PROPOSED CONSTRUCTION OF A RAILWAY LINE AND ASSOCIATED INFRASTRUCTURE FROM THE EXISTING RAILWAY, NORTH OF AND PARALLEL TO THE N4, TO THE KUSILE POWER STATION

TRAFFIC IMPACT ASSESSMENT

SEPTEMBER 2009

ISSUED TO:

ZITHOLELE CONSULTING
P O BOX 6002
HALFWAY HOUSE
1685

TEL. No. : +27 11 254-4982
FAX No. : +27 11 805-2100

PREPARED BY:

WSP SA CIVIL AND STRUCTURAL ENGINEERS (PTY) LTD
P O BOX 2330
EDENVALE
1610

TEL. No. : +27 11 450-2290
FAX No. : +27 11 450-2294

http://www.wspgroup.co.za
Reg. No.: 1973/09683/07

QM

Issue/revision	Issue 1	Revision 1	Revision 2	Revision 3
Remarks				
Date	September 2009	November 2009		
Prepared by	R.A.G. Strong *Pr Eng*	R. A. G. Strong *Pr Eng*		
Signature				
Checked by	R.A.G. Strong *Pr. Eng*	R. A. G. Strong *Pr Eng*		
Signature				
Authorised by	R.A.G. Strong *Pr. Eng*	R. A. G. Strong *Pr Eng*		
Signature				
Project number	329169	329169		
File reference	329169/11	329169/11		

Contents

1 Introduction

1.1 Purpose

WSP SA Civil and Structural Engineers (Pty) Ltd was appointed by Zitholele Consulting to prepare a traffic impact assessment for the proposed railway line and associated infrastructure from north of, and parallel to, the N4 to the Kusile Power Station. The purpose of this assessment is to form part of the Environmental Impact Assessment (EIA) that is required prior to undertaking this activity.

Kusile Power Station has been under construction since 2008 subsequent to Eskom obtaining environmental authorisation to construct it in 2007.

1.2 Locality

The study area is located between Bronkhorstspruit in the west, Witbank in the east and Ogies in the south. The study area stretches across the undulating Eastern Highveld of the Gauteng and Mpumulanga Provinces of South Africa which is marked by outstretched agricultural fields as well as untouched pieces of grassveld. The project area runs from the existing Pretoria-Witbank railway line between Bronkhorstspruit and Witbank, in the north, southwards across the R104 and the N4. It crosses the farms Onverwacht 532-IR, Kortfontein 530-JR and Bossemanskraal 538-JR and runs southwards along the Wilge River and then eastwards towards the emerging Kusile Power Station (see the Locality Plan in Appendix A).

1.3 Scope

The assessment covers the following aspects related to traffic:

- A brief description of the proposed development;
- An assessment of existing (2009) traffic and road conditions based on direct observations undertaken during an inspection of the roads in the defined study area;
- Discussion of trip generation, distribution and assignment associated with the proposal;
- Discussion of traffic operating conditions during the critical construction phase, and after the relocation of the infrastructure;
- Comment on access arrangements and road improvements;
- Comment on road safety issues;
- Comment on ongoing road pavement management and maintenance; and
- Conclusions and recommendations.

2 Description of the Development

2.1 Background

Sorbent is required as a re-agent in the power generation process to reduce power station emissions of sulphur dioxide through a process known as Flue Gas Desulphurization (FGD). Transportation of the sorbent by rail was authorised through the Kusile Power Station EIA process, however, during the detailed design of the infrastructure, the authorised rail route was deemed not feasible due to certain technical challenges, resulting in this new EIA project.

The planning process also showed that the rail construction and operation would not be ready when the first generation unit comes into operation thus necessitating an alternative sorbent transportation mechanism. Road transport was deemed an appropriate **temporary** alternative until the railway is operational, especially since Eskom has embarked on a major drive to reduce road transportation of its supplies. The proposed road was included in the initial Kusile Power Station EIA and as such has received Environmental Authorisation and construction has commenced.

The railway line to be assessed in this project will be used to connect the existing Pretoria-Witbank rail route along the N4 to the Kusile power station. Originally six routes were investigated which, for various reasons, has since been reduced to three alternatives which are being assessed in this EIA.

2.2 Proposed Development

Of the six rail route alternatives that were screened in terms of environmental and social impacts the following three were deemed technically feasible (see layout plan in Appendix B):

Alternative 1: Kusile-Wilge Rivier interchange shortcut

The Alternative 1 route alignment, which starts at the existing Pretoria-Witbank railway line, heads in a south-westerly direction and crosses the N4 highway. Thereafter the route follows the course of the Wilge River. This route then heads in a south-easterly direction and crosses an unnamed tributary of the Wilge River continuing for six kilometres into the Kusile Power Station. This route is approximately 12 km in length.

Alternative 2: Kusile–Wilge Rivier interchange

The second alternative follows the same initial alignment as Alternative 1 but after crossing the N4 highway the alignment continues in a south-westerly direction for approximately 4,5 kilometres. Thereafter the route crosses over the Klipfonteinspruit river and turns in a south-easterly direction for approximately two kilometres. The route then turns south-south-east for 2,5 kilometres, turns eastward and crosses the Klipfonteinspruit river a second time and then turns to run in a northerly direction for three kilometres before meeting up with alternative 1 approximately three kilometres from the Kusile Power Station. This route is approximately 18 km in length.

Alternative 3: Kusile-Wilge Rivier interchange shortcut alternative 2

The Alternative 3 route alignment follows the same initial alignment as Alternative 1 but it crosses the N4 highway 500 metres eastward of the Alternative 1 and 2 crossing (avoiding the farmstead complexes). The alternative rejoins alternative 1 for approximately seven kilometres before entering the Kusile Power Station. This route is very similar to Alternative 1, with some minor deviations is 12,2 kilometres in length.

No-Go Alternative

It has also been stated in the Scoping report that the so-called no-go alternative will also be assessed further in the EIA. In the case that the project does not take place and no railway and associated activities are constructed the social, financial and environmental impacts will be assessed and further alternative alignments, or project solutions, will be generated.

Notwithstanding the above the preferred railway route, once authorised by the Department of Environmental Affairs (DEA), still needs to be designed in detail which might result in minor changes to the alignment. It is for this reason that alternative corridors 500 metres wide (250m wide from the centre line) are being assessed in this EIA in order to allow the minor deviations from the route and to navigate around any environmental or engineering sensitivities or restrictions.

All three alternatives cross the N4 and R104 roads at more-or-less the same points and have the same impact on access to properties to the north of the R104. The link to the existing Transnet Freight Rail (TFR) main line is the same for all three, which has apparently been approved in principle.

2.3 Existing Road Network

The relevant elements of the existing road network in the study area are also shown on the layout plan included herewith in Appendix B and include the following:

- The N4 national road running east-west to the north of the Kusile Power Station;
- The R104 (P154-2) provincial road from Bronkhorstspruit to Balmoral which runs parallel to, and north of, the N4;
- The D2236 district road from the Wilgerivier N4 interchange which runs north-south on the western side of the Wilge River ; and
- Gravel access roads that serve various properties both to the north and south of the N4.

2.4 Potential Impact on Existing Road Network

In general the proposed railway line will not have a significant impact on the existing road network except for short-term traffic management and control issues during construction where road crossings are required.

The N4 National Road

The three alternative rail alignments cross the N4 approximately 2 km to the east of the Wilgerivier interchange (see photographs 6 and 17 in Appendix C). It is proposed that the proposed railway crossing of the N4 at this point be in approximately 15m of cut (see the long section in Appendix D). Depending on geotechnical conditions the structure to carry the N4 over the rail line could be constructed in a number of alternative ways thus;

- Bridge Jacking: This could be done without any disruption to traffic flows on the N4;
- Cut-and-Cover Construction: This involves excavation down to rail formation level, installing large concrete culvert type structures and backfilling over the top thus effectively creating a short tunnel for the rail line. This would involve the temporary closure of the N4 carriageways one at a time, with appropriate deviations. Given the cross-section of the carriageways and the wide median this should be perfectly feasible within the road reserve without too much disruption to peak traffic flows. A twelve hour traffic count was conducted on 22/09/2009 on the N4 at the proposed crossing point which shows that the temporary deviation of the carriageways would be quite manageable. These counts are supported by the attached extract from the 2004 traffic counts for the site carried out as part of the Comprehensive Traffic Observations on national routes (see Appendix E); and

- Normal Bridge Construction: This could be achieved in much the same way as the cut-and-cover option.

These options are all feasible without the need to alter the vertical alignment of the N4 given that the minimum top-of-rail to structure soffit for an electrified rail line is 6,4m. This however needs to be discussed with, and approved by, Trans African Concessions (TRAC) and the South African National Roads Agency (SANRAL).

The R104 (P 154-2) Provincial Road

As with the N4 crossing the three rail alternatives cross the R104 provincial road at the same point approximately 2 km to the east of its intersection with district road D2236 (see photographs 14 and 15 in Appendix C). At this crossing the intention is for the rail line to be on approximately 9,5m of fill (see Appendix D).

With a rail-over-road crossing the railway bridge could be constructed without any road closure or deviation (see photographs 14 and 15). At worst, single lane operation with stop-go control might be necessary for short periods. The twelve hour traffic counts carried out on 22/09/2009 at the intersection of the R104 and the D2236 (included in Appendix E) indicate that such measures would be quite manageable. With this crossing however the gravel access road to the north needs to remain accessible (see photographs 5 and 16 in Appendix C).

The D 2236 District Road

This road is not affected by any of the proposed rail alignments.

Gravel Access Roads

There are a number of gravel access roads that are potentially affected by the proposal.

The ones to the north of the R104 are depicted in photographs 1-4 in Appendix C. An accommodation plan for these roads will need to be developed as part of the Preliminary Design process in conjunction with the affected land owners.

Between the R104 and the N4 there are no affected access roads (see photograph 7 in Appendix C).

There is a gravel access road that runs southwards from the R104, from a point approximately 0,5 km to the west of the proposed rail crossing, and crosses over the N4 at a point approximately 300m to the west of the proposed N4 rail crossing. Photographs 6 and 7 were taken from the bridge that carries this road over the N4. This road then runs parallel to rail alternatives 1 and 3 for approximately 2 km and then turns sharply to the east where it is potentially affected by all three rail alternatives (see photographs 9 and 10 in Appendix C). At this point the proposed vertical alignment of the rail alternatives appears to be close to existing ground levels. This access road then reaches the Eskom property boundary as indicated in photographs 11 to 13 in Appendix C.

Also in this vicinity there is another gravel access road that branches off to the south (see photograph 8 in Appendix C).

