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Traffic Impact Assessment
Omitiomire Copper Project

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Project Number 1002938

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1 Introduction and Background

1.1 Introduction

The Omitiomire Copper Project is proposed on the farm Groot Omitiomire located approximately 140km north-east of Windhoek in the Khomas region of Namibia – refer to the locality map in Figure 1. The project involves a small scale, stand-alone oxide mining and beneficiation operation to mine near-surface areas of weathered copper oxide.

As part of the approval processes for the proposed project, the Namibian Ministry of Environment and Tourism requires that an Environmental Impact Assessment (EIA) be undertaken for the project and that this includes a Traffic Impact Assessment (TIA). Zutari was since commissioned by Environmental Compliance Consultancy (Pty) Ltd. (the EIA consultants) to undertake the latter. This report serves to document the process and results of the Traffic Impact Assessment.

The following information was provided and were used to carry out the assessment:

- Access to the mine will be from Main Road 53 (MR53).
- Two possible transport routes have been identified. With reference to Figure 1, these include:
  - The green route along MR59, MR60, DR2166 and MR53 which has been identified as the shorter route to Walvis Bay; and
  - The purple route along DR1535, DR1435 and MR53 which carries much less traffic.
- The green route intersects with the B1 and the purple route with the B6.

The terms of reference indicated a third route option, along DR2102, DR2170 and DR2166. After discussions with the mine, it was indicated that the mine will not make use of this route and no further evaluation was done. Route DR2102/DR2170/DR2166, winds through the Otjihavera mountains. The sharp horizontal curves and rolling vertical alignment present many safety challenges. In terms of safety and traveling speed, this road is not recommended as a preferred transport route. The route was not further evaluated.

Figure 1: Locality Map – Omitiomire Mine

- The mine is scheduled to operate 365 days per year. The mine will operate on a two 12 hour shift, 1 week (7 days) on and 1 week (7 days) off cycle for each year.

- The generated mining traffic is expected to be as follows:
  - 15x 32t trucks a day with salt/sulphur/diesel
  - 10x LDVs per day
  - 6x busses a week

1.2 Route Description

The study area was based on the current road network; the identified transport routes between the mine and Walvis Bay; present traffic operating and pavement conditions; and an evaluation of the impact of the proposed mine's trip generation. The following links were consequently considered significant for the purposes of this study:

Transport Route 1:

- The low volume sealed road section of MR59
- The gravel road MR59
- The gravel road MR60
- The gravel road DR2166;
- The MR53, a gravel road, from which access is to be taken;

Transport Route 2:

- The gravel road DR1535;
- The gravel road DR1435;
- The MR53, a gravel road, from which access is to be taken;

The gravel roads are connected to Walvis Bay by surfaced roads, B1-route, B2-route and B6-route. The B-routes follow the trunk road which are design to carry heavy transport vehicles and maintained by the Roads Authority. The district and gravel main roads provide an access function and the next figure shown the distance along these roads that will be used by the mining operation. These roads were evaluated in more detail during the study.

The distance from Walvis Bay to the Omitiomire Project taking Transport Route 1, is 491km long, 349km sealed and 142km gravel, making use of Transport Route 2 is 541km long, 460km sealed and 81km gravel.

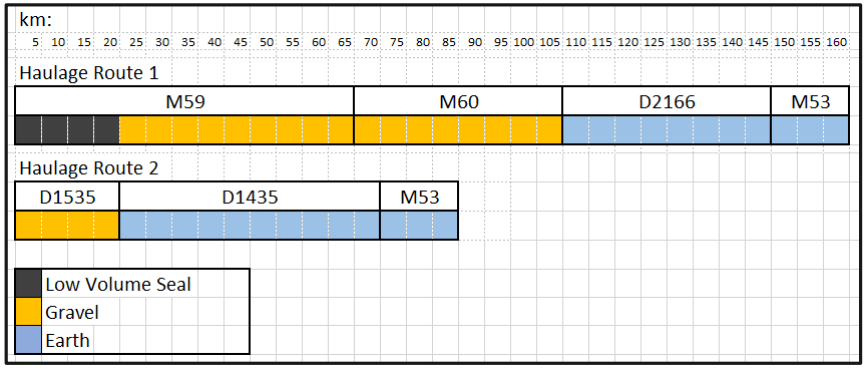


Figure 2: Haul Distance not on B-routes

1.3 Objectives of the Study

The objectives of this Traffic Impact Assessment include:

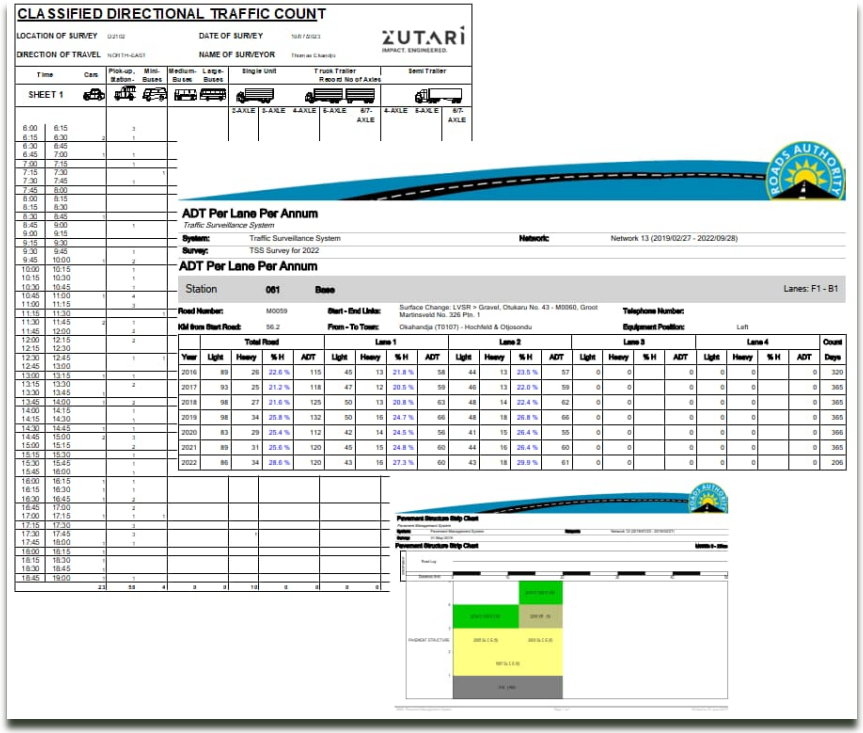
- The quantification of the expected traffic impact of the proposed mine on the immediate surrounding sensitive receptors, such as farmers, residents, competing mining and quarrying projects, and the tourism section;
- A visual assessment of the condition of the two transport routes to determine the expected effect of heavy vehicle traffic on road conditions;
- The identification of practical and feasible mitigation measures to maintain acceptable traffic flow operations and road conditions on the network within the study area.

2 Approach and Methodology

In line with the objectives of this study and with reference to the planned traffic expected to be generated by the mine, the following methodology guided the Traffic Impact Assessment:

- A meeting was held with the Client to clarify and confirm the proposed route options, items discussed at the participation meeting with regard to the road and traffic and items to be included in the study from ECC's side.
- Discussions were held with representatives of the Roads Authority to identify planned upgrading, maintenance activities and frequency of blading of roads under discussion.
- A site investigation was undertaken to evaluate the layout of the road network surrounding the site, to observe existing traffic flow operations and to visually assess the pavement conditions of the two identified transport routes.
- Data from existing traffic counting stations located on MR59, MR60 and MR53 was obtained from the Roads Authority to determine existing traffic flow characteristics.
- 12-hour traffic counts were undertaken on 4 predetermined locations as was set out in the terms of reference.
- Traffic data was used to determine the average daily traffic (ADT) and annual average daily traffic (AADT).
- The expected generated traffic as received from Craton Mine were assigned to the road network and added to the existing traffic volumes.
- The effect that the expected additional generated traffic will have on the conditions of the transport routes was assessed.

