in the development of a closure plan and rehabilitation programme. • Determine the regional needs and characteristics to ensure post mining use of land enhances the regional characteristics.

Social Aspect	Potential Impact	Proposed Mitigation measures
Institutional/Legal/Political/ Equity Impacts	Challenge to local government capacity	• Intensive engagement between MbeuYashu and the municipality well in advance of construction. In this context the responsibilities of local government should be well understood, and potential problems defined and addressed as early as possible. • Establishment of a limited and time-bound municipal support function. MbeuYashu should contribute funding and appropriate technical resources. The participation of other major mines and industries in the area should be promoted by both MbeuYashu and the local municipality.
Institutional/Legal/Political/ Equity Impacts	Participation and Consultation in process	• Either provide transport or reimbursement to the Historical Disadvantaged Communities. • During the Operational phase, the structures established for participation should have a proper constitution that addresses reimbursement of costs. • Arrangement of meetings in proximity to the mine or in affected communities to minimize the distance of directly affected parties to travel. • Cluster meetings together on the same day or over 2 days to minimize disruption of personal schedules.
Institutional/Legal/Political/ Equity Impacts	Impact equity	• Tax and Profit benefits must be ploughed back into the Local Municipal areas and immediate communities. • Employment should be prioritized to local communities. • Local beneficiation programmes to be investigated and implemented.
Socio-economic Wellbeing	Increase in South African GDP and Trade Balance	• Procure goods and services from South African suppliers as far as possible. • Procure ancillary services for goods procured abroad, such as installation, customisation and maintenance, from South African companies as far as possible.
Socio-economic Wellbeing	Increase in provincial and local GDP	• Procure goods and services from local or provincial suppliers as far as possible. • Procure ancillary services for goods purchased from outside of the Limpopo Province, such as installation, customisation and maintenance, from local or provincial companies as far as possible.
Socio-economic Wellbeing	Increase in government revenue	• None

Social Aspect	Potential Impact	Proposed Mitigation measures
Socio-economic Wellbeing	Increase in employment, income and skills development	• Aim to use local workers as far as possible and formalise this policy in contracts. • Consider implementing labour-intensive rather than capital-intensive work methods wherever possible. • Procure resources from local sources wherever possible. • Establish a database of local people with information on qualifications and skills, utilize this database to develop skills plans and recruit local people. • Implement early on skills development programmes in the areas where most job opportunities will be created, i.e. operators and drivers. • Include training for general life skills such as financial management and health. • Implement portable skills development programmes. • Design and implement economic development programmes that will assist people being retrenched in sustaining their livelihoods. • Establish a future forum with representation from the workforce to discuss potential difficulties and solutions. • Implementation of programmes to minimize and mitigate the impact of downscaling and retrenchment
Socio-economic Wellbeing	Impact on existing businesses in surrounding areas	• Devise a compensation plan for direct impacts of mining on adjacent farms, such as loss or pollution of land. • Screen mining activities from the adjacent farms and the main access road to minimize the impact on the general sense of place and tourists. • Identification of employees that may lose their employment and enrol in skills programme.
Socio-economic Wellbeing	Change in property values	• Attempt to minimize impacts through implementation of mitigation strategies focusing on aspects that may affect tourism characteristics including traffic, noise, and visual aspects such as screening mining activities from the adjacent farms and the main access road to minimize the impact on the general sense of place. • Establish a baseline of property values by conducting baseline valuations on representative properties and providing such to landowners, thereafter conducting monitoring valuations in periods of 5 years or as may be agreed with landowners. • Establish a communication channel with direct adjacent land owners to address impacts and grievances. • Adopting principles of good corporate citizenship focused on conservation of natural resources such as water, biodiversity, etc. Inclusion of these principles and actions into information disseminated in the local area ("how mining can be done differently").
Socio-economic Wellbeing	Decrease of visitors, tourists and hunting parties	• Attempt to minimize impacts through implementation of mitigation strategies focusing on aspects that may affect tourism characteristics including traffic, noise, and visual aspects such as screening mining activities from the adjacent farms and the main access road to minimize the impact on the general sense of place.

Social Aspect	Potential Impact	Proposed Mitigation measures
		• Collaborate with local stakeholders in terms of regional planning to ensure certain areas are protected for tourism and hunting activities. • Adopting principles of good corporate citizenship focused on conservation of natural resources such as water, biodiversity, etc. Inclusion of these principles and actions into information disseminated in the local area ("how mining can be done differently").
Socio-economic Wellbeing	Equity Participation of the Local Communities	• Ensure communities are fully involved and properly represented in the structures. • Ensure capacity is built at an early stage for communities to understand how equity and dividends work. • Place protective measures in place that will shield the communities from any business risk or liabilities.
Socio-economic Wellbeing	Participation of local business in procurement opportunities	• Ensure communities are fully involved and understand the local procurement policy and procedure. • Ensure capacity is built at an early stage through enterprise development to enable local business to participate in opportunities. • Identify local only opportunities that is reserved for local business.
Socio-economic Wellbeing	Decline in South African GDP and Trade Balance at Decommissioning	• None
Socio-economic Wellbeing	Decline in provincial and local GDP at decommissioning	• Actively promote the development of different economic sectors from an early stage, e.g. through incentivising other industries to locate in the area, providing adequate infrastructure and promoting an increase and diversity of skills in the local population. • Actively engage with a range of stakeholders throughout the life-of-mine to discuss potential consequences of mine closure and possible mitigation. • Incorporate measures to retrain workers in the Social and Labour Plan.
Socio-economic Wellbeing	Decline in government revenue at Decommissioning	• None
Socio-economic Wellbeing	Decline in employment, income and skills development at decommissioning	• Aim to use local workers as far as possible and formalise this policy in contracts. • Consider implementing labour-intensive rather than capital-intensive work methods wherever possible. • Purchase resources from local sources wherever possible. • Institute training programmes for local workers to raise skills levels. • Include training for general life skills such as financial management and health.