The connectivity of the above will need to be maintained in an acceptable way as part of the Preliminary Design process of the rail line.

3 Existing Traffic Characteristics

As stated above twelve hour classified traffic counts were undertaken on 22/09/2009 on the N4 east of the Wilgerivier interchange and at the intersection of the R104 and the D2236 as part of this assessment. These observations indicated the following:

- The N4 National Road, typically carries peak hour traffic that is of the order of less than 20 % of the theoretical capacity of the road;
- The R104 also carries relatively low peak hour volumes of traffic with peak hour traffic typically of the order of 110 vehicles per hour which is less than 10% of theoretical capacity;
- Whilst no detailed traffic counts were conducted on the various gravel access roads in the study area the site inspection conducted on 8/09/2009 showed that traffic on these roads is insignificant in terms of volume.

4 Trip Generation, Distribution and Assignment

4.1 Trip Generation

The only really significant element of trip generation associated with this project is that associated with the construction works for the construction of the railway line. The following information in this regard is based on a similar project carried out near Sishen in the Northern Cape:

- It is anticipated that the total construction period will be approximately two years;
- In the first five months the formation materials for the new rail lines will be delivered to site in 10 tonne tippers. Unsuitable material from cuttings might have to be removed from site;
- Over the first five month period the total number of delivery truckloads will be of the order of 8000 (This depends on the soil conditions but is expected to be high due to unsuitable soil for formation building purposes);
- As from about 5 months the materials for the new rail lines, ie sleepers, rails, rail fastenings, etc will be delivered to site in 57 tonne, 22m interlink trucks;
- The maximum number of the above deliveries will be 30 trucks per day arriving loaded and departing empty;
- Over the period from month six to month ten the total number of delivery truckloads will be of the order of 540;
- During the entire construction period there will also be of the order of 55 light vehicles arriving during the am peak period and departing during the pm peak period transporting construction personnel;
- All other construction vehicles, eg tippers, dump trucks, compactors, water bowsers, etc. will as far as possible be confined to site and will not travel on public roads;
- The normal working day will be 07:30 to 17:30, Mondays to Saturdays, with work on Sundays only in exceptional circumstances.

4.2 Trip Distribution and Assignment

The daily origins and destinations of personnel and materials is uncertain at this stage, however to develop perhaps a worse case scenario the following assumptions have been made:

- Based on the above discussion of the three railway alignment alternatives it is assumed that Alternative 1 will be the preferred route from a technical point of view;
- All trips for delivery of materials will utilise the N4 either from the east or west;
- The above trips to and from the N4 will use the R545 to the Kusile Power Station construction site;
- It is assumed that construction personnel will originate in equal proportions from east and west using the N4/R545 interchange; and
- The location of access to the rail construction site is not known but at this stage it is assumed it will be via the power station construction site and utilise the service road to be constructed within the proposed rail reserve.

5 Operational Assessment

5.1 Introduction

As discussed earlier traffic volumes on the various elements in the road network in the study area are low and would not normally warrant any detailed analysis in terms of service levels and delay factors

At this point it is worth considering what is meant in terms of levels of service. In this regard the following is an extract from the US Highway Capacity Manual:

"The concept of *level of service* uses qualitative measures that characterize operational conditions within a traffic stream and their perception by motorists and passengers. The descriptions of individual levels of service characterize these conditions in terms of such factors as speed and travel time, freedom to manoeuvre, traffic interruptions, and comfort and convenience.

Six levels of service are defined for each type of facility for which analysis procedures are available. They are given letter designations, from A to F, with level of service (LOS) A representing the best operating conditions and LOS F the worst. Each level of service represents a range of operating conditions.

The volume of traffic that can be served under the stop-and-go conditions of LOS F is generally accepted as being lower than possible at LOS E, consequently, service flow rate E is the value that corresponds to the maximum flow rate, or capacity, on the facility. For most design or planning purposes, however, service flow rates D or C are usually used because they ensure a more acceptable quality of service to facility users."

5.2 Analysis Results

To put the above into perspective analysis of peak traffic conditions was carried out at the intersection of the R104 and the D2236 using SIDRA software. This analysis indicates that during AM and PM peak periods the approaches to this intersection are operating at Levels of Service (LOS) A and B with volume/capacity ratios of <0,1 which means that during the daily peak hours the intersection is operating at less than 10% of its capacity. Even if the peak hour traffic volumes are doubled and all infrastructure construction traffic passes through this intersection levels of service remain at A and B. Sample SIDRA output is included herewith in Appendix F.

The conclusion of the above is that peak period road capacity will not be an issue through the construction phase and beyond and the activities associated with the railway construction will have no discernable impacts on traffic operating conditions in the vicinity of the site. Furthermore there are no discernable impacts even if all existing peak hour traffic movements are doubled. In this regard therefore there will be no need for any capacity related road improvements in the vicinity.

There are however other traffic issues that will be discussed later in this report.

6 Road Safety Issues

The following can be considered as the issues relevant to road safety:

- Shoulder sight distance;
- Heavy vehicle turning movements;
- Dust; and
- Road surface conditions.

6.1 Shoulder Sight Distance

Shoulder sight distance is the distance that the driver of a vehicle that is stationary at the stop line of a minor road can see along the major road to be able to cross the major road before an approaching vehicle reaches the intersection.

It is therefore a function of the speed of vehicles travelling on the major road, the width of the major road and the type of vehicles that are trying to cross.

As can be seen from photographs 14 and 15 in Appendix C, shoulder sight distance along the R104 where the rail crossing will be located is more than adequate for this class of road and will not be an issue even if construction traffic gains access to and from the site at this point.

6.2 Heavy Vehicle Turning Movements

Notwithstanding the above, with the increase in heavy vehicle volumes that could be associated with future construction activities, it is recommended that W107 and W108 intersection warning signs with IN 11.569 supplementary warning plates be erected on the R104 approaching the existing intersection with the D2236, and at the potential point of access to the site, indicating the presence of heavy vehicles at the intersections.

6.3 Dust

Dust is obviously not an issue on the R104 which has a tarred surface. It could however be an issue on the service road within the railway reserve. After the construction is finished this road will carry sporadic very low volumes of traffic and thus traffic-generated dust will not be an issue. This will however be a more significant issue with construction traffic using it. Similarly, apart from exceptional circumstances, construction traffic should not be permitted to use any of the other gravel access roads in the study area.

6.4 Road Surface Conditions

(i) Gravel Access Roads

For the very low daily volumes of basically farm-related traffic that currently uses the gravel access roads in the area road safety should not be an issue related to road surface conditions. This will however become a completely different issue if heavy construction traffic is permitted to use them.

(ii) Road R104

Road R104 between Bronkhorstspruit and the Balmoral is a tarred road which, from visual inspection, appears generally to be in good condition for the volumes of traffic that uses it (see photographs 14 and 15). However with heavy construction traffic over a period of two years, if this road pavement is not monitored, surface distress and edge deterioration could develop and accelerate and potentially become road safety hazards.

7 Road Pavement Management

7.1 Gravel Access Roads

As stated above road pavement management of the various gravel access roads will not be an issue if their uses remain as is at present, this will however change quite significantly if construction vehicles are allowed to use them in all but exceptional circumstances.

7.2 Road R104

As stated earlier this road is surfaced and is generally in good condition for the current daily volumes of traffic that it carries. It must be stressed however that this statement is based only on visual inspection with no investigation of the underlying pavement layers.

If, however, during the construction period the number of heavy vehicles using this section of road is significantly increased this could have a significant impact on the integrity of both the road surface and underlying pavement layers. This would then need to be monitored on a regular basis during the construction period by means of visual/photographic surveys and a road pavement management programme implemented.

8 Conclusions and Recommendations

8.1 Conclusions

In view of the findings of this assessment, the following conclusions may be drawn:

(i) Peak hour traffic operating conditions on public roads in the vicinity of the study area will not be significantly affected by the construction of the rail line and associated infrastructure that is proposed therefore no mitigation measures should be required.

(ii) Whilst additional road signs, and specifically heavy vehicle warning signs, on the R104 are strongly recommended at least during the construction period there would not seem to be any significant road safety issues that need to be addressed at this stage.

(iii) The R104 currently appears to be in very good condition although this could change quite rapidly with the addition of heavy construction traffic, especially at intersections.

(iv) The N4 is a national road designed to carry much higher volumes of traffic than current levels.

(v) Railway alternatives 1 and 3 would seem to be the more feasible from a traffic point of view, although all three alternatives will have much the same impact on the local road network. Alternative 2 is the longest alternative and crosses more access roads than alternatives 1 and 3 and is therefore the least desirable.

8.2 Recommendations

(i) With respect to roads and traffic there would not seem to be any reason why the proposed rail construction should not be approved.

(ii) In terms of the contents of this report Alternative 1 or 3 for the railway line is recommended.

(iii) A detailed construction-related traffic management plan will need to be addressed prior to the start of any construction work both in terms of road safety and road pavement maintenance and implemented for the full duration of the construction period. Construction traffic should not in normal circumstances be permitted to use any portion of the existing gravel access roads, the proposed service road within the future rail reserve would be more appropriate as a site access road.

(iv) All road design work must be carried out by suitably qualified personnel, compliant with relevant standards and be approved by the appropriate road authority.