A detailed traffic modelling was not done as traffic volumes on the gravel roads surrounding the mine are relatively low and a preliminary evaluation of the expected trip generation of the mine indicates that the number of vehicles to be added to the network will not be substantial. Instead, the study largely focuses on geometric alignment and the condition of the transport routes to the mine and the upgrading options necessary. The effect of the traffic on the affected communities were also assessed in terms of dust and noise pollution.


CLASSIFIED DIRECTIONAL TRAFFIC COUNT

LOCATION OF SURVEY

DIRECTION OF TRAVEL

DATE OF SURVEY

NAME OF SURVEYOR

SHEET 1

ADT Per Lane Per Annum

Traffic Surveillance System

System: Traffic Surveillance System

Survey: TSS Survey for 2022

Network: Network 13 (2019/02/27 - 2022/09/28)

ADT Per Lane Per Annum

Station 061 Base

Lanes: F1 - B1

Year	Total Road Light	Heavy	% H	ADT	Lane 1 Light	Heavy	% H	ADT	Lane 2 Light	Heavy	% H	ADT	Lane 3 Light	Heavy	% H	ADT	Lane 4 Light	Heavy	% H	ADT	Count Days
2016	89	26	22.6 %	115	45	13	21.8 %	58	44	13	23.5 %	57	0	0		0	0	0		0	320
2017	93	25	21.2 %	118	47	12	20.5 %	59	46	13	22.0 %	59	0	0		0	0	0		0	365
2018	98	27	21.6 %	125	50	13	20.8 %	63	48	14	22.4 %	62	0	0		0	0	0		0	365
2019	98	34	25.8 %	132	50	18	24.7 %	68	48	18	26.8 %	66	0	0		0	0	0		0	365
2020	83	29	25.4 %	112	42	14	24.5 %	56	41	15	26.4 %	55	0	0		0	0	0		0	366
2021	89	31	25.6 %	120	45	15	24.8 %	60	44	16	26.4 %	60	0	0		0	0	0		0	365
2022	86	34	28.6 %	120	43	16	27.3 %	60	43	18	29.9 %	61	0	0		0	0	0		0	206

Figure 3: Example of traffic and pavement condition data

3 Site Investigation

A site investigation was undertaken at the start of the project and the following observations were recorded during the visit:

- Sensitive receptor identification.

  An inventory of all the accesses to the farms with the different name bords were recorded. This information was used to provide an indication of the affected communities along the proposed transport routes.

- Existing Pavement Condition

  The condition of the existing pavement was surveyed. Except for the first 20km section of MR59, which is a light sealed road, most road sections evaluated were unpaved roads. Some roads were gravel-surfaced, and some were earth-graded roads. The following primary distress types were surveyed during the survey.

  - Corrugations
  - Aggregate loss
  - Dust generation
  - Potholes
  - Improper cross section / deficient crown
  - Rutting
  - Improper roadside drainage

- Material sampling

  During the site visit, one material sample per road sections were taken and delivered for testing to a soil testing laboratory.

- Geometric Alignment Evaluation

  GPS points were captured and used to produce a single line survey. This information was used to evaluate the geometric alignment to identify sections in need of upgrading.

3.1 Sensitive Receptor Identification

Receptors identified in the study area are businesses, the Otjosondu Manganese Mine, Hunting Farms and Guest Lodges. Most of the tourist attractions along the route consists of hunting farms and guest lodges, comprises mostly of a main building with multiple chalets. The farmsteads consist of farmhouses with added workers houses.

The Otjosondu Manganese Mine makes use of MR59 as their transport route.

There are twenty-seven receptors along the low-volume seal section of MR59 as shown in Figure 4 below. There are six business receptors located within the first 10km.

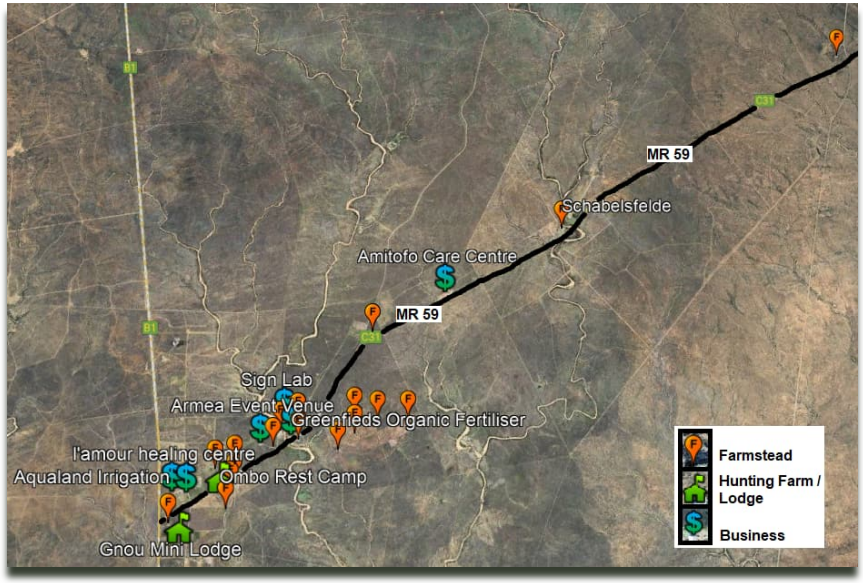


Figure 4: Low volumed sealed section of MR59 indicating receptors along route.

The table below indicates the offset from the road of twenty-six receptors taking access from the low volume sealed section of MR59. Some of the receptors share an access point onto MR59 as detailed in the following table.

Road	Access at km	Offset (m) from CL	Description
MR59	0.7	300	Bio Security Area
MR59	0.7	70	Poultry farm
MR59	0.7	200	Aqualand Irrigation
MR59	0.7	250	l'amour healing centre
MR59	0.92	170	Farmstead
MR59	1.6	100	Ombo Rest Camp
MR59	1.6	460	Farmstead
MR59	1.41	320	Farmstead
MR59	1.6	200	Farmstead
MR59	1.6	100	Lodge
MR59	1.6	200	Farmstead
MR59	2.5	250	Armae Event Venue
MR59	2.5	80	Farmstead
MR59	2.5	183	Farmstead
MR59	2.5	300	Farmstead
MR59	2.87	45	Farmstead
MR59	2.87	700	Farmstead
MR59	2.92	60	Farmstead
MR59	3.03	465	Sign Lab
MR59	3.03	245	Farmstead
MR59	5.18	235	Construction Site
MR59	5.18	100	Quarry
MR59	5.18	450	Farmstead
MR59	7.4	40	Amitoto Care Centre
MR59	10.8	150	Schnabelsfelde Farmstead
MR59	18.34	260	Farmstead
MR59	21		Gravel Road Begins

The identified receptors on the gravel section of Route 1 are mostly farmsteads, hunting farms and guest lodges as shown in Figure 5.