Social Aspect	Potential Impact	Proposed Mitigation measures
Vulnerable Group Impacts	Gendered Division of labour	• Women must have equal employment opportunities. • Training and skills development for women. • Salaries of women must be equal to that of men. • Establish opportunities that are suitable for women employment. • Implement measures to enable working environment for women. • Establishing gender-sensitive policy positions, such as for cultural heritage, employment and business development. • Mainstreaming gender into project planning, particularly for community development. • Using gender-sensitive indicators, such as employment data disaggregated by gender. • Consultation with national women's organizations.
Vulnerable Group Impacts	Potential Infringements on Historically Disadvantaged People's Human Rights	• Focusing local benefits on those communities previously disadvantaged to ensure upliftment. • Enter into agreements with local communities to address post closure land use and sustainability. • Optimization of local employment to minimize impacts of external or migrant workers on the local communities.

9 STAKEHOLDER ENGAGEMENT

The report on the results of consultation with communities and interested and affected parties is attached as ANNEX-11 (Naledi Development, 2013). This document presents the results of the Consultation with landowners, lawful occupants, communities and interested and affected parties in terms of the MPRDA for the Mopane Project NOMR application. Compliance with other South African legislation will not be done in parallel but will follow a staggered process, which will only commence after compliance with the MPRDA is complete.

The consultation process of the Greater Soutpansberg Project (GSP) is subject to a newly developed MbeuYashu Stakeholder Policy, whose primary aim is to create sustainable value for all stakeholders, while recognising that stakeholders contribute, create and develop, together with the MbeuYashu's management, the company for its advantage and success. The company seeks to earn its social licence to operate through its engagement processes with its key stakeholders.

This policy was benchmarked against international best practice, and included the principles of inclusivity, mutuality, materiality and open and collaborative engagement. The adherence to ensure compliance has not been compromised through the process.

The following aspects are addressed in the Stakeholder Engagement Policy and are only highlighted here:

- The foundation for the policy is the Company Vision and the Management Commitment to sustainable development and participatory co-operative governance;
- The policy is based on global and local frameworks (compliance with South African legislation), guidelines and standards;
- Changing expectations and the role of business in society;
- Emerging and latest thinking on Stakeholder Engagement theory and practice;
- Changes in cultures and behavior; and
- Reflections, thinking and discussion with internal role-players.

Public participation provides the opportunity for Interested and Affected Parties (IAPs) to participate on an informed basis, and to ensure that their needs and concerns are considered during the impact assessment process. In so doing, a sense of ownership of the project is vested in both the project proponent and interested or affected parties. The Public Participation Process is aimed at achieving the following:

- Striving for adherence to best practice and international standards;
- Compliance with the MPRDA and its Regulations;
- Encourage involvement and participation in the environmental specialist studies and process for authorization;
- Provide opportunities for IAPs and the authorities to obtain clear, accurate and understandable information about the expected environmental and socioeconomic impacts of the proposed development;
- Establish a formal platform for the public with the opportunity to voice their concerns and to raise questions regarding the project;

- Utilise the opportunity to formulate ways for reducing or mitigating any negative impacts of the project, and for enhancing its benefits;
- Enable MbeuYashu to consider the needs, preferences and values of IAPs in their decisions;
- Clear up any misunderstandings about technical issues; and
- Provide a proactive indication of issues which may inhibit project progress resulting in delays, or which may result in enhanced and shared benefits.

The following methodology was utilised:

- Establishment and Maintenance of the Interested and Affected Party Register and Landowner Register (ANNEX-11: Appendix A1).
- Announcement of Project Activities via letters (emailed, faxed, posted and hand-delivered), SMS's, advertisements, and on site notices (ANNEX-11: Appendix A2, A3 & A4).
- Notification of the availability of Project Documentation such as the Background Information Document, Scoping Report and Environmental Impact Assessment Report (ANNEX-11: Appendix A2, A3 & A4).
- Arrangement and Facilitation of Engagement Sessions and Public Meetings (ANNEX-11: Appendix A5).
- Recording, Considering and Responding to Comments, Issues and Inputs from Interested and Affected Parties (ANNEX-11: Appendix A6 & A7)

The main comments and responses raised throughout the Public Participation Process focused on the following aspects:

- Water scarcity / availability for mining
- Surface & groundwater impacts (quantity & quality)
- Wetlands & springs (fountains)
- Ecological impact (destruction)
- Biodiversity and Sensitive Areas, Protected areas, Conservation value and initiatives of the area, Sand River Riparian Biodiversity
- Cumulative impacts
- Heritage and Cultural Resources, Graves & Verdun ruins
- Noise & dust pollution
- Visual and aesthetic value of the area, Sense of place
- Impact on existing land use, eco-tourism and employment
- Land value, compensation, Impact on Property Values
- Consultation process
- Sustainability of land use options in the short and long term, Phasing of project (schedule of larger GSP)
- Potential selling of rights – EMP commitments
- Potential changes in social structure and character of the area, due to the influx of work-seekers and illegal immigrants to the area, Labour and accommodation (squatting)
- Job creation, procurement opportunities
- Equity / Community ownership in project
- Safety and Security

10 ADEQUACY OF PREDICTIVE METHODS AND KNOWLEDGE GAPS

10.1 ACCESS CONSTRAINTS

A number of properties (49% of MRA area) could not be accessed for specialist surveys for a number of reasons. In total, only 61% of the MRA area could be accessed; however, 100% of the planned mining and infrastructure footprint area could be accessed for specialist surveys as indicated in the figure below. Thus, all directly impacted properties were surveyed.