9 Appendices

Appendix A	Locality Plan
Appendix B	Layout of Existing and Proposed Road and Rail Infrastructure
Appendix C	Photographs of Existing Roads in the Study Area
Appendix D	Rail Option 1 Vertical Alignment
Appendix E	Sample Traffic Counts
Appendix F	Sample SIDRA Output

Appendix A Locality Plan

Appendix B Layout of Existing Road and Rail Infrastructure

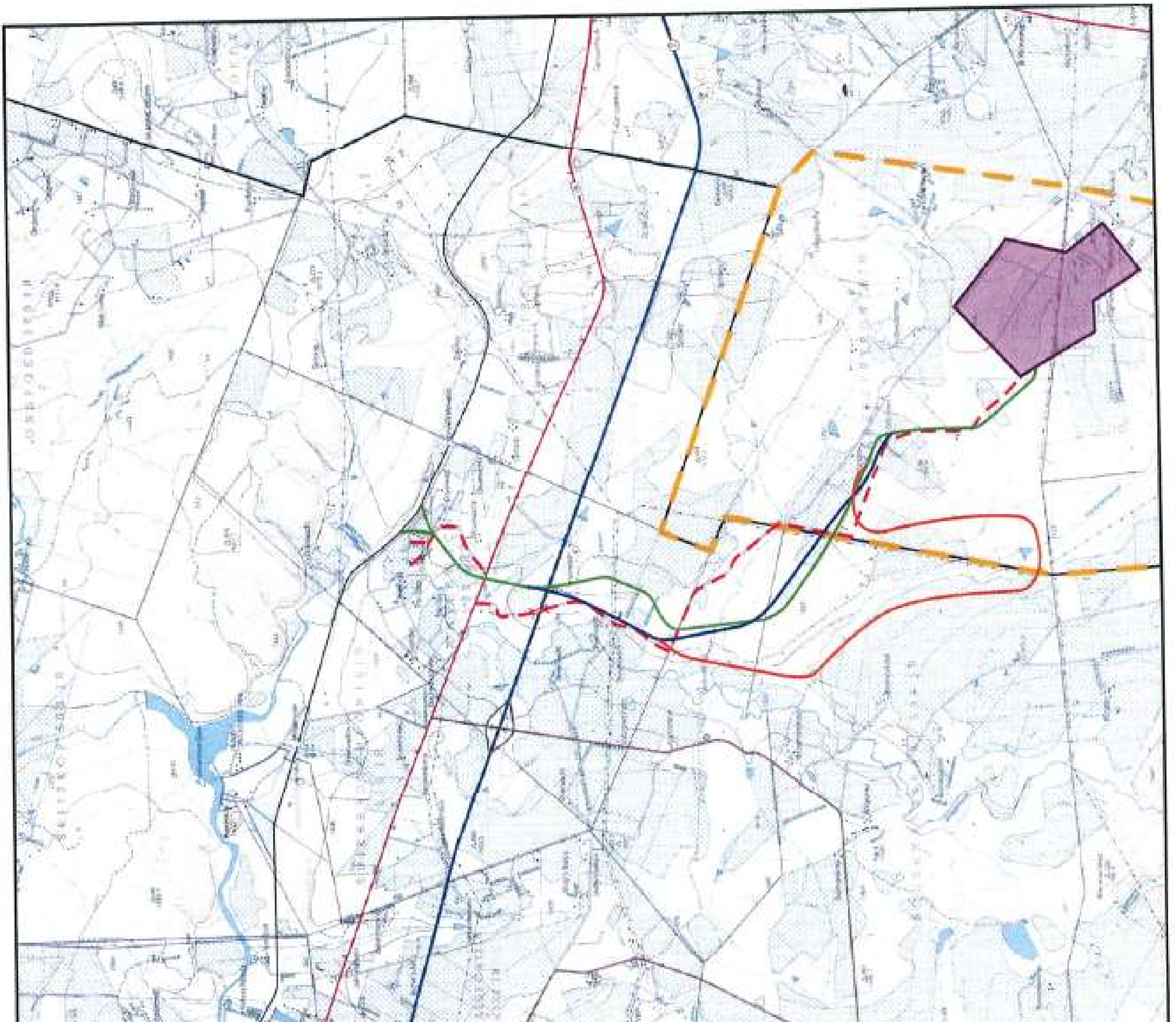
Appendix C   Photographs of Study Area

Appendix D Rail Option 1 Vertical Alignment

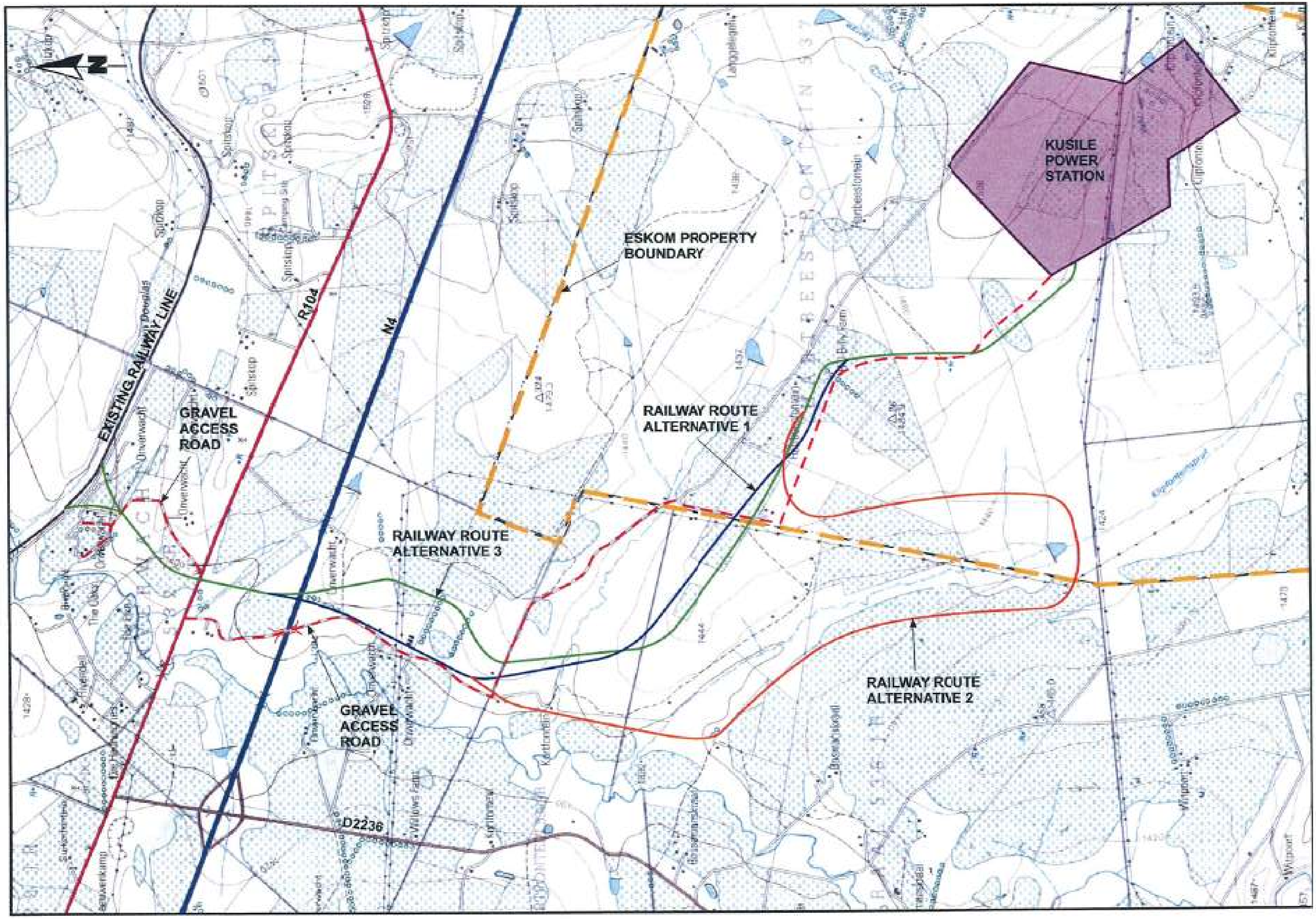
Appendix E Sample Traffic Counts

Appendix F Sample SIDRA Output

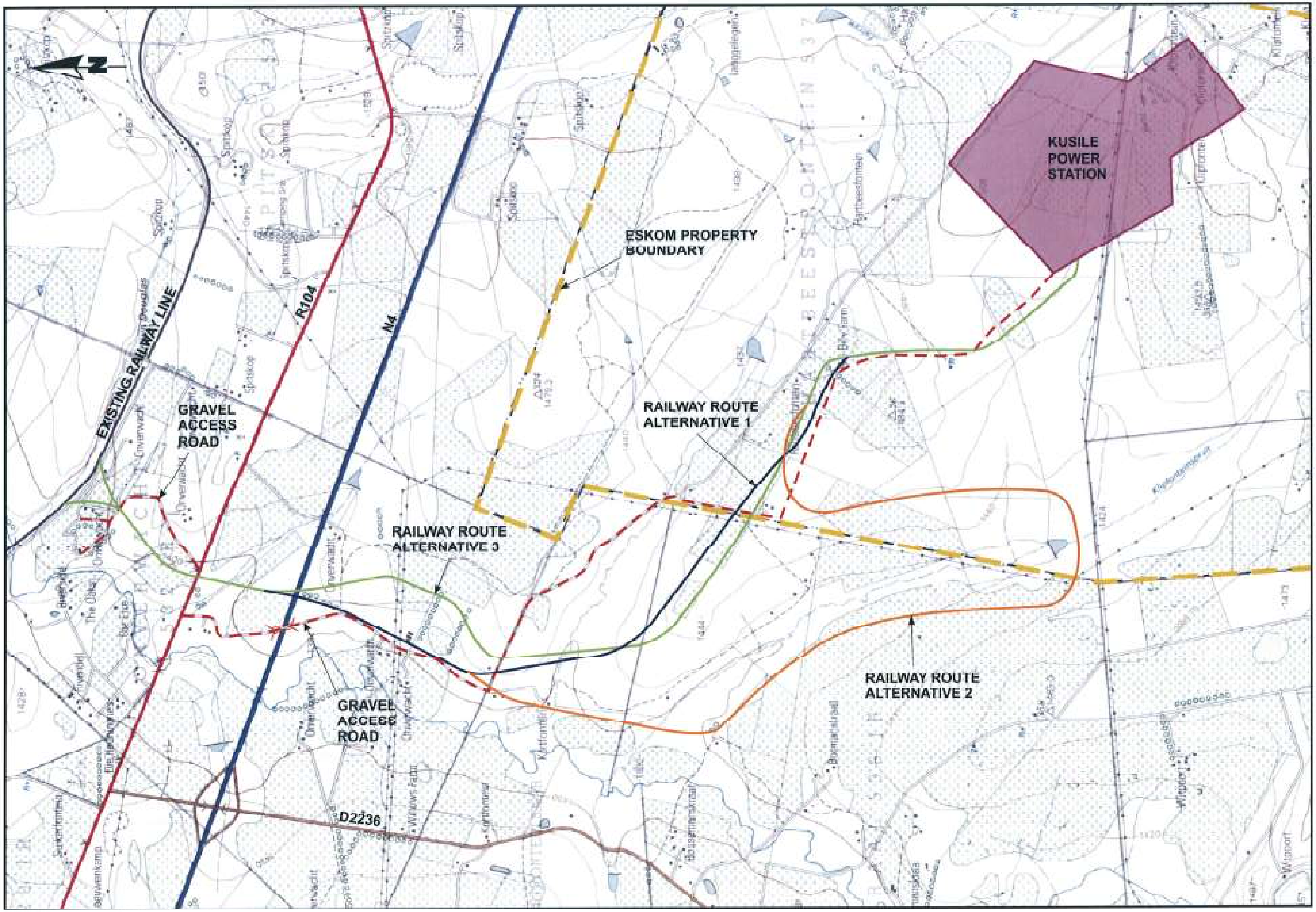
Appendix A Locality Plan



Appendix B Layout of Existing Road and Rail Infrastructure



KUSILE POWER STATION
ESKOM PROPERTY BOUNDARY
RAILWAY ROUTE ALTERNATIVE 1
RAILWAY ROUTE ALTERNATIVE 2
RAILWAY ROUTE ALTERNATIVE 3
GRAVEL ACCESS ROAD
GRAVEL ACCESS ROAD
EXISTING RAILWAY LINE
R104
N4
D2236
N