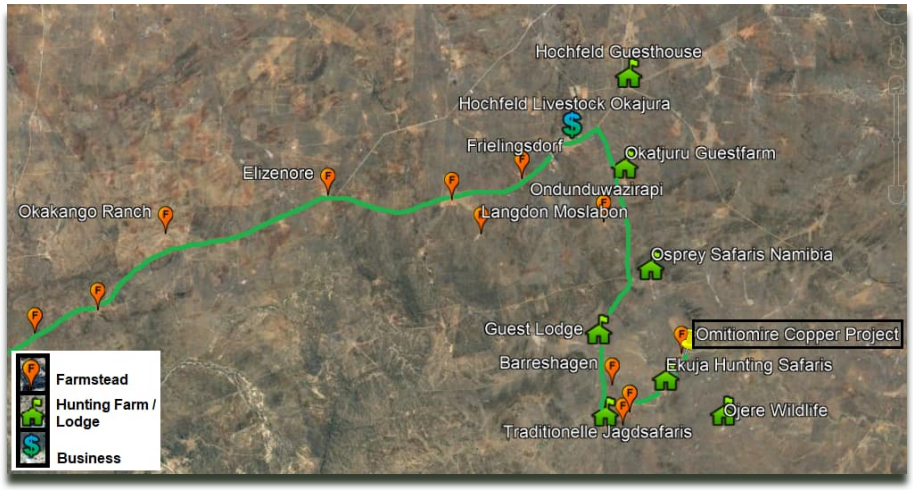


Figure 5: Route 1, gravel section, indicating receptors along route.

The table below indicates the offset from the road of nine receptors taking access from the gravel section of Route 1.

Road	Access at km	Offset (m) from CL	Description
MR59	29	560	Otjombal
MR59	60	1000	Farmstead
MR59	67.98	100	Elizenore Farmstead
	70.2		Intersection with MR60
MR60	21.5	220	Farmstead
MR60	31.8	530	Frielingsdorf Farmstead
MR60	40.09	370	Hochfeld Livestock Okajura
			Intersection with D2166
D2166	8	1000	Okatjuru Guestfarm
D2166	32.5	200	Guest Lodge
D2166	38.6	200	Barreshagen Farmstead
			Intersection with MR53

One of the receptors to remark on is Hochfeld Livestock auction pens on Okajura farm. This receptor consists of homesteads, auction facilities, cattle pens and plantations under irrigation. The facility generates relative high volume traffic during auctions with a high percentage heavy vehicles making use of the roads surrounding this auction facility.

Figure 6: Arial view of Hochfeld Auction Pens

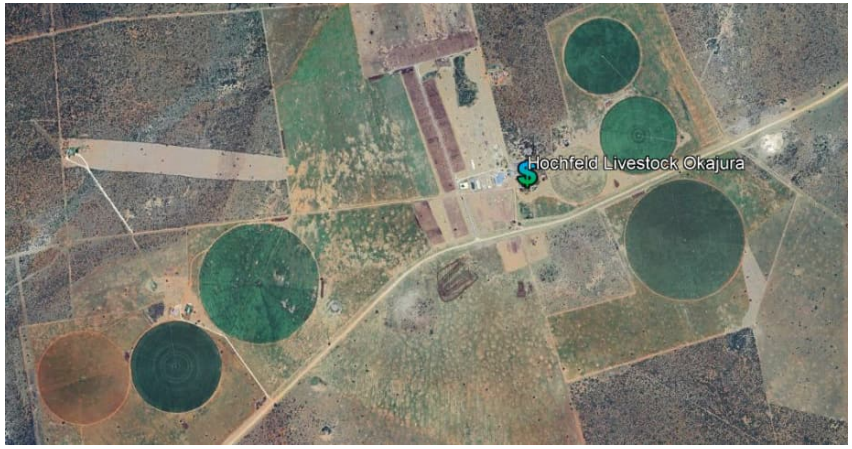


Figure 7: Satellite image of Hochfeld Auction Pens

The roads included in Route 2 is all gravel roads. It follows DR1535, DR1435 and MR53 up to the Omitiomire Mine. There are some farmsteads and a few hunting farms located along this route as shown in Figure 6.

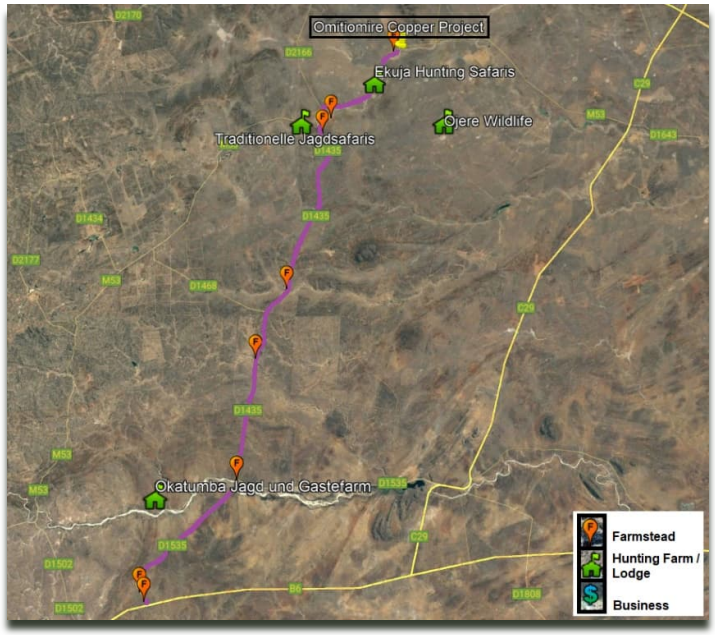


Figure 8: Route 2, gravel section, indicating receptors along route.

The table below indicates the offset of seven receptors taking access from Route 2.

Road	Access at km	Offset (m) from CL	Description
D1535	0.45	150	Farmstead
D1535	1.7	90	Farmstead
			Intersection with D1435
D1435	1.2	60	Farmstead
D1435	15	245	Farmstead
D1435	24.5	150	Farmstead
D1435	44.25	70	Farmstead
D1435	46.8	500	Farmstead
			Intersection with MR53

3.2 Existing Pavement Condition

This survey was conducted during June 2023. This time of the year, the gravel roads in Namibia tends to be at its worst condition as a result of the dry conditions.

The survey findings of 66km on MR59, 41km on MR60, 42km on DR2166, 13km on MR53, 49km on DR1435 and 19km on DR1583 are presented hereunder.

Main Road 59 (MR59)

The first 20km of this road has a low volume sealed surfacing. Evidence of regular maintenance is visible.

Photos taken at km 1.2 and km 14.7 respectively, indicating the low volume seal pavement and some pothole repairs.

The gravel section, 44km, of MR59 has reached the end of its service live due to pavement failures. There are numerous potholes, exposed stormwater pipes, extreme rutting, exceptional dust, and no crown left.

Photos taken on km32 and km40 respectively indicating pavement failure.

The Roads Authority of Namibia plans to upgrade MR59 to bitumen standards in the next three years, budget restraints could prolong this period. This road has not been re-gravelled in the last 12 years and upgrading needs to be done as a matter of urgency. For MR59 and MR60, the upgrading actions recommended could be negotiated with the Roads Authority and other road users for example the Hochfeld Auction Pens owners as the current traffic volumes on these two roads warrant for upgrading and actions are planned for both these roads in the Roads Authority's maintenance plans.

Main Road 60 (MR60):

This gravel road of 41km, MR60, is failing on some sections. Corrugation, improper roadside drainage, and large potholes were encountered. Large sections of the MR60 are however still in a relatively good, ridable condition.

Photos taken on MR60 at km 17.5 and km 43 respectively indicating the road condition.

District Road 2166 (DR2166) and Main Road 53 (MR53)

DR2166 and MR53 are both earth graded roads, no imported gravel layers have been constructed on these roads. As these sections have only been

graded, no roadside drainage is present. Most sections however do seem to have a high PI, which was also confirmed with the material test results received. A high PI assist in reducing dust generation, corrugation and help prevent potholes forming. The downside is the road might become slippery when wet and once the pavement starts to fail, the deterioration is swift.

Photos taken on km 21, DR 2166 and km 10.7, MR 53, respectively, indicating the road condition.

District Road 1435 (D1435)

Most of DR1435 is earth graded with isolated gravelled sections. The pavement is in a good ridable condition with minor failures. No drainage structures have been recorded and some water course crossings need to be upgraded. Two cattle grids, at different locations, pose width restrictions and potential safety hazards. The road crosses a railway near the intersection with DR1535.