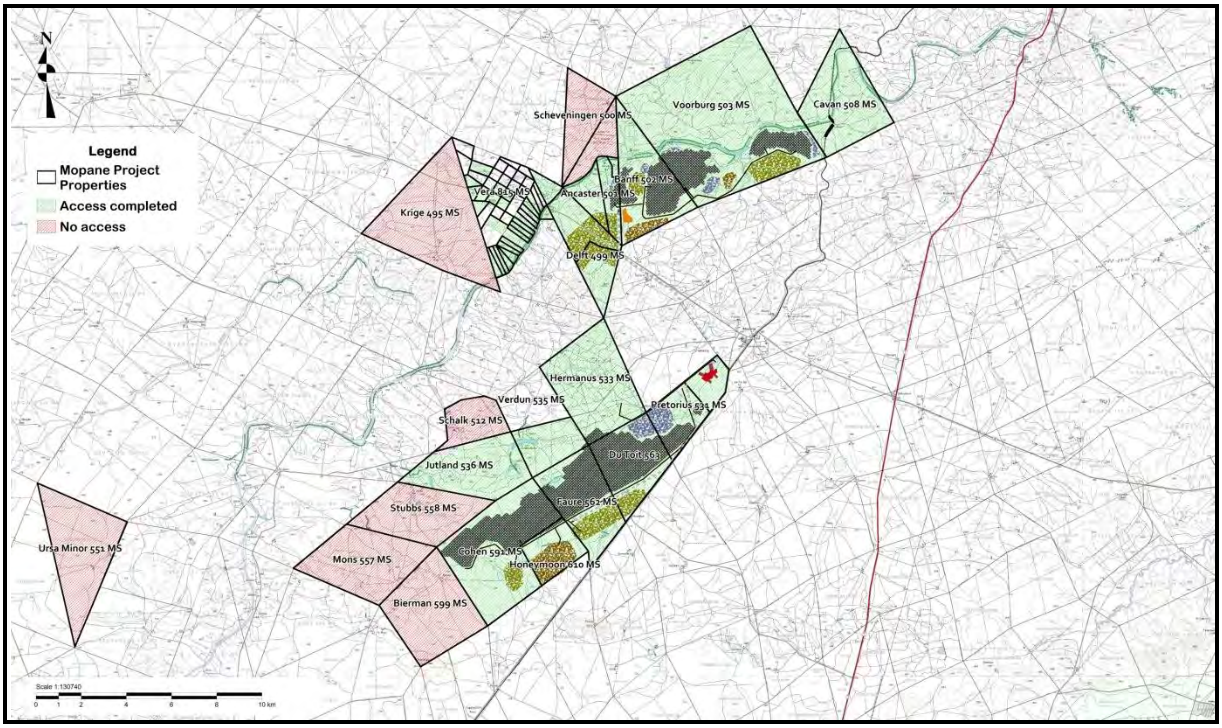


Figure 102: Properties accessed during specialist investigations

10.2 TIME CONSTRAINTS

In order to obtain a comprehensive understanding of the dynamics of the communities and status of the endemic (rare or threatened species in an area), ecological studies should be ideally replicated over several seasons and over a number of years. However, due to time constraints imposed by the MPRDA, such long-term studies are not always feasible and the specialist surveys were only conducted in one season (dry winter season).

Due to the arid climate with a very dry winter, the vegetation is deciduous, with only a few tree species retaining leaves. The herbaceous layer is absent, which limits the effectiveness of conducting vegetation surveys. An early spring (within a few weeks of the first rainfall) and mid to late summer survey is strongly recommended due to the scale of the project. This resulted in numerous constraints to sampling and the effectiveness of a applying a multivariate community analysis as per the terms of reference. Data collected is thus considered to be incomplete at this point in time.

Aquatic, wetland and riparian ecosystems are dynamic and complex. Some aspects of the ecology of these systems, some of which may be important may have been overlooked. The findings of this study were largely based on a single site visit undertaken late in the low flow season at a time when extremely low flows were being experienced. A more reliable assessment would have required that seasonal assessments take place with at least one assessment in the high flow season also undertaken.

It is therefore recommended that further detailed biodiversity surveys be conducted during the Feasibility Phase to determine additional species that may have been omitted and to clarify indeterminate species that may be resolved during their flowering seasons, i.e. Early-mid spring (September – November, after first rains) and late summer (March - April). The same applies for the surface water and aquatic surveys in order to collect intermediate-high flow data/events.

10.3 LIMITATIONS ON AVAILABLE BASELINE DATA

10.3.1 GROUNDWATER

Although, all available data was collected and utilised to develop the groundwater model, and ensure that the model presents the actual situation as accurately as possible, some limitations can be noted:

- Limited and inaccurate data on actual groundwater usage, hence abstraction estimates are based on hectares observed under irrigation. Registered and claimed water uses do not correlate with observed water use based on lands under irrigation. Since recharge to the area is low, abstraction estimates have a significant impact on water levels.
- Current water levels were only obtained from a local hydrocensus. Due to the cumulative impacts of several mining projects, current water levels need to be obtained over a broad area covering the entire impacted area.
- Data collected in a relatively wet period.
- Aquifer storage data based solely on best estimate and inflows into the bulk sample pit undertaken at Makhado. Similar data is required at the Mopane Project to calibrate projected inflows.

To further improve the conceptual groundwater model and validate the conclusions made in this report, several items require additional work:

- Monitoring: Establishment of monitoring piezometers near where initial mine workings will commence. Transient state parameters of mining are at present best estimates based on data collected during the box-cut exploration at Makhado. Predictions cannot be calibrated without data collected after mining commences. Water level changes once open bit mining begins should be used to further refine storage parameters in the groundwater model and drain conductance's used for the mine workings. These estimates will affect projections of inflows at other mines and the cumulative impacts of all mining operations in the region.
- Verification of inflows and water levels by monitoring is required to validate model after mining commences.
- Verification of abstractions especially from irrigation farmers.