KUSILE POWER STATION
ESKOM PROPERTY BOUNDARY
RAILWAY ROUTE ALTERNATIVE 1
RAILWAY ROUTE ALTERNATIVE 2
RAILWAY ROUTE ALTERNATIVE 3
GRAVEL ACCESS ROAD
GRAVEL ACCESS ROAD
EXISTING RAILWAY LINE
R104
N4
D2236
N

Appendix C Photographs of Study Area

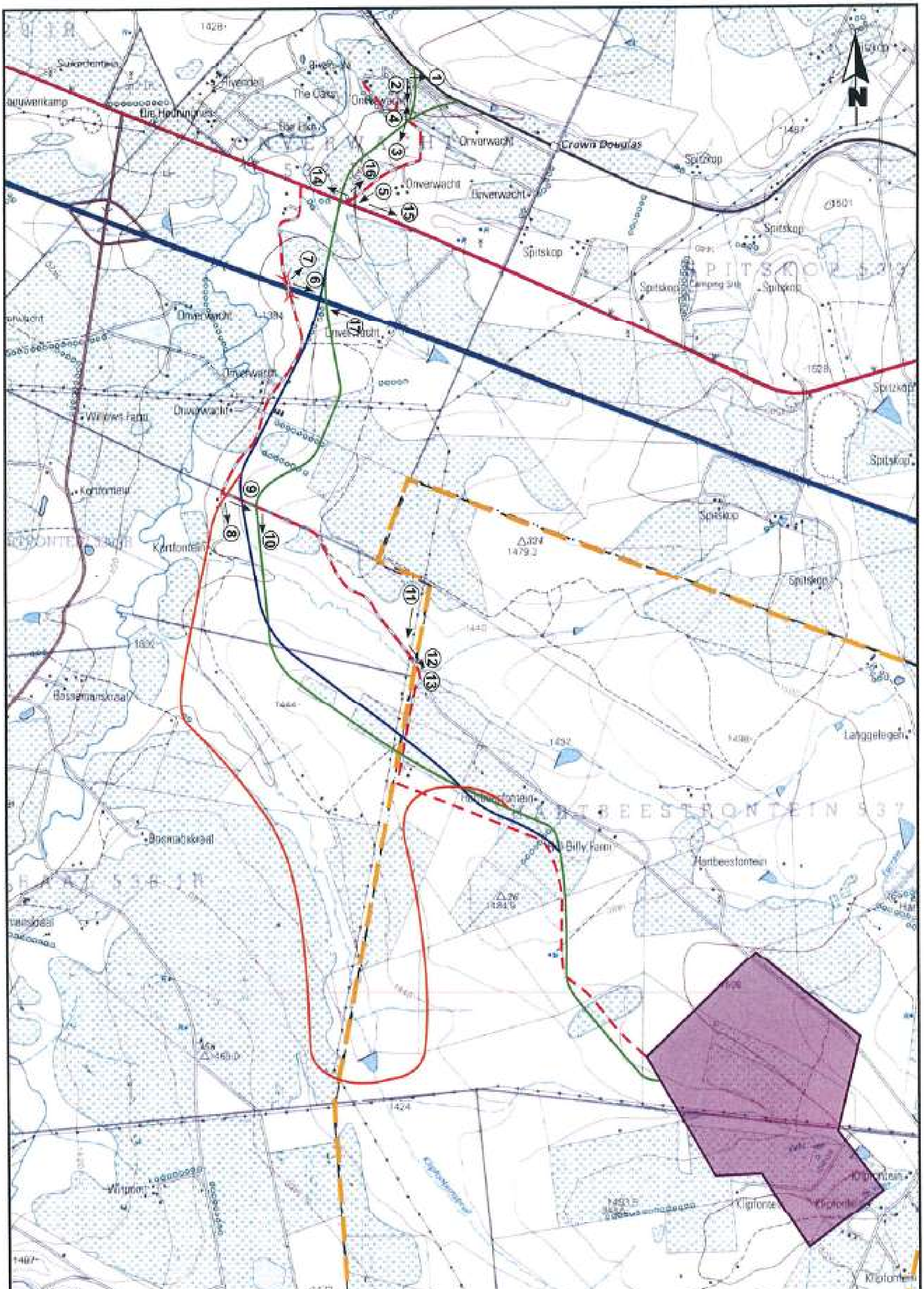

N
Crown Douglas
Onverwacht
Spitskop
Rivendell
The Oaks
Die Hoewe
Kortfontein
Kortfontein
Willows Farm
Bossemanskraal
Bosmabiskraal
Billy Farm
Hartbeestfontein
Langgelegen
Klipfontein
Witpoort
Wagpan

Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

Photo 6

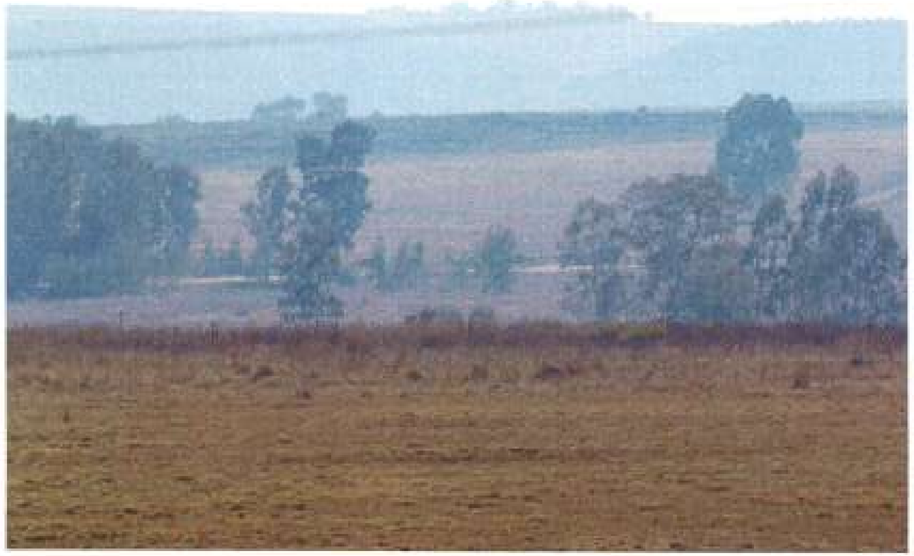


Photo 7

Photo 8

Photo 9

Photo 10

Photo 11

Photo 12


Photo 13

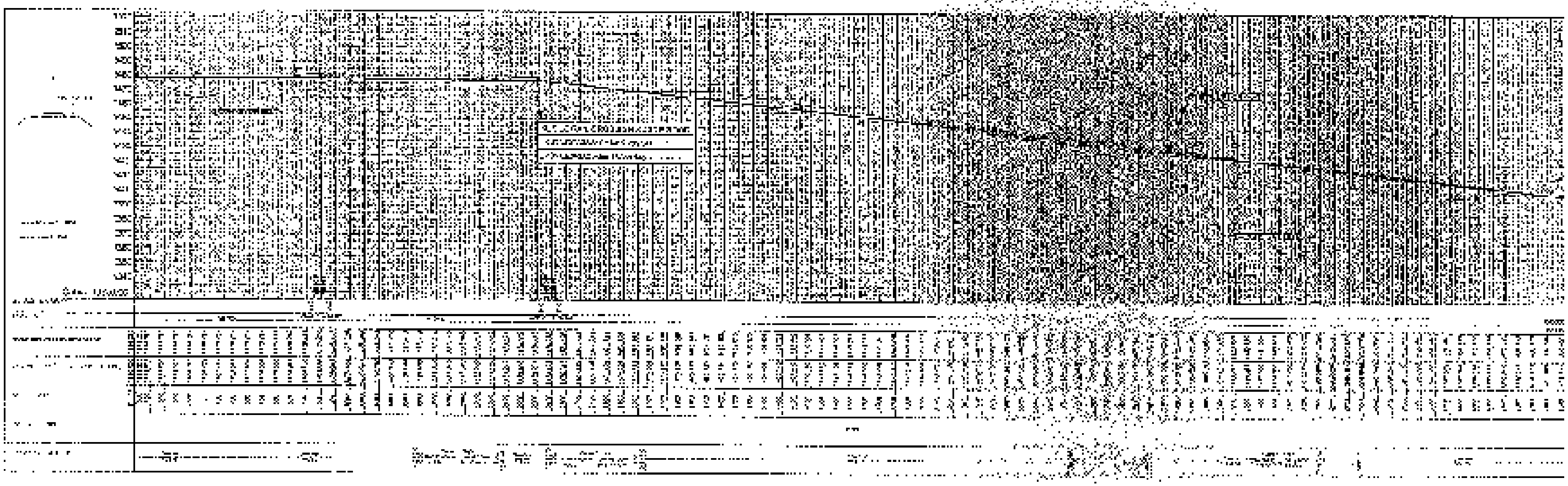

Photo 14


Photo 15


Photo 16

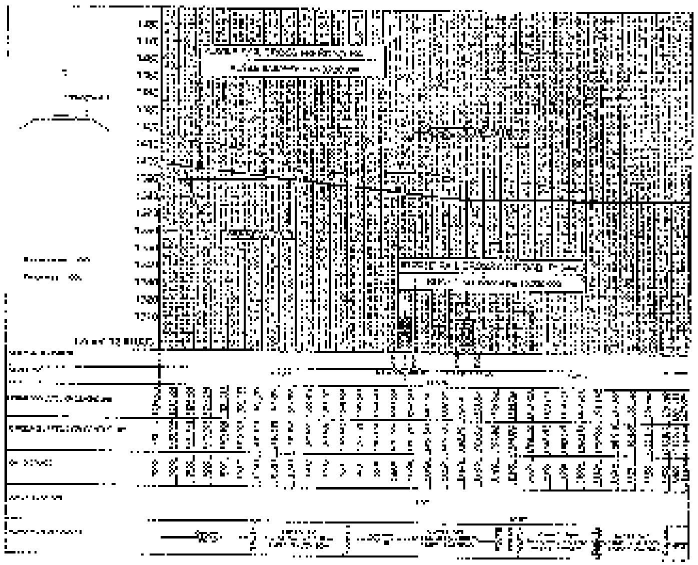
Photo 17

Appendix D Rail Option 1 Vertical Alignment



PANGALA KY3

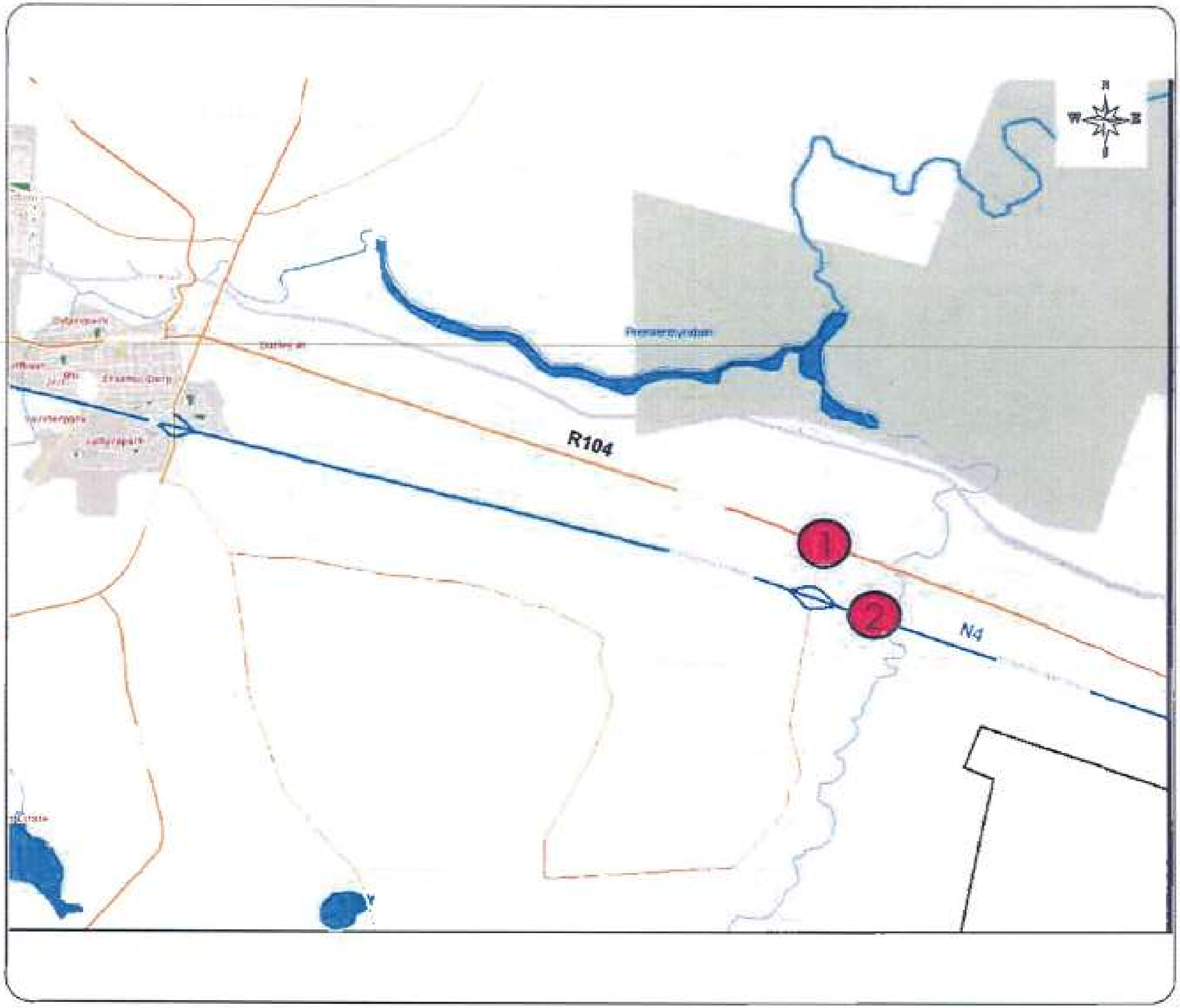
Eskom



PANGAEA KY3

Eskom

Appendix E Sample Traffic Counts



PROJECT

R104 EAST OF BRONKHORSTSPRUIT

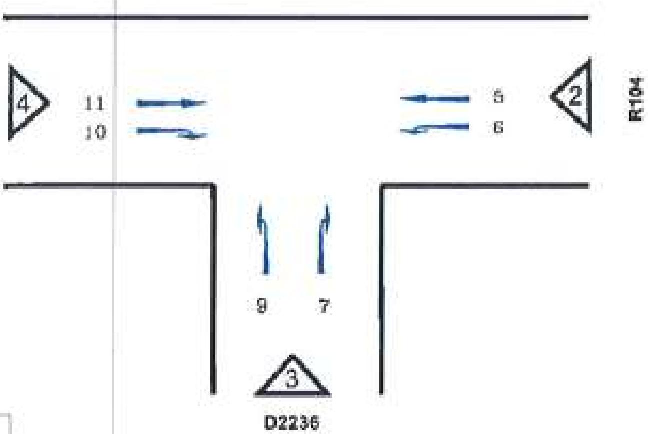
LOCALITY PLAN

KEY

SURVEY STATION(S)

TRAFFTRANS (PTY) LTD

Proj. T2009/068 Fig. 1



CO-ORDINATES

LATITUDE : 25° 50'24.6" S
LONGITUDE: 28° 51' 34.5" E

LOCATION:	INTERSECTION: R104 & D2236
AREA:	BNKHORSTSPRUIT
STATION NUMBER:	1
DATE:	22/09/2009
DAY:	TUESDAY
TIME:	06:00 to 18:00
TYPE OF COUNT:	CLASSIFIED COUNTS PER TURNING MOVEMENT
DESCRIPTION:	CLASSIFICATION: LIGHT AND HEAVY VEHICLES

STATION LAYOUT

R104 - EAST OF BRONKHORSTSPRUIT

PROJ. T2009/088

DATE Sept 2009

TRAFFTRANS (EDMS) BPK

SUMMARY OF TRAFFIC COUNTS

STATION: 1
LOCATION: R104 & D2236

LAT: 25° 50' 24.6" S
LONG: 28° 51' 34.5" E

DATE: 22/09/2009
Tuesday

MOVEMENT		AM PEAK HOUR					PM PEAK HOUR					12 HOUR COUNT			
FROM	NO	LIGHT VOL	HEAVY VOL		TOTAL VOL	PHF	LIGHT VOL	HEAVY VOL		TOTAL VOL	PHF	LIGHT VOL	HEAVY VOL		TOTAL VOL
NORTH	1					n.a.					n.a.				
	2														
	3														
EAST	4					0.70					0.72				
	5	64	4	6%	68		23			23		315	34	10%	349
	6	2			2		2	1	33%	3		34	5	13%	39
SOUTH	7	1			1	0.25	4	1	20%	5	0.40	27	2	7%	29
	8														
	9	2	1	33%	3		3			3		35	7	17%	42
WEST	10	2			2	0.80	3	1	25%	4	0.81	26	5	16%	31
	11	37	3	8%	40		33	2	6%	35		258	30	10%	288
	12														
TOTAL		108	8	7%	116	0.85	68	5	7%	73	0.87	695	83	11%	778
		PERCENTAGE OF:		12H	14.9%		PERCENTAGE OF:		12H	9.4%					

	AM	MID	PM
STARTING TIME OF PEAK HOUR	06:15	11:30	15:00

PREPARED BY TRAFFTRANS (PTY) LTD

TRAFFIC SURVEY: MANUAL COUNTS BRONKHORSTSPRUIT

TRAFFITRANS

LOCATION: R104 & D2520
STATION NR:
DATE OF SURVEY: [illegible]

TYPE OF SURVEY: 12H TURNING MOVEMENTS
TYPE OF VEHICLE: ALL

MOVEMENTS

End Time	1 QH	1 H	2 QH	2 H	3 QH	3 H	4 QH	4 H	5 QH	5 H	6 QH	6 H	7 QH	7 H	8 QH	8 H	9 QH	9 H	10 QH	10 H	11 QH	11 H	12 QH	12 H	TOTALS QH	TOTALS H
06:15									5								1				7				16	
06:30									15		5										4				24	
06:45									22												11				34	
07:00									13	65		1						2			5	23			[illegible]	101
07:15									14	56	1	8	1	1			4	5	2	2	12	42			35	136
07:30									3	59	1	3						3	1	0	4	43			17	[illegible]
07:45									4	40		2	1	2				3		0	2	37			35	[illegible]
08:00									5	29	1	9		2				3	2	5	2	22			10	[illegible]
08:15									5	24		3	1	2						4	2	15			17	[illegible]
08:30									5	27		5	2	4						5	2	13			10	[illegible]
08:45									6	25		3	1	4			1	2	0	7	0	14			10	53
09:00									5	23	1	4		4			2	4		5	3	20			17	[illegible]
09:15									4	22	1	2		5				2		5	7	25			12	[illegible]
09:30									0	[illegible]		3	1	2				3		4	1	30			23	[illegible]
09:45									5	22		[illegible]		1			1	3		1	[illegible]	26			[illegible]	[illegible]
10:00									8	[illegible]	5	7	1	2			9	4			4	25			[illegible]	60
10:15									4	25	3	4		2			1	5	1	1	2	20			11	[illegible]
10:30									8	23		4		1			1	5	1	1	5	15			14	[illegible]
10:45									7	25		1	1	2				5		2	3	16			[illegible]	[illegible]
11:00									12	20	1	4	3	4			1	2	2	4	4	15			22	[illegible]
11:15									3	23		1		4				2		3	3	24			[illegible]	[illegible]
11:30									9	33	3	2		4			1	2		2	4	15			[illegible]	[illegible]
11:45									8	25	1	3	2	6			1	5		2	11	27			23	65
12:00									6	22	2	3	1	3			2	4	1	1	6	25			[illegible]	[illegible]
12:15									4	24	1	5	1	3				5		1	4	26			[illegible]	[illegible]
12:30									12	31	2	2		4				3	1	2	5	25			28	[illegible]
12:45									6	29	2	1		2			1	3	1	3	3	23			10	[illegible]
13:00									6	20		5	1	3			2	3	2	4	4	25			12	[illegible]
13:15									11	30	0	5		1				3		4	5	20			21	[illegible]
13:30									7	30		2		1				3	1	4	5	24			12	[illegible]
13:45									10	32		1		1			1	3		3	5	24			14	[illegible]
14:00									6	31		1					1	2		1	6	26			13	[illegible]
14:15									5	34	4	4	1	1			1	0		3	6	20			21	[illegible]
14:30									7	34		4		1				3		2	3	18			11	[illegible]
14:45									10	34	7	6	1	2			1	3		5	6	20			22	[illegible]
15:00									4	28		6		2			1	3		5	0	17			5	[illegible]
15:15									3	24		2	2	3				2	2	4	10	12			17	[illegible]
15:30									5	22	2	4		3			1	3		2	3	26			15	[illegible]
15:45									8	20	1	2	0	2			2	4		1	7	28			21	[illegible]
16:00									7	23		3		3				3	2	4	10	25			19	[illegible]
16:15									3	23		0	1	4			2	3		2	1	28			[illegible]	[illegible]
16:30									10	20		1	1	5			2	2		2	4	25			16	[illegible]
16:45									4	24	1	1	1	3			3	7	1	8	4	23			16	[illegible]
17:00									2	10		1	1	4			1	3		1	7	18			11	[illegible]
17:15									6	21	1	2		2				3	7	9	4	23			12	[illegible]
17:30									7	18	1	5		3			2	3		3	2	24			15	[illegible]
17:45									4	15		2		1				3		2	5	25			17	[illegible]
18:00									8	15	2	5	1	1			7	2		2	8	21			16	[illegible]
TOTAL	12H		12H		12H		12H		12H	349	12H	38	12H	33	12H		12H	42	12H	31	12H	78	12H		12H	278