Photos: km 14.5, km 34 and km 34.4 indicating a water course crossing, cattle grid and isolated gravelled sections.

District Road 1535 (DR1535)

DR1535 is a gravelled road in a good condition. Only minor failures have been recorded. No drainage structures have been recorded except for a single lane, 150m long, concrete drift through a river crossing. The road crosses a railway at two separate locations.

Photos: km 6.8, km 13.8 and km 18.1 indicating minor failures, a rail crossing and a concrete drift.

3.3 Material sampling

During the site visit, one material sample per road sections were taken and delivered for testing to a soil testing laboratory. Samples have been taken at the edge of the road and might therefore impose a finer material as on the roadway itself.

Main Road 59 (MR59)

The material test result received from the sample taken on MR59 indicates that this material is suitable for a wearing course, the structural top layer in a gravelled road. As this sample was taken on the edge of the road and the layer has been constructed more than 10 years ago, there are a good possibility to obtain G5 material in the vicinity. G5 material could be used for the supporting layer in a bituminous sealed road.

Main Road 60 (MR60)

The result received for the sample taken on MR60, is of a weaker quality as the one received from MR59. This might be due to the position it was taken. The material visually appeared to be of higher quality as indicated by the test result. The presence of calcrete in the in-situ material, indicates the possibility of more suitable gravel material in the vicinity.

District Road 2166 (DR2166) and Main Road 53 (MR53)

The material samples taken on DR2166 and MR53 consists mostly of sand with little to no gravel present. The high PI content provided for good rideability and little corrugation. The in-situ material seems to be suitable for a SSG layer, the supporting layer in a gravelled road.

Photos taken om MR59, MR60 and DR2166 respectively, indicating material on sections of these roads.

District Road 1435 (DR1435)

The material result received on the test taken on DR1435 meets a SSG layer standard. The result of the test taken on the short, gravelled section, also meets a SSG standard. The only limit not meeting the subbase course standard, is the Grading Modulus. Wearing course material, which is mostly the same as subbase material, except for a higher "clay" content, could be expected to be available in the vicinity if this road needs to be upgraded to a gravelled road.

District Road (DR1535)

For the material test result received from DR1535, the limits meet a subbase standard except for the Grading Modulus of 1.43, which needs to be 1.5. The result correlates with the visual observation of the pavement structure. It could be expected to find wearing course material on the road and in the vicinity.

Photos taken om DR1535, DR1435 and DR1435 (gravelled section) respectively, indicating material on sections of these roads.

3.4 Geometric Alignment Evaluation

GPS captured points were used to produce a single line survey. The horizontal and vertical alignment of the road sections were evaluated to establish approximate design speed parameters and the necessity for upgrading the geometric alignment.

Main Road 59 (MR59) and Main Road 60 (MR60)

The first 10 kilometres of MR59 is through rolling terrain with numerous accesses to homesteads and businesses. The road geometry of the first 10km of MR59 especially the vertical alignment relating to 100km/h standard. The remainder of MR59 as well as the whole MR60 in terms of the road geometry appears to comply with a design speed of 120km/h standard.

Three significant streams cross the sealed section of MR59 at km 2.8, km 7.1 and the Swakop River at km 10. The crossing at km 2.8 consists of a 55m long bridge structure with a road width of 5.4m wide, suitable for two-way light traffic. The narrow bridge width will be a road safety risk for two heavy vehicles crossing simulations. The stream crossing at km 7.1 is a sealed concrete drift, crossing the 16m wide stream. The Swakop River at km 10 is 40m wide and is crossed with a sealed concrete drift.

Photos at km 2.8, MR 59, stormwater structure: 5.8m wide

Photos at km 7.1, MR 59, sealed concrete drift

The gravel section of the route, running along MR59 and MR60, is fitted with stormwater structures such as small bridges and culverts. These sections are relatively flat and little to no upgrading to the vertical alignment is expected.



Photos of stormwater structures on km 42.8, MR 59 and km 12.4, MR60.

A few entrances were noted to be positioned on crests or curves. If the road is upgraded, travel speed will increase, and the sight distances should be evaluated. Upgrading to entrances might be needed if the sight distance is insufficient. Insufficient site distance might pose a safety hazard.


Photo of entrance to Ombo Rest Camp, km1.2 on MR59

The intersection between MR59 and MR60 need to be redesigned and reconstructed. Currently this intersection is a Y-intersection and a major safety hazard for traffic traveling on MR59 onwards on MR60. The issue is the intersection angle which restrict sight visibility and poor guidance to the priority of traffic.


Photo of intersection MR59/MR60

District Roads DR2166

The horizontal and vertical alignment of this road mostly meet 100km/h standards. On the DR2166 there is no existing stormwater structures and no prominent streams are crossed.


Photo of DR2166

District Roads DR1535 and DR1435

The horizontal and vertical alignment of these roads, mostly meet 80km/h standards. It is unlikely that heavy vehicles will be able to navigate the sharp horizontal curves at this speed. The sharp horizontal curves together with dust generation could cause safety hazards and upgrading to these sections are recommended.

The White Nossob River crosses DR1535 with a single lane concrete drift. The crossing is some 50km upstream of the Otjivero Dam. No other stormwater structures were recorded along these roads. The road crosses two major water courses on D1435 where structures need to be considered to improve the vertical alignment as well as guaranteed access during the rainy season.

On D1435 at km 25, a dam was constructed next to the road. During the survey no problems were identified at this water course crossing, but it might pose a problem in a good rainy season.


Photos of water course crossing on DR1435 at km 48.6


Photos of water course crossing on DR1435 at km 14.5 and concrete drift on DR1535, km 18.9

Intersection of DR1435 and DR1468 at km 22 on DR1435 is situated on a curve. This pose as a safety hazard, especially if this road is upgraded and traveling speed increases. Sight distance is limit and should be evaluated in more detail.

Photo of intersection DR1435/DR1468

4 Dust and Traffic Noise Pollution

4.1 Dust Pollution

One major and obvious problem associated with all unpaved roads is dust. To residents living along unpaved roads the airborne dust can penetrate their homes causing a nuisance and health problems such as hay fevers and allergies.

Photos taken on MR53 of dust generated by heavy vehicles.

The fine suspended dust particles contribute significantly to the particulate loading in the atmosphere making road dust one major source of air pollution. The dust cloud formed when vehicles use these roads can impair the visibility and cause a safety hazard to road users. The fine abrasive particles can greatly increase the wear and tear on the moving parts of vehicles. The dust can also pollute nearby surface waters and stunt crop growth by shading and clogging the pores of the plants.

In a study carried out by Colorado State University called the Effectiveness and Environmental impact of Road Dust Suppressants, it mentioned that "For every vehicle traveling one mile of unpaved roadway once a day, every day for a year, one ton of dust is deposited along a 1,000-foot (300m) corridor centered on the road".

For this project, a survey was done of all homesteads, cultivated fields and major open water sources to determine the affected farmsteads along the routes. Most of the farms along the route is hunting farms consisting of multiple chalets or farmhouses with added workers houses.

Farmsteads lying within 100m from the road center will be affected significantly, while farmsteads lying more than 500m away will most probable not be affected.

Table 1: Number of Farmsteads located near road

Road no	No of Farmsteads: 0 – 100m	No of Farmsteads: 100 – 300m	No of Farmsteads: 300 – 500m
MR59 (gravel)	1	2	
MR60	1	1	
DR2166		2	
MR53			1
DR1535	1	1	
DR1435	4	1	1
Total	7	9	2

The Hochfeld Auction Facilities on MR60 consist of houses, barns, offices, cultivated fields under irrigation systems and holding pens. Some of the houses are located less than 200m from the center of the road while some of the irrigation systems is less than 100m from the road. Regular auctions are being held here accommodating hundreds of cattle standing in holding pens for a few days.