- Derivation of local more detailed multilayer models at a monthly time scale for each mine once a more detailed mining plan becomes available.
- Model Sensitivity analysis: Once the model is complete with all the required information, supported by monitoring data, a sensitivity analysis needs to be undertaken to determine how sensitive the model results are to parameters with some uncertainty. This involves simulations with parameter values increased and reduced to determine how it affects the calibration results, and the confidence in the selected parameter values
- Model Verification: Model verification means comparing model results against an independent data set from that which the model was calibrated against. Monitoring data can be used, as well as the extended model data, and additional data to be obtained from farmers private records not previously submitted to the consulting team.

10.3.2 SURFACE WATER

Similarly, limited surface water flow and quality data are available for the area and due to the season (no flow), limited additional data could be gathered. Further monitoring is therefore proposed during the Feasibility Phase.

10.3.3 SOCIO- AND MACRO-ECONOMIC ASSESSMENTS

Due to a number of properties where field workers could not gain access, the necessary current land use calculations for such farming enterprises were based on assumptions made for the possible crops cultivated, or beef production according to the land carrying capacity and/or game reared for trophy or biltong hunting with or without accommodation facilities. The required information was, as far as possible, acquired, but could not be verified. Therefore, more detailed surveys are proposed for the Mopane Project area in order to validate the macro-economic results.

11 MONITORING AND MANAGEMENT OF ENVIRONMENTAL IMPACTS

A comprehensive monitoring system was developed for the Mopane Project in line with the proposals of the specialists. The objective of the environmental monitoring system is to:

- Prevent and/or minimise the environmental impact associated with the proposed mining operation;
- Ensure that the environmental management system at the Mopane Project performs according to specifications;
- Ensure conformance with the environmental objectives;
- Ensure timeous implementation of the environmental strategies and implementation programme;
- Act as a pollution early-warning system;
- Obtain the necessary data required to address knowledge gaps;
- Check compliance with license requirements; and
- Ensure consistent auditing and reporting protocols.

11.1 MONITORING REQUIREMENTS

Based on the impact assessment and risk assessment, the following aspects were identified that require monitoring.

Aspect	Issue	Purpose
Climate	Weather station	To obtain detailed weather records for the LOM
Surface water	Surface water quality	Determine any deterioration in water quality as a result of the mining related activities
	Potable water	Determine quality of drinking water
	Sewage effluent	Determine water quality of sewage effluent
	Clean water canals	Determine the sediment levels or any other contamination prior to discharge into the Sand River and its tributaries
	Water management infrastructure	Monitoring of condition, identifying areas that require maintenance
	Dirty water systems	Determine the water quality and long-term chemical changes in the dirty water systems
	Haul road crossings	To identify and mitigate any spillages into the clean water system
	Aquatic monitoring	To determine the impact on the aquatic ecosystems
	Riverine vegetation	To early detect impact on riverine vegetation as a result of dewatering and reduced surface runoff
Groundwater	Groundwater quality	To determine any impact on the groundwater quality as a result of mining
	Groundwater levels	To determine any impact on the groundwater levels as a result of mining

Aspect	Issue	Purpose
	Geochemical	To collect sufficient geochemical data to verify and quantify the geochemical models during mining
	Surface-groundwater interaction	To quantify the interaction between surface and groundwater to determine possible seepage volumes
Mine water balance	Water levels in dams	To verify water balance and volume of water stored
	Dirty water recycled	To determine volume of dirty water abstracted & recycled for processing and dust suppression
	Clean water abstraction	To determine volume of clean water abstracted
	Process flow	To determine accurate process water balance
Land use management	Concurrent rehabilitation	To determine conformance with environmental objectives for concurrent rehabilitation
	Rehabilitation plan	To ensure conformance with final rehabilitation plan
	Soil analysis	To determine any deficiencies in soil fertility prior to seeding
	Soil erosion	To pro-actively identify soil erosion in order to rectify prior to serious degradation
Biodiversity	Land use coverage / Vegetation health	To determine effectiveness of reclamation plan and long-term sustainability of vegetated areas
	Species diversity	To determine species diversity (fauna & flora)
	Landscape Function Analysis	To establish ecosystem functionality of rehabilitated areas
	Riparian condition assessment	To determine the impact on the riverine forest as a result of mining
	Alien vegetation	To monitor conformance with alien vegetation programme
Air quality	Dust outfall	To determine the levels of dust outfall as a result of the mining activities
	Particulate Matter	To determine the particular matter levels for PM_{10} and $PM_{2.5}$
Environmental noise	Noise levels	To determine the noise levels within the communities and sensitive areas
Blasting	Air blast and ground vibration	To determine the effectiveness of the blasting procedure
Waste	Waste generation & management	To determine volume of waste generated & disposed
Heritage	Heritage/cultural resources	To capture all heritage/cultural resources exposed by mining

11.2 ROLES AND RESPONSIBILITY

The Action Plan for Implementation, together with frequency and responsibility is given below:

Activity	Implementation Phase	Review / Repeat Frequency	Responsibility
Implement Rescue and Relocation Plan (flora)	Prior to mining	Annual rescue operation for areas to be disturbed in the next 12 months	Specialist to be appointed
Develop and implement Biodiversity Action Plan, including avifaunal plan	Within one year of mining	Annual review	Specialist to be appointed
Develop Rehabilitation Plan and Materials Placement Plan in line with the final mining plan	Feasibility Phase	Annual review or if major change in scheduling	Mining Dept
Reporting of rehabilitation plan • Areas disturbed • Areas levelled • Areas topsoiled/capped • Areas vegetated	Construction Phase	Monthly	Environmental Dept
Initiate alien vegetation programme	Construction Phase	Annual review	Environmental Dept
Phases 1B and 2 heritage studies	Prior to Construction Phase	Prior to new areas being disturbed	Specialist to be appointed
Heritage monitoring	Construction phase	Prior to new areas being disturbed	Archaeologist to be appointed
Identify offset programmes	Construction Phase	Annual review	Environmental specialist in conjunction with relevant stakeholders
Revision of groundwater flow & geochemical model	During Feasibility Phase in line with final mining plans	Revise every 5 years	Specialist to be appointed
Develop detail blasting procedure in line with specialist advise	Prior to opencast mining	Ongoing review based on monitoring data	Blasting contractor
Stipulate best practice requirements in tender documentation iro emissions, noise, equipment, transport, etc.	Prior to appointment of contractors	Ongoing review as new technology becomes available	Procurement Dept
Implement environmental awareness programme	Construction Phase	Ongoing review Include in annual induction programme	Environmental Dept Human Resources
Maintenance of clean and dirty water system	Operational Phase	Weekly	Engineering Dept
Dam safety inspections of clean and dirty water dams	Operational Phase	Annually	Specialist to be appointed
Identify and clean-up of any spillages along transport routes (haul roads / rail line / overland conveyor)	Operational Phase	Weekly	Engineering Dept
Identify and report any road maintenance issues	Operational Phase	Ongoing	Engineering Dept RAL
Implement aftercare and maintenance programme for rehabilitated areas	Within 2 years of mining	Ongoing implementation as per specialist recommendations	Environmental Dept
Implement monitoring programme	Prior to mining	Annual review of monitoring programme or if major change in scheduling	Environmental Dept

Activity	Implementation Phase	Review / Repeat Frequency	Responsibility
Review and analyses of monitoring data for: • Surface & groundwater • Mine water balance Land use management • Air quality • Environmental noise • Blasting • Natural resources, including riverine forest • Waste management	Commencement of mining	Monthly	Environmental Dept HSEC Committee
Internal review of EMP compliance, conformance to environmental objectives and strategies and their implementation	Commencement of mining	Bi-annually (6-monthly)	Environmental Dept HSEC Committee
EMP performance assessment to determine conformance with the EMP, including effectiveness and appropriateness of EMP	Commencement of mining	Annually	External appointment
Vegetation audit to determine effectiveness of land use management plan and long-term sustainability	Commencement of rehabilitation	Annually	External appointment
Environmental legal compliance audit	Commencement of mining	Bi-annually (2-yearly)	External appointment
Revision of closure cost assessment	Commencement of mining	Annually	Engineering Dept
Stakeholder Engagement Forum	Commencement of mining	Quarterly	Mine Management
Establish and update Recruitment database	Commencement of construction	Upfront and then Annually updated	Human Resource Manager
Compile and workshop of recruitment procedure	Commencement of construction	Prior construction Prior operations	Human Resource Manager
Define and communicate the Community Safety and Traffic Management Plan	Prior to construction	Prior construction	Community Engagement Manager
Compilation of an existing and future land use plan	Commencement of construction	Annually	Community Engagement Manager
Awareness Newsletters	Commencement of construction	Bi-annually (6-monthly)	Community Engagement Manager
Establish a Grievance and Issue Management Procedure	Construction and Operational Phase	Continuously	Community Engagement Manager

11.3 MONITORING MANAGEMENT AND REPORTING

A proper data management system will be set up to facilitate trend analyses and preparation of reports. All the monitoring data will be collated and analysed on a bi-annual basis and included in management reports.

It must be noted that the monitoring programme is a dynamic system changing over the different life-cycle phases of the mine. The programme will be reviewed on a bi-annual basis and revised if necessary.

12 TECHNICAL AND SUPPORTING INFORMATION

12.1 SPECIALIST REPORTS

The EIA specialist reports are attached as Annexures, as indicated below.

Annexure	Aspect	Independent Consultant
ANNEX-1	Soils, Land Use & Capability	Gudani Consulting - EcoSoil Consortium
ANNEX-2	Surface Water Groundwater	WSM Leshika Consulting (Pty) Ltd
ANNEX-3	Groundwater	WSM Leshika Consulting (Pty) Ltd
ANNEX-4	Biodiversity	Phaki Phakanani Environmental Consultants
ANNEX-5	Aquatic Systems	Scientific Aquatic Services
ANNEX-6	Ambient Noise	Gudani Consulting
ANNEX-7	Air Quality	Royal Haskoning DHV
ANNEX-8	Heritage Resources	Mbofho Consulting and Projects
ANNEX-9	Socio-Economic Aspects	Naledi Development Restructured (Pty) Ltd
ANNEX-10	Macro-Economic Aspects	Mosaka Economic Consultants cc

12.2 REFERENCES

ALEXANDER, G. & MARAIS, J. 2007. A Guide to the Reptiles of Southern Africa, Struik Publishers. Cape Town, 408 pp.

ANON. UNDATED. Birds of the Greater Kuduland Conservancy. Unpublished.

ARC-ISCW (2004) Overview of the Agricultural Natural Resources of South Africa. ARC-ISCW Report No. GW/A/2004/13, ARC-Institute for Soil, Climate & Water.

ARC-ISCW (2011). National Soil Profile Information System. Arc-Institute for Soil, Climate and Water, Pretoria, South Africa.

BRANCH, W.R. (ED.) 1988. South African Red Data Book - Reptiles and Amphibians. S. Afr. Nat. Sci. Prog. Rpt 151: I-Iv, 242pp.

BRANCH, W.R. 1998. Field Guide to the Snakes and other Reptiles of Southern Africa. Rev. ed. Struik Publ., Cape Town, 399pp.

BRANCH, W.R, 2002. The Conservation Status of South Africa's Threatened Reptiles. Pp 89-103. In: "The State of South Africa's Species" Proceedings of a Conference held at the Rosebank Hotel in Johannesburg 4 - 7 September 2001, Endangered Wildlife Trust and WWF-SA.