STARTING TIMES AND COMBINED PEAK PERIOD VOLUME FOR STATION

	1 QH	1 H	2 QH	2 H	3 QH	3 H	4 QH	4 H	5 QH	5 H	6 QH	6 H	7 QH	7 H	8 QH	8 H	9 QH	9 H	10 QH	10 H	11 QH	11 H	12 QH	12 H	TOTALS QH	TOTALS H
AM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Vol									23	65		2						2			11	[illegible]			35	[illegible]
MID	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Vol									13	25	3	9		4				5			5	30			28	[illegible]
PM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Vol									[illegible]	22		3		3				[illegible]	2	4	[illegible]	[illegible]			[illegible]	[illegible]

PREPARED BY TRAFFITRANS (PTY) LTD

KEY: QH - QUARTER HOURLY VOLUMES

TRAFFIC SURVEY: MANUAL COUNTS - BRONKHORSTSPRUIT

LOCATION: R104 & D2200

STATION NO: 1

DATE OF SURVEY: 22/09/2002

TYPE OF SURVEY: 12H TURNING MOVEMENTS

TYPE OF VEHICLE: LIGHT

MOVEMENTS

End Time	1 QH	1 H	2 QH	2 H	3 QH	3 H	4 QH	4 H	5 QH	5 H	6 QH	6 H	7 QH	7 H	8 QH	8 H	9 QH	9 H	10 QH	10 H	11 QH	11 H	12 QH	12 H	TOTALS QH	TOTALS H
06:15									9								1				6				13	
06:30									14		1														23	
06:45									24												9				[illegible]	
07:00									18	60		3?						1			9	32			24?	54?
07:15									14	64	1	2	1				2	2	2	2	11	33			30	105?
07:30									5	55	1	2						3	1	2		30			21?	57
07:45									3	37		3	1	2				2		2	5	29			9	[illegible]
08:00									4	25	1	2		2				2	2	4	2	28			8	54?
08:15									8	21		2	1	2			1	1	5	3	2	16?			14	[illegible]
08:30									1	20		1	2	4					3	2	3	13?			9	[illegible]
08:45									8	25		1	1	4				2	6	5	5	14			15	[illegible]
09:00									5	24	5?	1		2				3	5	5	4	16			12	[illegible]
09:15									4	19	1	2		3			1	2		5	4	18			8	19?
09:30									0?	33?		2	1	2				2		4	7	20			16	35?
09:45									4	21		2		1			2	2		1	6	21			11	[illegible]
10:00									7	33?	1	9		2			2	2			2	16			13	[illegible]
10:15									5	22	5	4		2			1	1	1	1	2	17			10	[illegible]
10:30									5	13		4		1			1	5		1	6	15			11	[illegible]
10:45									5?	21		4		1				4		1	2	12			9	[illegible]
11:00									6	23	1	4	3	3				2	2	3	4	11			19	[illegible]
11:15									2	29?		1		3				1		2	6	21			[illegible]	[illegible]
11:30									6	23		1		3			1	1		2	2	12?			10	[illegible]
11:45									8	25	1	2	2	3			1	3		2	5	25			21	[illegible]
12:00									4	22?	2	3	1	3			4	5		1	2?	28			[illegible]	[illegible]
12:15									4	22	1	4	1	4				4		1	4	21			[illegible]	[illegible]
12:30									11	27	4?	4		4				3		2		27			23	[illegible]
12:45									6	26	2	3		2			1	3		3	5	21			[illegible]	[illegible]
13:00									5	25		7	1	2			2	3		2	4	20			[illegible]	[illegible]
13:15									8	33?	1	2?						3		3	6	13?			[illegible]	[illegible]
13:30									7	29		2?						3		2	7	22			[illegible]	[illegible]
13:45									3?	21		1					1	3?		2	2	12			11?	[illegible]
14:00									3	34?		1					1	2		1	6?	24			15	[illegible]
14:15									7	22	4	2	1	5			1	3		2	1?	21			[illegible]	[illegible]
14:30									5	29		2		4				3		2	2	16			8	[illegible]
14:45									5	30	2	2	1	2			1	3		2	6	16			17	[illegible]
15:00									4?	29?		4		2			1	3		2	2	14			7	[illegible]
15:15									5	[illegible]		2	1	2				2		2	8	15?			14	[illegible]
15:30									5	20	3?	2		2			1	3		1	8	24			16?	[illegible]
15:45									5	20	3?	2	3	3			2	4		1	8	28			20	[illegible]
16:00									7	33		2		4				2	2	3	10	30			18?	[illegible]
16:15									2?	12		2	1	4				4		2	[illegible]	45?			5	[illegible]
16:30									7	28		1	1	5			2	2		2	5	24?			17	[illegible]
16:45									4	33	1	1	1	3			5?	3		3	[illegible]	[illegible]			12	[illegible]
17:00									3?	17		1	2?	4				4		1	[illegible]	13?			15?	[illegible]
17:15									6	20	1	2		3				3	2	3	[illegible]	13?			11?	[illegible]
17:30									6	17	1	3		2			2	3?		3	8	22			17	[illegible]
17:45									4	17		2		1				3		2	8	20			12	[illegible]
18:00									2?	18	1	3		1			1	3		2	2	21			7?	[illegible]
TOTAL	12H		12H		12H		12H		12H	375	12H	94?	12H	27?	12H		12H	35?	12H	26?	12H	251?	12H		12H	865?

STARTING TIMES AND COMBINED PEAK PERIOD VOLUMES FOR STATION

	1 QH	1 H	2 QH	2 H	3 QH	3 H	4 QH	4 H	5 QH	5 H	6 QH	6 H	7 QH	7 H	8 QH	8 H	9 QH	9 H	10 QH	10 H	11 QH	11 H	12 QH	12 H	TOTALS QH	TOTALS H
AM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VOL									[illegible]	[illegible]		2						3		4	[illegible]	[illegible]			[illegible]	[illegible]
MID	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VOL									[illegible]	[illegible]	4	9		2				[illegible]		3	[illegible]	[illegible]			[illegible]	[illegible]
PM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VOL									7	[illegible]		2					2	2		4	[illegible]	[illegible]			[illegible]	[illegible]

PREPARED BY TRAFFICWAYS (PTY) LTD

KEY: QH - QUARTER HOURLY VOLUMES

TRAFFIC SURVEY: MANUAL COUNTS - BRONKHORSTSPRUIT

TRAFSTRANS

LOCATION: [illegible]
STATION NR: 1
DATE OF SURVEY: [illegible]

TYPE OF SURVEY: 12H TURNING MOVEMENTS
TYPE OF VEHICLE: HEAVY

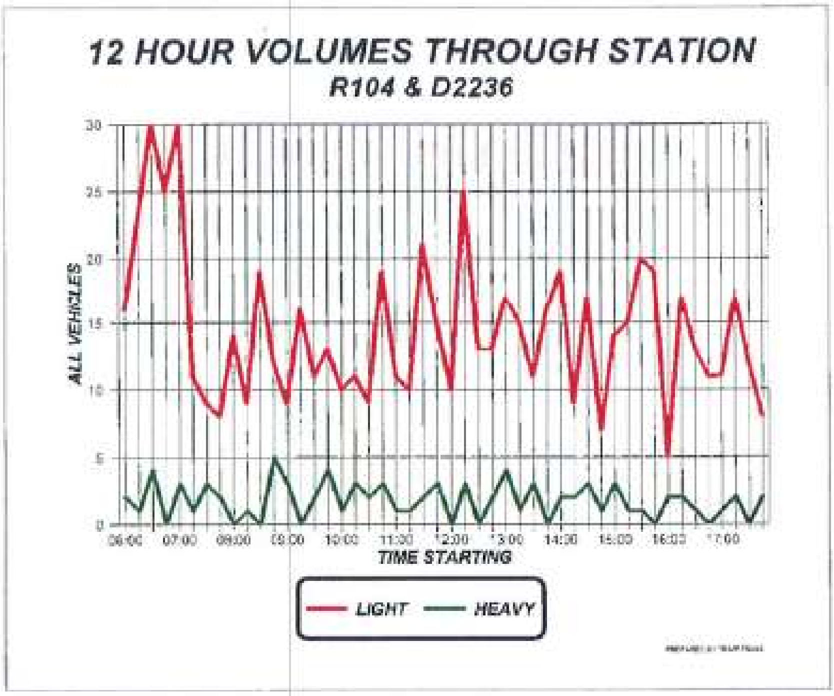
End Time	1 QH	1 H	2 QH	2 H	3 QH	3 H	4 QH	4 H	5 QH	5 H	6 QH	6 H	7 QH	7 H	8 QH	8 H	9 QH	9 H	10 QH	10 H	11 QH	11 H	12 QH	12 H	TOTALS QH	TOTALS H
06:15																									2	
06:30									1																	
06:45									2												2				4	
07:00										3												2				
07:15									1	1												2			3	6
07:30									1									1				3			1	3
07:45									1	2								1			3	3			1	
08:00									1	4								1	1	1		2				5
08:15										3										1						5
08:30									1	4										1		2			1	5
08:45										2																
09:00										1							1	1			2	5			5	5
09:15										1								1			3	7			3	1
09:30																		1				3				3
09:45									1	1								1				4			2	3
10:00									1	2								1			2	6			4	5
10:15									1	4												5			1	
10:30									1	4									1	1	1	4			3	7
10:45									1	4										1		3			3	7
11:00									2	5										1		1			3	3
11:15									1	5										1		1			1	3
11:30										4															1	2
11:45										3											2	2			2	
12:00									2	3												3			3	3
12:15										2			1									2				
12:30									2	4												3			3	
12:45										3			1													
13:00									1	3			1						1	1					3	
13:15									1	3										1	1				2	3
13:30										4										1	1	2				
13:45									3	7										1		2			3	10
14:00																						2				
14:15										4											1	2			2	5
14:30									1	3											1	3			3	3
14:45									2	1												1			2	2
15:00										4											2	3			3	5
15:15										3			3							2	1				3	
15:30												1								2		3			3	2
15:45																					1	3			1	2
16:00																						3				3
16:15									2	1							1	1				1			2	4
16:30									1	1								1			1	2			2	
16:45										2								2				1			1	2
17:00										3								2				3				3
17:15																		1			2	3			1	3
17:30									3	1								1			1	2			2	4
17:45										1												2			1	2
18:00									1		2	2				1						2			2	5
TOTAL	12H		12H		12H		12H		12H	34	12H	5	12H	2	12H		12H	7	12H	5	12H	35	12H		12H	83