Photo of cultivated field under irrigation system on MR60.

Other affected facilities on MR59, are a hunting farm at km 60, consisting of a homestead and 5 chalets a mere 100m from the road.

On DR1435 at km 24, a dwelling is located within 60m from the road. This dwelling consists of three houses and an earth dam.

A dwelling consisting of two houses and a dam is located on km 45.5 on DR1435 at an offset of 50m from the road.

Photo taken at km 24 on DR1435.

4.2 Traffic Noise Pollution

In a study, "Research on Motor Transport Produced Noise on Gravel and Asphalt Roads" carried out in Lithuania in 2010, it was found that a car moving at a speed of 50km/h on a road with gravel pavement is higher by 4 dBA than that on a road with asphalt pavement. It was further found that if the traffic speed is 105 km/h, it produces twice the perceived noise level than the 50 km/h traffic flow. One heavy weight vehicle (HV > 3.5 tons) with a speed of 70 km/h creates a perceived noise level of 28 lightweight vehicles (LV <3.5 tons).

Travelling speed, outside temperature, wind direction and density in vegetation, all plays a major role in reduction of noise levels. Dwellings located within 100m of the road will be more affected than dwellings 500m away from the road.

On MR59, the first 10km are in rolling terrain, naturally reducing speed. The first 20km is also surfaced. The next 142 km gravel section towards the Omitiomire Copper Projects, on MR59, MR60 and DR2166, passes eight farmsteads, located within 500m from the road, some consisting of several farmhouse and outer buildings.

On the route DR1535, DR1435 and MR53 to Omitiomire Copper Project, the 81km gravel road passes nine farmsteads, located within 500m from the road, consisting of several homesteads and outer buildings.

It could be expected that dwellings located along routes with low traffic volumes will be more affected by the noise generated by the mine's traffic than dwellings located along routes where heavy vehicles are already using the road, especially on MR59 and MR60 where high traffic volumes occur.

The effect of traffic noise during nighttime is more severe than during daytime. A study conducted in 2017 called "A Population – Based Study on Nightime Road Traffic Noise and Insomnia", noted the relationship between nighttime traffic noise and the symptoms of insomnia and sleep medication use. Transporting during nighttime hours are therefore highly discouraged. Nighttime travel, especially on gravel roads, also present a major safety hazard.

4.3 Conclusion

Possible mitigation measures include the application of dust suppression on sections passing farmsteads located near the road. Speed reduction measures could also be implemented, especially for heavy trucks. In the most severe cases, road sections could also be surfaced.

Nighttime transport is also highly discouraged.

5 Traffic Assessment

5.1 Existing Traffic Data

Existing traffic data collected included moving traffic counts during the site visit, available historic traffic data from the Roads Authority and traffic counts carried out on positions as per ToR (ECC traffic counts). Below are the positions where traffic counts were taken.

- Permanent Counting Station 061 (RA St 061) on MR59 (7-year data 2016 - 2022);
- Ad hoc counting station 117 (RA St 117) on MR60 (21-day data, 2016);
- ECC traffic count on intersection B1/MR59 (ECC St 1, 2023);
- ECC traffic count on intersection MR60/DR2166 (ECC St 2, 2023);
- Ad hoc counting station 366 om MR53 (green section indicated on Figure 6) (252 days data, 2022);
- ECC traffic count on intersection B6/DR1535 (ECC St 3, 2023);

Photos taken on MR60 and DR2166 of typical heavy vehicles currently travelling on these roads.

Figure 9: Traffic stations and counts on MR59/MR60/DR2166/MR53

Figure 10: Traffic stations and counts on DR1535/DR1435/MR53

In the table below, traffic data, as received from the Roads Authority, ECC traffic counts and moving traffic counts are being summarized. The Average Daily Traffic (A.D.T) has been presented in following table.

Table 2: Average Daily Traffic Volumes per Link

Description	ADT Light	ADT Heavy	ADT Total
MR59:			
ECC Station 1	259	18	263
RA Station 061 (2016 - 2022)	91	29	120
Moving Traffic Counts	82	21	103
MR60:			
ECC Station 2	46	19	65
RA Station 117 (21 days, 2016)	52	17	69
Moving Traffic Counts	24	0	24
DR2166			
ECC Station 2	9	8	17
Moving Traffic Counts	0	0	0
MR53			
Moving Traffic Counts	32	0	32
RA Counts (green section Fig 6) (40 days, 2022)	30	3	33
DR1435			
Moving Traffic Counts	19	0	19
DR1535			
ECC Station 3	37	5	42
Moving Traffic Counts	24	0	24

The data received from the ECC count as well as the data from the moving vehicle count, has been converted to 24 hour counts by using the information from the permanent and ad hoc stations.

Heavy vehicles are 25% of the ADT on MR59 and MR60 and 10% on DR1535.

5.2 Average Growth Rate

Historic data received from the RA includes:

- Data received for MR59. Data is of 7 years from the permanent RA counting station 61.
- Data for MR60 is from an ad hoc station, counted for 21 days in 2016.
- Data on MR53 is from an ad hoc station.

Although the position of the ad hoc counting station on MR53 does not form part of our route, the data was used to compare the moving vehicle counts taken on the section of MR53 forming part of the project route.

The data on MR59 was analysed to determine a growth factor over 7 years. This was also compared with the moving traffic counts done in 2023. The data on MR60 was compared to a ECC count done in 2023 as well as the moving traffic count.

Main Road 59 (MR59)

The table below summarise the Annual Average Daily Traffic (AADT) from 2016 to 2022.

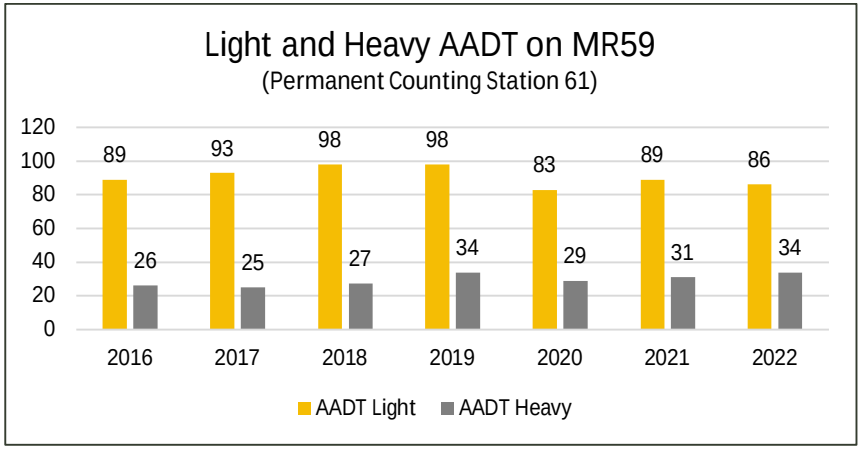


Figure 11: Traffic data form RA Counting station 061, MR59

There is a slight growth rate of 1% in light and 2% in heavy vehicles travelling on MR59 between 2016 and 2019. On 28 March 2020 Namibia went into full lockdown due to the COVID-19 pandemic. This explains the drop in AADT for 2020. From 2020 to 2022 the average light vehicle growth rate was 0.5%, while the heavy vehicle growth rate was 2%.

If the AADT is compared with the ECC count done in 2023, the heavy vehicles counted correlates with the data from counting station 061. The light vehicles however seem to be much more. This could be due to the location of the ECC count. The count was done at the intersection of MR59 and B1. There are numerous dwellings and businesses located within the first 20 km of MR59 and which generate a lot of light vehicles.

Main Road 60 (MR60)

The ECC count done in 2023 were compared to the average daily data as received from the Roads Authority for the 21-day count from the ad-hoc station counted in September and October 2016.