BROADLY, D. G. 1990. Fitzsimons' Snakes of Southern Africa. Delta Books (PTY) LTD, Johannesburg.

CACHIER, H., LIOUSSE, C., BUAT-MENARD, P. AND GAUDICHET, A. 1995. Particulate Content of Savanna Fire Emissions. J. Atmos. Chem., 22(1-2), 123-148.

CEPA/FPAC WORKING GROUP, 1999. National Ambient Air Quality Objectives for Particulate Matter. Part 1: Science Assessment Document. Minister, Public WORKS AND GOVERNMENT SERVICES, ONTARIO. Available at URL: http://www.hc-sc.gc.ca/bch.

CHIEF DIRECTORATE: NATIONAL GEO-SPATIAL INFORMATION (CD:NGI). Topographic and Orthographic vector data and basemaps of South Africa.

CHUTTER, F. M. 1998. Research on the Rapid Biological Assessment of Water Quality Impacts in Streams and Rivers. Report to the Water Research Commission by Environmentek, CSIR, WRC Report No 422/1/98. Pretoria: Government Printer.

COAL OF AFRICA LIMITED, 2011. Proposed Makhado Colliery Project - Environmental Impact Assessment and Environmental Management Programme.

CONNINGARTH ECONOMISTS, 2007a. A Manual for Cost Benefit Analysis in South Africa with specific Reference to Water Resource Development, Second Edition (Updated and Revised). Water Research Commission. TT305/07.

CONNINGARTH ECONOMISTS, 2007b. Development and Construction of the South African and Provincial Social Accounting Matrix. (Updated 2013). Compiled under the auspices of the Development Bank of Southern Africa.

COUNCIL FOR GEOSCIENCE, 2000. 1:250 000 Geological Map Series, 2228, Alldays.

DADA, R., KOTZE D., ELLERY W. AND UYS M. 2007. WET-Roadmap: A Guide to the Wetland Management Series. WRC Report No. TT 321/07. Water Research Commission, Pretoria.

DALLAS, H.F. 1997. A Preliminary Evaluation of Aspects of SASS (South African Scoring System) for the Rapid Bio-assessment of Water in Rivers with particular reference to the Incorporation of SASS In a National Bio-monitoring Programme. South African Journal of Aquatic Science, 23: 79-94.

DAVIES, B., & DAY, J. 1998.Vanishing Water. Cape Town: UCT Press.

DEACON, H.J. & DEACON, J. 1999. Human Beginnings in South Africa. Cape Town: David Philip.

DE GRAAFF, G. 1981. The Rodents of Southern Africa. Butterworth, Pretoria.

DEPT OF AGRICULTURE, PRETORIA. 1984. Land types of the Maps, hard copy: 2228 (Alldays), 2328 (Pietersburg), 2230, (Messina), and 2330 (Tzaneen). Soil and Irrigation Research Institute.

DEPARTMENT OF WATER AFFAIRS AND FORESTRY, 1999. South Africa Version 1.0 of Resource Directed Measures for Protection of Water Resources [Appendix W3].

DEPARTMENT OF WATER AFFAIRS AND FORESTRY 2001. Report No. P/01000/00/0101. Limpopo Water Management Area: Water Resources Situation Assessment. WSM (Pty) Ltd.

DEPARTMENT OF WATER AFFAIRS AND FORESTRY 2004. Report No. P WMA 01/000/00/0304. Internal Strategic Perspective: Limpopo WMA. Water Resources Planning of the Nzhelele River Basin - Study of the water resources. Tlou and Matje.

DEPARTMENT OF WATER AFFAIRS AND FORESTRY, 2006. Groundwater Resource Assessment Phase II.

DICKENS, C. & GRAHAM, M. 2001. South African Scoring System (SASS) Version 5. Rapid Bio Assessment For Rivers May 2001. CSIR.Http.//Www.Csir.Co.Za/Rhp/Sass.Html

DORST, J. & DANDELOT, P. 1983. A field guide to the larger mammals of Africa. Macmillan. Johannesburg.

DRIVER, A., SINK, K.J., NEL, J.N., HOLNESS, S., VAN NIEKERK, L., DANIELS, F., JONAS, Z., MAJIEDT, P.A., HARRIS, L. & MAZE, K. 2012. National Biodiversity Assessment 2011: An assessment of South Africa's biodiversity and ecosystems. Synthesis Report. South African National Biodiversity Institute and Department of Environmental Affairs, Pretoria.

DUBEL INTEGRATED ENVIRONMENTAL SERVICES CC, 2012. Description of the Natural Environment and Biodiversity Assessment of the Farm Voorburg 503 MS on Sheldrake Game Ranch.

ENPAT INFORMATION, Undated. Land cover, Land use, Land Types of South Africa (Based on Memoirs on the Agricultural Resources of South Africa.: Erosivity, Clay content, Land types, soil depth, soil potential and plant available water.)

FRIEDMANN, Y. & DALY, B. (EDS.) 2004. Red Data Book of the Mammals of South Africa: A Conservation Assessment. CBSG Southern Africa, Conservation Breeding Specialist Group (SSG/IUCN), Endangered Wildlife Trust, South Africa. 722 pp.

G&A HERITAGE, 2011. Environmental Impact Assessment: Sheldrake Game Ranch, Voorburg 503 MS. Unpublished report.

GHAZOUL, J. 2006. Mopane Woodlands and the Mopane Worm: Enhancing Rural Livelihoods and Resource Sustainability. Final Technical Report. London: Division of Biology, Imperial College London.

GOLDING, J. 2002. Workshop Proceedings: Revision of the National list of Protected Trees as per Section 12, National Forests Act of 1998. Roodeplaat. Pretoria.

HAHN, N. 2002. The Endemic Flora of the Soutpansberg. MSc Thesis University of Natal, South Africa.