STARTING TIMES AND COMBINED PEAK PERIOD VOLUMES FOR STATION

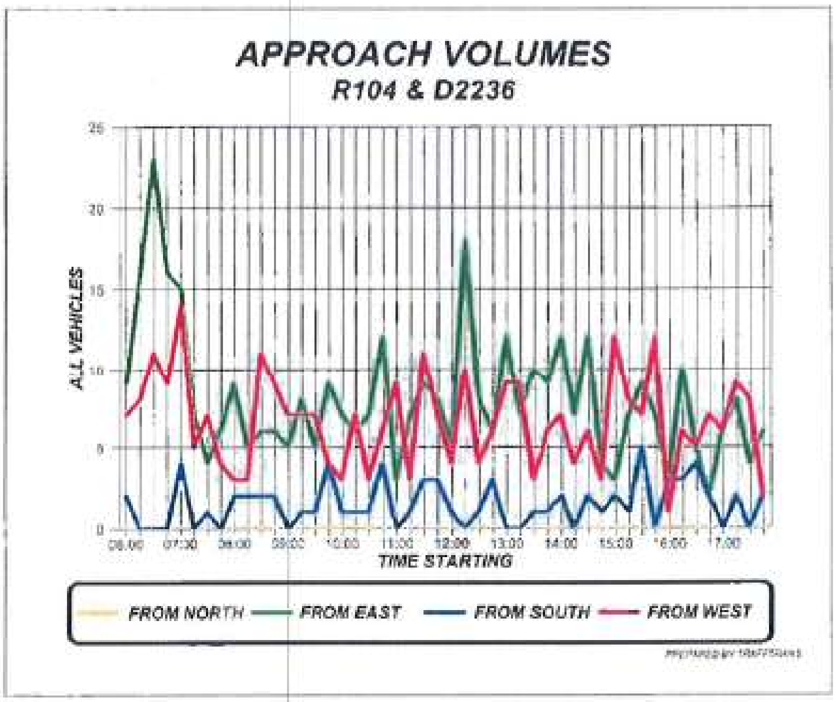
	1 QH	1 H	2 QH	2 H	3 QH	3 H	4 QH	4 H	5 QH	5 H	6 QH	6 H	7 QH	7 H	8 QH	8 H	9 QH	9 H	10 QH	10 H	11 QH	11 H	12 QH	12 H	TOTALS QH	TOTALS H
AM	[illegible]																									
VOL	[illegible]																									
MID	[illegible]																									
VOL	[illegible]																									
PM	[illegible]																									
VOL	[illegible]																									

[illegible] (PTY) LTD

KEY QH - QUARTER HOURLY VOLUMES


12 HOUR VOLUMES THROUGH STATION
R104 & D2236
ALL VEHICLES
0
5
10
15
20
25
30
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
TIME STARTING
LIGHT
HEAVY

STATION 1


APPROACH VOLUMES
R104 & D2236
ALL VEHICLES
0
5
10
15
20
25
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
TIME STARTING
FROM NORTH
FROM EAST
FROM SOUTH
FROM WEST

N4

CO-ORDINATES

LATITUDE : 25° 51' 06.4" S
LONGITUDE: 28° 51' 54.8" E

LOCATION:	ROAD LINK: N4 EAST OF D2236 INTERCHANGE
AREA:	BNKHORSTSPRUIT — STATION NUMBER: 2
DATE:	22/09/2009 — DAY: TUESDAY — TIME: 06:00 to 18:00
TYPE OF COUNT:	CLASSIFIED COUNTS PER TURNING MOVEMENT
DESCRIPTION:	CLASSIFICATION: LIGHT AND HEAVY VEHICLES

STATION LAYOUT

R104 - EAST OF BRONKHORSTSPRUIT

PROJ. T2009/068

DATE Sept 2009

TRAFFTRANS (EDMS) BPK

SUMMARY OF TRAFFIC COUNTS

TRAFFTRANS

STATION: 2
LOCATION: N4: West of D2236

LAT: 25° 51' 06.4" S
LONG: 28° 51' 54.8" E

DATE: 22/09/2009
Tuesday

MOVEMENT		AM PEAK HOUR					PM PEAK HOUR					12 HOUR COUNT			
FROM	NO	LIGHT VOL	HEAVY VOL		TOTAL VOL	PHF	LIGHT VOL	HEAVY VOL		TOTAL VOL	PHF	LIGHT VOL	HEAVY VOL		TOTAL VOL
NORTH	1														
	2					n.a.					n.a.				
	3														
EAST	4														
	5	354	38	10%	392	0.93	584	49	8%	633	0.93	5123	559	10%	5682
	6														
SOUTH	7														
	8					n.a.					n.a.				
	9														
WEST	10														
	11	554	59	10%	613	0.94	404	42	9%	446	0.88	4859	587	11%	5446
	12														
TOTAL		**908**	**97**	**10%**	**1005**	**0.93**	**988**	**91**	**8%**	**1079**	**0.95**	**9982**	**1146**	**10%**	**11128**
		PERCENTAGE OF:	12H		9.0%		*PERCENTAGE OF:*	12H		9.7%					

	AM	MID	PM
STARTING TIME OF PEAK HOUR	07:15	12:15	16:00

PREPARED BY TRAFFTRANS (PTY) LTD

TRAFFIC SURVEY: MANUAL COUNTS - BRONKHORSTSPRUIT

TRAFFTRANS

LOCATION: N4: West of D2235
STATION NR : 2
DATE OF SURVEY : 22/09/2009

TYPE OF SURVEY: 12H TURNING MOVEMENTS
TYPE OF VEHICLE: ALL

End	MOVEMENTS 1		2		3		4		5		6		7		8		9		10		11		12		TOTALS	
Time	QH	H	QH	H	QH	H	QH	H	QH	H	QH	H	QH	H	QH	H	QH	H	QH	H	QH	H	QH	H	QH	H
06:15									25												84				79	
06:30									47												78				125	
06:45									74												111				185	
07:00									107	393											147	390			254	843
07:15									92	320											161	497			253	817
07:30									88	361											144	563			232	924
07:45									87	374											165	617			252	991
08:00									98	365											152	622			250	987
08:15									119	392											152	613			271	1005
08:30									87	391											115	584			202	975
08:45									98	402											163	583			261	984
09:00									106	410											122	552			228	962
09:15									104	395											117	517			221	912
09:30									118	426											126	528			244	954
09:45									92	420											128	493			220	913
10:00									97	411											115	486			212	897
10:15									120	427											102	471			222	898
10:30									98	405											96	443			194	848
10:45									100	413											96	413			196	826
11:00									97	413											97	395			194	808
11:15									99	397											105	393			204	790
11:30									103	399											136	436			239	835
11:45									106	405											101	439			207	844
12:00									103	411											100	442			203	853
12:15									133	440											97	434			230	875
12:30									141	483											95	393			236	876
12:45									135	512											101	393			236	905
13:00									140	549											124	417			264	966
13:15									155	571											144	464			299	1035
13:30									129	559											88	457			217	1016
13:45									130	554											113	469			243	1023
14:00									106	520											103	448			209	968
14:15									123	488											102	406			225	894
14:30									130	497											109	427			247	924
14:45									142	500											109	423			251	932
15:00									123	528											92	412			215	938
15:15									147	550											96	406			243	956
15:30									111	523											133	430			244	953
15:45									136	518											119	440			254	956
16:00									157	550											111	459			268	1009
16:15									141	564											126	489			267	1053
16:30									167	600											112	468			279	1068
16:45									154	619											98	445			250	1064
17:00									171	633											112	446			283	1079
17:15									169	661											88	408			257	1069
17:30									156	650											95	391			251	1041
17:45									177	673											105	400			282	1073
18:00									139	641											89	377			228	1018
TOTAL	12H		12H		12H		12H		12H	5682	12H		12H		12H		12H		12H		12H	5446	12H		12H	11128

STARTING TIMES AND COMBINED PEAK PERIOD VOLUME FOR STATION

	1		2		3		4		5		6		7		8		9		10		11		12		TOTALS	
	QH	H	QH	H	QH	H	QH	H	QH	H	QH	H	QH	H	QH	H	QH	H	QH	H	QH	H	QH	H	QH	H
AM	08:00	07:15	08:00	07:15	08:00	07:15	08:00	07:15	08:00	07:15	08:00	07:15	08:00	07:15	08:00	07:15	08:00	07:15	08:00	07:15	08:00	07:15	08:00	07:15	08:00	07:15
Vol									119	392											152	613			271	1005
MID	13:00	12:15	13:00	12:15	13:00	12:15	13:00	12:15	13:00	12:15	13:00	12:15	13:00	12:15	13:00	12:15	13:00	12:15	13:00	12:15	13:00	12:15	13:00	12:15	13:00	12:15
Vol									155	571											144	464			299	1035
PM	16:45	16:00	16:45	16:00	16:45	16:00	16:45	16:00	16:45	16:00	16:45	16:00	16:45	16:00	16:45	16:00	16:45	16:00	16:45	16:00	16:45	16:00	16:45	16:00	16:45	16:00
Vol									171	633											112	446			283	1079