MR60:	Light	Heavy	Total
ECC Station 2	46	19	65
RA Station 117 (21 days, 2016)	52	17	69

According to the available data a negative traffic growth of 6% has taken place on MR60 between 2016 and 2023. The ECC count was carried out on a Wednesday, the weekly traffic for the ad-hoc station was calculated in order to compare the ECC count with the weekly average daily traffic.

The ECC count, as carried out on a Wednesday, was compared with the average daily traffic counted in 2016 over 4 Wednesdays. This growth for both the light as well as the heavy vehicles indicated a negative growth.

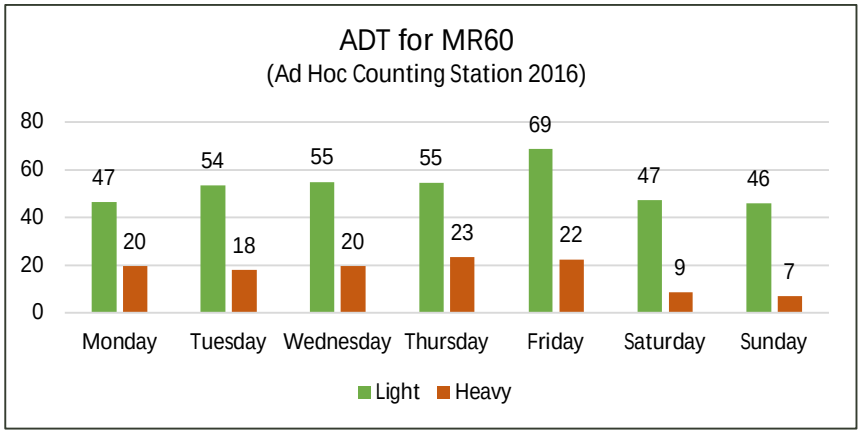


Figure 12: Traffic data from RA ad hoc counting station 117, MR60

The moving traffic counts were much less than the ECC counts as well as the counts received from the RA. This could be due to the time spend on the road and the time of day the road was travelled.

Main Road 53 (MR53)

An ad-hoc counting station was located at km 46 on MR53 some 60km away from the project road. The route portion on MR53 is from km 107 to km 125. When comparing the moving count with to the historic data a growth factor of 2% for the light vehicles were found. The heavy vehicles could not be compared as no heavy vehicles were encountered during the moving count.

5.3 Traffic Forecast

Normal traffic refers to the increase in traffic volumes over the years irrespective of any road upgrades or maintenance. Some of the factors that influence such growth included economic growth, population growth, growth in vehicle fleet and growth in fuel consumption. No towns or settlements lie within the project area and no known major developments, except for the Omitiomire Copper Project, is expected in the near future, for this area. From the available data, there was little growth in traffic over the past years.

Although the Namibian economic growth has averaged 4.5% over the past 10 years, traffic growth rates are not expected to be this high. Taking into account the calculated growth rates as well as the average economic growth, the traffic growth for this project will be taken as 2% annually.

The Omitiomire project expects to generate the following traffic when the mine is in full operation:

- 15x 32t trucks a day supplying salt, sulphur or diesel.
- 10x LDVs per day
- 6x busses per week

The table below is a summary of the average daily traffic, calculated with a traffic growth rate of 2% annually. Traffic data used was converted to 2023. Data selected for calculations was taken from the counting stations, ECC counts where stations were not available and moving counts where none other counts were available.

Table 3: Forecasted Average Daily Traffic

Road	Base Year (2023)			5 Years			10 Years		
	ADT Light	ADT Heavy	ADT Total	ADT Light	ADT Heavy	ADT Total	ADT Light	ADT Heavy	ADT Total
MR59	93	29	122	102	32	134	113	35	148
MR60	60	20	79	66	22	88	73	24	97
DR2166	9	8	17	10	9	19	11	10	21
MR53	31	3	34	34	3	37	37	4	41
DR1435	19	0	19	21	0	21	23	0	23
DR1535	37	5	42	41	6	46	45	6	51

The expected generated traffic was assigned to each road section of the transport routes and added to the existing traffic volumes as to ascertain the impact of the proposed mine on the surrounding road network. The table below indicates the traffic forecast with the expected generated traffic by the Omitiomire Copper Project.

Table 4: Forecasted Average Daily Traffic including Generated Traffic

Road	Base Year (2023)			5 Years			10 Years		
	ADT Light	ADT Heavy	ADT Total	ADT Light	ADT Heavy	ADT Total	ADT Light	ADT Heavy	ADT Total
MR59	103	45	148	114	50	163	125	55	180
MR60	70	36	105	77	39	116	85	43	128
DR2166	19	24	43	21	26	47	23	29	52
MR53	41	19	60	45	21	66	49	23	73
DR1435	29	16	45	32	18	50	35	20	55
DR1535	47	21	68	52	23	75	57	26	83

MR59 and MR60 currently carry 60 to 90 light vehicle per day and 20 to 30 heavy vehicles. The additional traffic due to the Omitiomire Copper Project will increase the light traffic with 12% and the heavy vehicles with 50% on these two road sections. The district roads have currently low traffic volumes and nearly no heavy vehicles. The Omitiomire Copper Project traffic will be the main traffic on these roads.

To illustrate the impact of the additional traffic on receptors along the routes, the following graphs were developed. These graphs show the current traffic, generated traffic and the total traffic on each road section.