HARRISON, J. A., ALLAN, D. G., UNDERHILL, I. G., HERREMANS, M., TREE, A. J., PARKER, V. & BROWN, C. J. (ESD). The atlas of Southern African birds. Vols i & ii. Birdlife South Africa, Johannesburg.

HENNING, G.A., TERBLANCHE, R.F. & BALL, J.B. 2009. South African Red Data Book: Butterflies. SANBI Biodiversity Series 13. Pp. 158. South African National Biodiversity Institute, Pretoria.

HUFFMAN, T. N. 2007. A Handbook of the Iron Age: The Archaeology of Pre-colonial Farming Societies in Southern Africa. Scottsville: University of KwaZulu Natal Press.

KEMPER, N. 1999. Intermediate Habitat Integrity Assessment for use in Rapid and Intermediate Assessments. RDM Manual Version 1.0.

KLEIN, H. 2002. Legislation regarding harmful plants in South Africa. PPRI Leaflet Series: Weeds Biocontrol , 12, pp 1-4.

KLEYNHANS, C. J. 1996. A Qualitative Procedure for the Assessment of the Habitat Integrity Status of the Luvuvhu River (Limpopo System, South Africa). Journal of Aquatic Ecosystem Health. 5: 41-54.

KLEYNHANS, C.J. 1999. A Procedure for the Determination of the Ecological Reserve for the Purposes of the National Water Balance Model for South African River. Institute of Water Quality Studies, Department of Water Affairs and Forestry, Pretoria.

KLEYNHANS, C.J., THIRION, C. AND MOOLMAN, J. 2005. A Level 1 Ecoregion Classification System for South Africa, Lesotho And Swaziland. Report No. N/0000/00/REQ0104. Resource Quality Services, Department of Water Affairs and Forestry, Pretoria.

KOTZE, D.C., MARNEWECK, G.C., BATCHELOR, A.L., LINDLEY, D.S. AND COLLINS, N.B. 2008. WET-Ecoservices: A Technique For Rapidly Assessing Ecosystem Services Supplied By Wetlands. WRC Report No. TT 339/09. Water Research Commission, Pretoria.

KOVAĆS, Z., 1988. Regional maximum flood peaks in southern Africa. Rep No TR137. DWAF. Pretoria.

KRUGER, E (ED) (2006). Drainage Manual. SANRAL. Pretoria.

KUPCHELLA, C.E. AND M.C. HYLAND, 1993. Environmental Science. Living within the System of Nature. Prentice Hall, New Jersey.

LOUBSER, J.H.N., 1991. The Ethnoarchaeology of the Venda-speakers in Southern Africa. Navorsinge van die Nasionale Museum, Bloemfontein 7(8): 145 – 464.

LOW, A.B. AND REBELO, A.G. 1996. Vegetation of South Africa, Lesotho and Swaziland. Department of Environmental Affairs and Tourism, Pretoria.

MACFARLANE, D.M., KOTZE, D.C., ELLERY, W.N., WALTERS, D., KOOPMAN, V., GOODMAN, P. AND GOGE, C. 2008. WET-Health: A Technique for Rapidly Assessing Wetland Health. WRC Report No. TT 340/08. Water Research Commission, Pretoria.

MARAIS, E. UNDATED. A guide to the birds of Ben Lavin Nature Reserve. Unpublished.

MARAIS, J. 2004. A Complete Guide to the Snakes of Southern Africa, Struik Publishers. Cape Town.

MCMILLAN, P. H. 1998. An Integrated Habitat Assessment System (IHAS V2) for the Rapid Biological Assessment of Rivers and Streams. A CSIR Research Project. Number ENV-P-I 98132 for the Water Resources Management Programme. CSIR.Ii +44 Pp

MIDDLETON, B.J.& BAILEY, A.K. 2009. Water Resources of South Africa, 2005 study. WRC Rep No TT381. Pretoria.

MIDGLEY, D.C., PITMAN W.V. AND MIDDLETON, B.J. 1994. Surface Water Resources of South Africa 1990. (WR90 study). Vol V Appendices, WRC Report No 298/5.1/94. Pretoria.

MINTER, L.R., BURGER, M., HARRISON, J.A., BRAACK, H.H., BISHOP, P.J. & KLOEPFER, D. 2004. (eds.). Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland. SI/MAB Series #9.Smithsonian Institution, Washington, DC.

MUCINA, L. & RUTHERFORD, M.C. (EDS). 2006. The Vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria, RSA.

NOISE QUEST, How does noise affect domestic animals and wildlife? http://www.noisequest.psu.edu/pmwiki.php?n=NoiseAffect.Animals.

NORTON, M.P. AND KARCZUB, D.G. 2003. Fundamentals of Noise and Vibration Analysis for Engineers, Second Edition.

OLLIS, D.J., JOB N., MACFARLANE, D. AND SIEBEN, E.J. 2009. Further Development of a Proposed National Wetland Classification System for South Africa. Supplementary Project Report: Application And Testing Of Proposed National Wetland Classification System. Prepared for the South African National Biodiversity Institute, Pretoria.

R&R CULTURAL RESOURCE CONSULTANTS. 2012. Phase 1 Heritage Impact Assessment Sheldrake Game Ranch.

RADLE, A.L. 2001. The Effect of Noise on Wildlife: A Literature Review. World Forum for Acoustic Ecology, University of Oregon.

RAUTENBACH, I. L. 1978. The mammals of the Transvaal. Ph.d. Thesis, University of Natal.

REPUBLIC OF SOUTH AFRICA. 1999. The National Heritage Resources Act, No 25.

ROSEN, L. 1980. The excavation of American Indian Burial Sites: A problem in law and professional responsibility. American Anthropologist, New Series, Vol 82 No 1.

ROWNTREE K.M. & WADESON R.A. 2000. An Index of Stream Geomorphology for the Assessment of River Health. Field Manual for Channel Classification and Condition Assessment. NAEBP Report Series No. 13, Institute of Water Quality Studies, Department of Water Affairs and Forestry, Pretoria. Available: Http://Www.Csir.Co.Za/Rhp/Reports/Reportseries13.Html.

RUTHERFORD, M.C. & WESTFALL, R.H. 1994. Biomes of Southern Africa - An Objective Categorization. Memoirs of the Botanical Survey of South Africa 63.

SANBI. 2009. Further Development Of A Proposed National Wetland Classification System For South Africa. Primary Project Report. Prepared By The Freshwater Consulting Group (FCG) For The South African National Biodiversity Institute (SANBI).

SANBI - BIODIVERSITY GIS (BGIS) [Online]. Retrieved 2013/05/03 URL: Http://Bgis.Sanbi.Org

SANS 0103:2004. The measurement and rating of environmental noise with respect to annoyance and to speech communication.

SANS 0210:2004. Calculating and predicting road traffic noise.

SANS 10328:2003. Methods for environmental noise impact assessments.

SANS 10357:2004. The calculation of sound propagation by the Concave Method.

SCIENCE IN AFRICA [Online] Retrieved 2013/06/08 URL: http://scienceinafrica.com/old/index.php?q=2003/june/mopane.htm

SCHMIDT, E., M. LÖTTER, AND W. MCCLELAND. Trees and shrubs of Mpumalanga and Kruger National Park, Johannesburg, S Africa.

SKINNER, J.D. & SMITHERS, R. H. N., 1990. The Mammals of the Southern African sub-region. New ed. University of Pretoria, Pretoria. 769p.

SMITHERS, R. H. N., 1986. South African Red Data Book - Terrestrial Mammals. S. Afr. Nat. Sci. Prog. Rpt. 125, 214p.

STEWART, C. T., STEWART, T., GAIGHER, I. G., GAIGHER, M. J. 2001. Checklists for the fauna of the western Soutpansberg. Soutpansberg Conservancy, Louis Trichardt.

STUART, C. & STUART T. 2001. Field guide to the mammals of southern Africa. Struik Publishers, Cape Town.

STUART, C.T & STUART, M.D. 2000. A Field Guide to the Tracks and Signs of Southern and East African Wildlife. 3rd ed. Struik Publishers, Cape Town.

TARBOTON, W. R., KEMP, M. I. & KEMP, A. C. 1987. Birds of the Transvaal. Transvaal Museum, Pretoria.

THIRION, C.A., MOCKE, A. & WOEST, R. 1995. Biological Monitoring of Streams and Rivers Using SASS4. A Users Manual. Internal Report No.N 000/00REQ/1195. Institute for Water Quality Studies. Department of Water Affairs and Forestry. 46.

TYSON, P.D., R.A. PRESTON-WHYTE, 2000. The Weather and Climate of Southern Africa. Oxford University Press, Cape Town.

U.S ENVIRONMENTAL PROTECTION AGENCY (USEPA), 1996. Compilation of Air Pollution Emission Factors (AP-42), 6th Edition, Volume 1, as contained in the AirCHIEF (AIR Clearinghouse for Inventories and Emission Factors) CD-ROM (compact disk read only memory), US Environmental Protection Agency, Research Triangle Park, North Carolina. Also available at URL: http://www.epa.gov/ttn/chief/ap42/.

UNESCO. 2003. Intangible Heritage Convention. Paris: World Heritage Centre.

UNESCO. 2005. Operational Guidelines for the Implementation of the World Heritage List. Paris: UNESCO.

UNESCO. 2009. World Heritage Cultural Landscapes. World Heritage Papers 26. Paris: World Heritage Centre.

UYS, M. C., GOETCH, P. A.&O'KEEFFE, J. H. 1996. National Bio-monitoring Program for Riverine Ecosystems: Ecological Indicators, A Review and Recommendations. NBP Report Series No 4. Institute for Water Quality Studies, Department of Water Affairs and Forestry, Pretoria.

VAN WYK, B. & VAN WYK, P. 1997. Field Guide to Trees of Southern Africa. Struik Publishers. Todkill.

VAN WYK, B. & MALAN, S. 1998. Field guide to the wild flowers of the Highveld. Cape Town: Struik Publishers.

VAN WYK, E. & OUDTSHOORN, F. 2006. Guide to grasses of Southern Africa. Briza Publications, Pretoria. 288 pp.

WHO. 1999: Guidelines for Community Noise, Geneva.

WHO. 2009: Night noise guidelines for Europe.

WORLD ARCHAEOLOGICAL CONGRESS. 1989. Vermillion Accord on Human Remains.

WORLD ARCHAEOLOGICAL CONGRESS. 1990. First Code of Ethics on Human Remains.

WSM LESHIKA, 2012. Voorburg Baseline Groundwater Study.

13 ANNEXURES

ANNEX-1	SOILS, LAND USE & CAPABILITY	Gudani Consulting - EcoSoil Consortium
ANNEX-2	SURFACE WATER	WSM Leshika Consulting (Pty) Ltd
ANNEX-3	GROUNDWATER	WSM Leshika Consulting (Pty) Ltd
ANNEX-4	BIODIVERSITY	Phaki Phakanani Environmental Consultants
ANNEX-5	AQUATIC SYSTEMS	Scientific Aquatic Services
ANNEX-6	NOISE	Gudani Consulting
ANNEX-7	AIR QUALITY	Royal Haskoning DHV
ANNEX-8	HERITAGE RESOURCES	Mbofho Consulting and Projects
ANNEX-9	SOCIO-ECONOMIC	Naledi Development Restructured (Pty) Ltd
ANNEX-10	MACRO-ECONOMIC	Mosaka Economic Consultants cc
ANNEX-11	STAKEHOLDER ENGAGEMENT	Naledi Development Restructured (Pty) Ltd