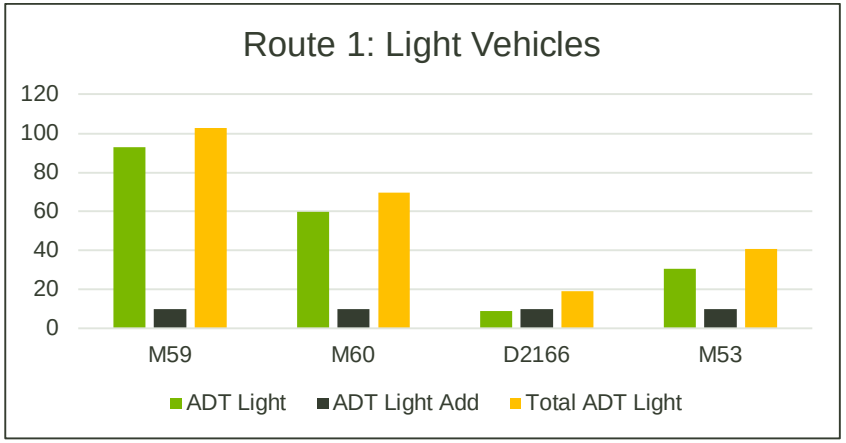


Figure 13: Impact of generated light traffic on Route1

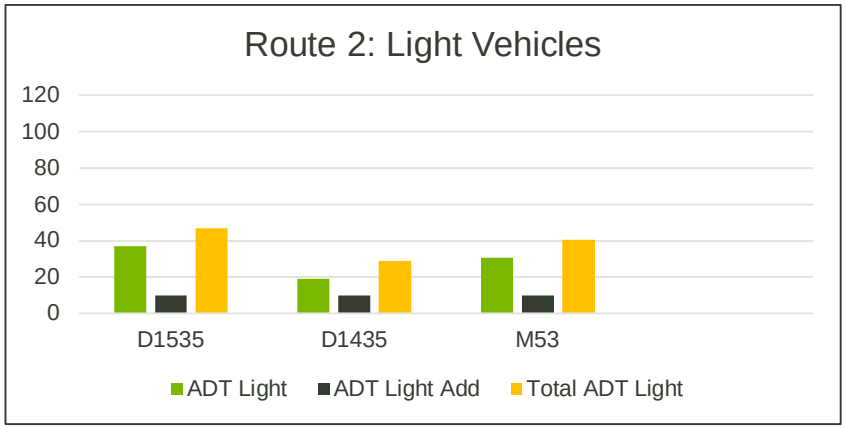


Figure 14: Impact of generated light traffic on Route 2

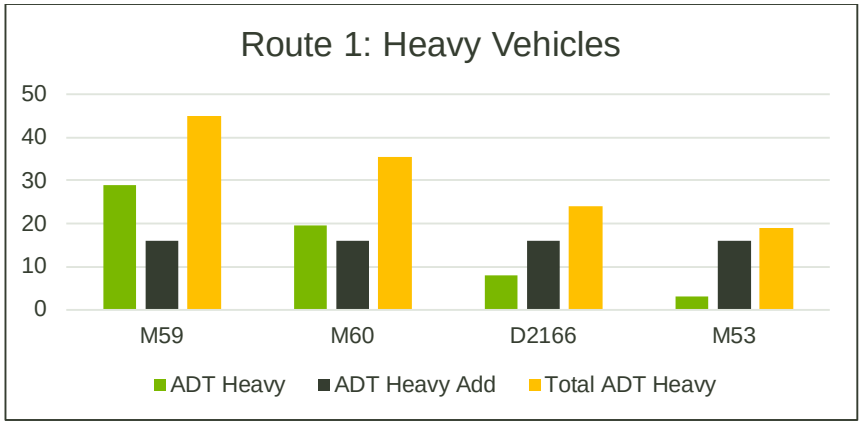


Figure 15: Impact of generated heavy traffic on Route 1

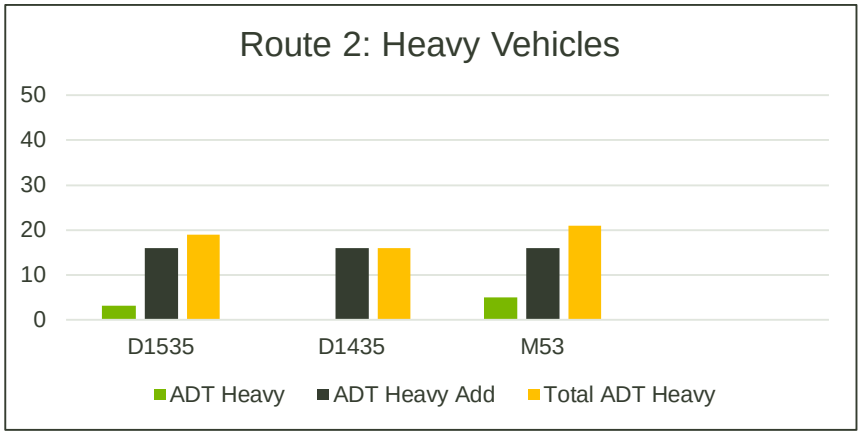


Figure 16: Impact of generated heavy traffic on Route 2

5.4 Conclusion

MR59 and MR60 currently have substantial volume of vehicles with some 80 light vehicles and 30 heavy vehicles. The district roads have low traffic volumes, some 20 light vehicles and 5 heavy vehicles per day. The Omitiomire Copper Project traffic will be the major traffic on the district roads and the effect of the heavy vehicles will therefore be substantial on these roads.

The traffic on MR59 and MR60 currently consist of 25% heavy vehicles which will increase to 30% when the Omitiomire Copper Project is operational. The traffic impact due to the Omitiomire Copper Project on MR59 and MR60 will be less noticeable as on the district roads.

6 Pavement Options

The Annual Average Daily Equivalent Vehicle Units (A.A.D.E.V.U) is the annual average daily traffic expressed in equivalent vehicle units. A light vehicle is equivalent to one unit and a heavy vehicle of mass 3.5t or more, to three units (Roads Authority of Namibia standards). The A.A.D.E.V.U is used to evaluate the required road cross-section and the preferred road pavement.

The road sections of the two routes investigated forms part of the national road network under the Roads Authority of Namibia (RA). The RA has minimum standards to which these roads need to be constructed and these have been taken into consideration in this study.

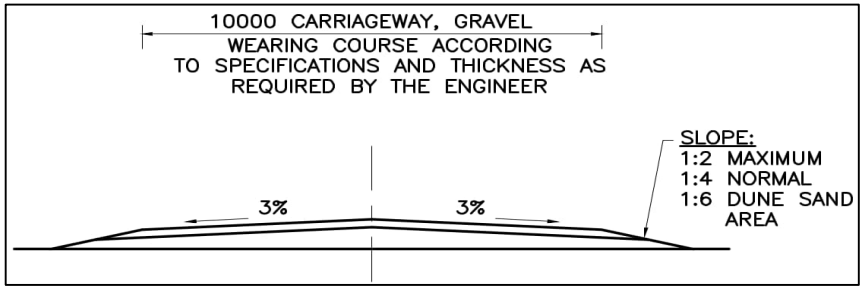


Figure 17: Typical gravel road cross-section

According to the Roads Authority of Namibia's standards it should be considered to upgrade roads carrying traffic of 75 vehicles or more to a gravel road with a suitable wearing coarse on a raised constructed formation.

When traffic exceeds 150 vehicles per day, the application of a Low volume Seal is suggested. The Roads Authority of Namibia plans to upgrade MR59 to bitumen standards in the next 3 years, budget restraints might prolong this period. This road was not re-gravelled in the last 12 years and upgrading need to be done as a matter of urgency.

MR60 has been identified for re-gravelling on the re-gravelling program of the Roads Authority. The re-graveling project is subject to availability of funding.

6.1 Proposed Upgrading Options

To determine the expected pavement impact of the proposed Omitiomire Copper Project, the annual average daily equivalent vehicle units (A.A.D.E.V.U.) that the mine is expected to add to each link was compared to the existing A.A.D.E.V.U, as indicated in **Table 5** below:

Table 5: Annual Average Daily Equivalent Vehicle Units

Link Road	Existing AADEVU	Omitiomire Expected AADEVU	Total AADEVU	% AADEVU Added
MR53	180	58	238	24%
MR60	118	58	176	33%
DR2166	33	58	91	64%
MR53	40	58	98	59%
DR1435	19	58	77	75%
DR1535	52	58	110	53%

The traffic volumes on MR59 and MR60 are much higher than on the other road sections.

With consideration of the existing traffic volumes, it is evident that the heavy vehicle impact will be proportionally larger on the gravel roads surrounding the site that currently low heavy vehicle traffic volumes. Taking into consideration the existing pavement conditions, the following is recommended to mitigate the expected impact on road conditions.

Route 1: MR59/MR60/DR2166/MR53

- The pavement of MR59 is failing and with the high traffic volumes, this road needs to be upgraded. Traffic volumes on this road warrant an upgrading to a low volume seal. This road is already equipped with stormwater structures and the geometric alignment doesn't need upgrading. The road is flat and most horizontal curves comply with a

120km/h standard. The minimum action suggested is the reworking of the existing layer and the addition of a wearing course layer.

- It is suggested that MR60 be re-gravelled before the mine is fully operational. This road is equipped with stormwater structures and no upgrading to the geometric alignment is needed. Minimum actions to be taken will be spot re-gravelling on sections where the pavement has failed.
- The DR2166 is mainly an earth graded road, and the pavement is not expected to last under heavy traffic. It is recommended that DR2166 be gravelled before the mine is fully operational to ensure the road is maintained in an accessible condition. This road is not equipped with stormwater structures and culverts will need to be constructed at critical places.
- MR53 need to be gravelled as it is not expected to withstand heavy traffic. This road is not equipped with stormwater structures and culverts will need to be constructed at critical places.

Route 2: DR1535/DR1435/MR53

- DR1535 is in a good condition, and it is expected that the road could withstand the additional heavy traffic for the first few years. The road, or sections thereof, will need to be re-gravelled before the mine is fully operational. The only stormwater structure is a single lane concrete drift. This drift should be upgraded to a culvert crossing to ensure all year access to the mine. Culverts should be constructed at critical places.
- DR1435 will be able to withstand the initial construction traffic but as this road is largely an earth graded road, the pavement is not expected to last under heavy traffic. It is recommended that D1435 be gravelled prior to the mine going into full operation to ensure the road remains in an accessible condition. This road is not equipped with stormwater structures and culverts will need to be constructed at critical places. The road has various sharp horizontal curves and some geometrical improvements should be considered to reduce the road safety risks.

The expected upgrading cost of each upgrading action is tabled below:

Table 6: Pavement Upgrading Costs

Upgrading Actions		
Bitumen (6.8m wide)	Upgrade road to bitumen standards. Road width 6.8m wide. Actions include the roadbed, subbase, stabilized base, 19mm Cape Seal and shoulders.	N$ 2 950 000.00/km
LVS (6m wide)	Upgrade road to Low Volume Seal standards. Road width 6.0m wide. Actions include roadbed preparation, stabilized subbase and a single seal with slurry.	N$ 1 700 000.00/km
Re-gravel	Re-gravel road by adding an additional wearing course layer.	N$600 000.00/km
Gravel	Shape, Roadbed preparation and adding a wearing Course Layer	N$700 000.00/km

The expected cost of installing culverts, re-alignment of the road and upgrading of intersections is tabled below:

Table 7: Construction Costs

Construction Actions		
Box culvert	Installing box-culverts at places where road crosses major water courses. Cross width, 12m wide	N$130 000.00/m
Concrete Drift	Construction of concrete drift, 7m wide through river.	N$11 000/m
Balancing pipe culverts	Installing pipe culverts at low points for balancing of stormwater (single pipe width)	N$42 000 per crossing
Geometric alignment	Upgrade sharp horizontal curves to accommodate higher speed limits	N$ 800 000.00/km
Intersection upgrade	Upgrade intersection to accommodate large trucks	N$ 980 000.00

6.2 Maintenance Actions

Good gravel road maintenance depends on two basic principles: proper use of a grader and the use of good surface gravel to gravel or re-gravel the road. It is further most important to keep water drained away from the roadway. Standing water at any place within the cross section is one of the major reasons for distress and failure of a gravel road. The effect of heavy vehicles on these roads are significant. Regular maintenance is therefore of paramount importance. Road maintenance are divided into routine maintenance and periodic maintenance. Routine maintenance are non-structural in nature and are meant to extend the life of the road pavement. Periodic maintenance is to maintain the structural condition of the road.

The following maintenance actions are required on a gravel road and the maintenance costs for each action has been tabled below.

Maintenance actions		Cost
Routine maintenance: Blading	Road with high traffic volume to be bladed once a week, other roads every second week (bi-weekly): - Main Roads 5 blades per road - District Roads 4 blades per road	 N$ 900/km N$ 1125/km
Periodic Maintenance: Re-gravel	Re-gravel every 5 years	N$600 000/km

Foto of Routine Maintenance on MR53

7 Conclusions and Recommendations

7.1 Conclusions

It is concluded that:

- The Omitiomire Copper Project is proposed on the farm Groot Omitiomire located approximately 140km north-east of Windhoek in the Khomas region of Namibia. The majority of the expected mining traffic will be 15 heavy vehicles per day delivering salt, sulphur or fuel from Walvis Bay. The other mine-related traffic will consist of some ten light vehicles and six busses per week. There are two potential routes to the mine from Walvis Bay which this study had to evaluate.
- Route 1 follows the B2 route from Walvis Bay to Okahandja where it turns north towards Otjiwarongo. The route turns east 8km north of Okahandja onto MR59 which forms part of the C31 route, this section is 66km long up to the intersection with MR60. The first 20km are surfaced with a low volume seal from there it is a gravelled road up to the Omitiomire Project. The section on MR60 is 41km and turn off on D2166 for 42km. These routes are all gravelled roads. The last section of 13km is on MR53 to the Omitiomire Copper Project. The Roads Authority intends to surface MR59 which will substantially impact the related cost as shown in this study.
- Route Option 2 follows the B2 route from Walvis Bay to Okahandja where it turns south towards Windhoek on the B1. The route turns at Windhoek towards Gobabis on the B6, passing the Hosea Kutako International Airport and Seeis. Some 9km east of Seeis, the route turns north on D1535 towards Omitiomire. D1535 is a gravelled road, after crossing the White Nossob River at km 19, the road intersection with DR1435 is reached. The route turns right onto the DR1435 and follows the gravelled road D1435 for 49km after which it turns east on MR53 for 13km towards the Omitiomire Copper Project.
- During the site visit the existing pavement was surveyed. It was found that MR59 and MR60 on Route1 will require re-gravelling. The districts roads on Route 1 and on Route 2 are mainly earth roads and will require a gravel wearing course to carry the heavy vehicles of the mining operations. The results of the material samples, taken during the site visit, indicate that suitable material for gravel wearing course could be expected to be along the roads.
- The road safety and geometrical review highlighted the alignment of Route 1 complies to a higher design speed than Route 2. Potential safety issues on Route 1 are the narrow bridge at km 2, accesses with limited sight distance on the initial 10km section of MR59, the Y-intersection of MR59 and MR60. On route 2 the potential safety issues are various sharp horizontal curves, the intersection of DR1435 and DR1468 and some stream crossings.
    - Dust and traffic noise will have an effect on the nearby farmsteads. Dust suppression and speed reducing measures should be considered at road sections passing farmsteads located less than 100m away from the road. There are two farmsteads on Route 1 within 100m from the road and five on Route 2. Nighttime transport is also highly discouraged.
- MR59 and MR60 currently have substantial volume of vehicles with some 80 light vehicles and 30 heavy vehicles. The district roads have low traffic volumes, some 20 light vehicles and 5 heavy vehicles per day. The Omitiomire Copper Project traffic will be the major traffic on the district roads and the effect will be substantial on these roads. The traffic on MR59 and MR60 currently consist of 25% heavy vehicles which will increase to 30% when the Omitiomire Copper Project is operational. The traffic impact due to the Omitiomire Copper Project on MR59 and MR60 will be less noticeable as on the district roads. The traffic volume on MR59 and MR60 warrant the investigation into the feasibility to upgrade these roads to low volume seal roads to reduce the annual and periodical maintenance actions.

7.2 Recommendations

The recommended route for the heavy vehicles to the Omitiomire Copper Project is Route 1, which is along the B2 route from Walvis Bay to Okahandja, northwards on the B1 route and after 9km along MR59, MR60, DR2166 and finally along MR53 to the mine entrance. The recommendation of the preferred route is based on factors as defined hereafter.

- Route 1 is 50km shorter than Route 2 which will reduce the travel time with about 45 minutes per trip. This has a potential safety benefit as drivers are shorter exposed to travel risk.
- The traffic volumes along Route 1 are substantially higher than on Route 2 and the mine-related traffic will have less impact on the traffic and surroundings.
- There is eight farmsteads and receptors within 500m from the road along Route 1 versus the nine along Route 2, of these there are two within 100m on Route 1 and five along Route 2. There are less receptors along Route 1 that will be impacted by noise and dust.
- Route 2 passes over the Auas mountains at Windhoek while Route 1 is without mountainous sections.
- The road alignment of Route 1 is to higher design standard with subsequent reduce road risks.
- The upgrading of MR59 and re-gravelling of MR60 are on the RA priority list.

The routes are along roads under the jurisdiction of the Roads Authority. Any roadworks needs to be executed either by them or under their consent. The Roads Authority experience budget constraints which hinder the maintenance of the road network. It is advised to engage with the Roads Authority regarding the upgrading, maintenance and periodical maintenance to ensure roads in good to fair condition for the Omitiomire Copper Project's transport needs.

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