PREPARED BY TRAFFTRANS (PTY) LTD

KEY QH - QUARTER HOURLY VOLUMES

TRAFFIC SURVEY: MANUAL COUNTS - BRONKHORSTSPRUIT

TRAFFTRANS

LOCATION: N4: West of D2236
STATION NO : 2
DATE OF SURVEY : 22/09/2009

TYPE OF SURVEY: 12H TURNING MOVEMENTS
TYPE OF VEHICLE: LIGHT

End Time	1 QH	1 H	2 QH	2 H	3 QH	3 H	4 QH	4 H	5 QH	5 H	6 QH	6 H	7 QH	7 H	8 QH	8 H	9 QH	9 H	10 QH	10 H	11 QH	11 H	12 QH	12 H	TOTALS QH	TOTALS H
06:15									21												48				69	
06:30									43												72				115	
06:45									67												103				170	
07:00									98	229											136	359			234	588
07:15									81	289											151	462			232	751
07:30									78	324											129	519			207	843
07:45									80	337											165	571			235	908
08:00									88	327											130	565			218	892
08:15									108	354											140	554			248	908
08:30									77	353											100	528			177	878
08:45									85	356											143	513			228	871
09:00									95	365											111	494			206	859
09:15									100	357											100	454			200	811
09:30									108	388											110	464			218	852
09:45									85	388											120	441			205	829
10:00									89	382											104	434			193	816
10:15									112	394											87	421			199	815
10:30									86	372											83	394			169	766
10:45									89	376											85	359			174	735
11:00									90	377											82	337			172	714
11:15									95	360											90	340			185	700
11:30									85	359											127	384			212	743
11:45									99	369											87	386			186	755
12:00									96	375											84	388			180	763
12:15									117	397											82	380			199	777
12:30									130	442											79	332			209	774
12:45									117	460											90	335			207	795
13:00									127	491											110	361			237	852
13:15									142	516											124	403			266	919
13:30									117	503											76	400			193	903
13:45									118	504											96	406			216	912
14:00									95	473											93	391			188	864
14:15									111	442											92	359			203	801
14:30									124	449											101	384			225	833
14:45									128	459											100	386			228	845
15:00									107	470											82	375			189	845
15:15									127	486											87	370			214	856
15:30									92	454											118	367			210	841
15:45									115	441											104	391			219	832
16:00									138	472											104	413			242	885
16:15									128	473											114	440			242	913
16:30									153	534											101	423			254	957
16:45									142	561											88	407			230	968
17:00									161	584											101	404			262	988
17:15									145	606											82	372			231	977
17:30									143	595											88	359			231	954
17:45									163	616											95	366			258	982
18:00									123	578											73	338			196	916
TOTAL	12H		12H		12H		12H		12H	5123	12H		12H		12H		12H		12H		12H	4859	12H		12H	9982

STARTING TIMES AND COMBINED PEAK PERIOD VOLUME FOR STATION

	1 QH	1 H	2 QH	2 H	3 QH	3 H	4 QH	4 H	5 QH	5 H	6 QH	6 H	7 QH	7 H	8 QH	8 H	9 QH	9 H	10 QH	10 H	11 QH	11 H	12 QH	12 H	TOTALS QH	TOTALS H
AM	08:00	06:45	08:00	06:45	08:00	06:45	08:00	06:45	08:00	06:45	08:00	06:45	08:00	06:45	08:00	06:45	08:00	06:45	08:00	06:45	08:00	06:45	08:00	06:45	08:00	06:45
Vol									108	337											140	571			248	908
MID	13:00	12:15	13:00	12:15	13:00	12:15	13:00	12:15	13:00	12:15	13:00	12:15	13:00	12:15	13:00	12:15	13:00	12:15	13:00	12:15	13:00	12:15	13:00	12:15	13:00	12:15
Vol									142	516											124	403			266	919
PM	16:45	16:00	16:45	16:00	16:45	16:00	16:45	16:00	16:45	16:00	16:45	16:00	16:45	16:00	16:45	16:00	16:45	16:00	16:45	16:00	16:45	16:00	16:45	16:00	16:45	16:00
Vol									161	584											101	404			262	988

PREPARED BY TRAFFTRANS (PTY) LTD

KEY: QH - QUARTER HOURLY VOLUMES

TRAFFIC SURVEY: MANUAL COUNTS - BRONKHORSTSPRUIT

LOCATION: [illegible] D2255
STATION NR.: 2
DATE OF SURVEY: 22/09/2009

TYPE OF SURVEY: 12H TURNING MOVEMENTS
TYPE OF VEHICLE: HEAVY

MOVEMENTS

End Time	1 QH	1 H	2 QH	2 H	3 QH	3 H	4 QH	4 H	5 QH	5 H	6 QH	6 H	7 QH	7 H	8 QH	8 H	9 QH	9 H	10 QH	10 H	11 QH	11 H	12 QH	12 H	TOTALS QH	TOTALS H
06:15									[illegible]												0				10	
06:30									[illegible]												0				10	
06:45									1												1				15	
07:00									6	26											16	31			22	[illegible]
07:15									11	31											10	38			21	[illegible]
07:30									10	37											16	44			26	[illegible]
07:45									7	37											10	40			17	[illegible]
08:00									10	30											22	57			32	[illegible]
08:15									11	38											12	56			23	[illegible]
08:30									13	38											16	56			29	[illegible]
08:45									13	44											20	65			33	[illegible]
09:00									11	40											11	56			22	[illegible]
09:15									[illegible]	36											17	63			21	[illegible]
09:30									16	36											18	64			26	[illegible]
09:45									7	25											9	52			16	[illegible]
10:00									5	20											11	57			19	[illegible]
10:15									8	70											15	45			23	[illegible]
10:30									16	25											16	49			36	[illegible]
10:45									[illegible]	27											13	54			24	[illegible]
11:00									3	30											13	20			22	[illegible]
11:15									4	22											15	36			19	[illegible]
11:30									18	40											3	57			27	[illegible]
11:45									5	36											14	53			21	[illegible]
12:00									7	36											16	54			23	[illegible]
12:15									15	48											16	64			31	[illegible]
12:30									[illegible]	41											16	61			27	[illegible]
12:45									18	52											[illegible]	56			36	[illegible]
13:00									13	66											12	56			[illegible]	[illegible]
13:15									[illegible]	[illegible]											23	61			33	[illegible]
13:30									14	56											13	57			24	[illegible]
13:45									13	50											15	6			27	[illegible]
14:00									13	47											10	57			26	[illegible]
14:15									12	46											10	47			25	[illegible]
14:30									15	40											8	40			23	[illegible]
14:45									14	50											9	37			[illegible]	[illegible]
15:00									16	56											10	37			26	[illegible]
15:15									20	64											9	36			29	[illegible]
15:30									15	69											5	40			34	[illegible]
15:45									30	75											5	49			35	[illegible]
16:00									14	76											7	40			20	[illegible]
16:15									13	71											12	45			25	[illegible]
16:30									14	66											11	45			[illegible]	[illegible]
16:45									12	50											10	36			20	[illegible]
17:00									12	49											11	43			21	[illegible]
17:15									26	56											6	32			26	[illegible]
17:30									13	25											7	32			20	[illegible]
17:45									14	52											10	34			24	[illegible]
18:00									16	60											16	39			32	[illegible]
TOTAL	12H		12H		12H		12H		12H	543	12H		12H		12H		12H		12H		12H	587	12H		12H	1346

STARTING TIMES AND COMBINED PEAK PERIOD VOLUME FOR STATION

	1 QH	1 H	2 QH	2 H	3 QH	3 H	4 QH	4 H	5 QH	5 H	6 QH	6 H	7 QH	7 H	8 QH	8 H	9 QH	9 H	10 QH	10 H	11 QH	11 H	12 QH	12 H	TOTALS QH	TOTALS H
AM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Vol									15	44											26	63			[illegible]	[illegible]
MID	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Vol									[illegible]	[illegible]											[illegible]	[illegible]			[illegible]	[illegible]
PM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Vol									[illegible]	[illegible]											[illegible]	[illegible]			[illegible]	[illegible]

PREPARED BY TRAFFTRANS (PTY) LTD

KEY QH: QUARTER HOURLY VOLUMES

N004

TRAFFIC HIGHLIGHTS OF SITE 1025

1.1	Site Identifier			1025
1.2	Site Name			Wilgerivier I/C
1.3	Site Description			Western side of Wilgerivier I/C
1.4	Road Description	Route : N004	Road : N004 Section : 02	Distance : 45.7km
1.5	GPS Position			28.85408E 25.84778S
1.6	Number of Lanes			6
1.7	Station Type			Secondary
1.8	Requested Period			2004/01/01 - 2004/12/31
1.9	Length of record requested (hours)			8784
1.10	Actual First & Last Dates			2004/11/17 - 2004/11/26
1.11	Actual available data (hours)			216
1.12	Percentage data available for requested period			2.5
2.1	Total number of vehicles	51262	50369	101631
2.2	Average daily traffic (ADT)	5691	5592	11284
2.3	Average daily truck traffic (ADTT)	687	645	1332
2.4	Percentage of trucks	12.1	11.5	11.8
2.5	Truck split % (short:medium:long)	29 : 38 : 33	34 : 37 : 29	32 : 37 : 31
2.6	Percentage of night traffic (20:00 - 06:00)	11.6	9.6	10.6
3.1	Speed limit (km/hr)			120.0
3.2	Average speed (km/hr)	115.7	111.9	113.8
3.3	Average speed - light vehicles (km/hr)	119.1	116.2	117.7
3.4	Average speed - heavy vehicles (km/hr)	91.1	78.1	84.0
3.5	Average night speed (km/hr)	115.7	107.1	111.6
3.6	15th centile speed (km/hr)	95.8	89.0	91.0
3.7	85th centile speed (km/hr)	130.0	127.0	130.0
3.8	Percentage vehicles in excess of speed limit	41.5	35.6	38.6
4.1	Percentage vehicles in flows over 600 vehicles/hr			76.7
4.2	Highest volume on the road (vehicles/hr)		2004/11/19 15:00:00	1342
4.3	Highest volume in the East (vehs/hr)		2004/11/19 16:00:00	725
4.4	Highest volume in the West (vehs/hr)		2004/11/21 18:00:00	693
4.5	Highest volume in a lane (vehicles/hr)		2004/11/21 18:00:00	458
4.6	15th highest volume on the road (vehicles/hr)		2004/11/18 16:00:00	899
4.7	15th highest volume in the East direction (vehs/hr)		2004/11/26 12:00:00	468
4.8	15th highest volume in the West direction (vehs/hr)		2004/11/24 17:00:00	489
4.9	30th highest volume on the road (vehicles/hr)		2004/11/24 17:00:00	824
4.10	30th highest volume in the East direction (vehs/hr)		2004/11/22 09:00:00	419
4.11	30th highest volume in the West direction (vehs/hr)		2004/11/22 17:00:00	437
5.1	Percentage of vehicles less than 2s behind vehicle ahead	6.7	7.5	7.1
6.1	Total number of heavy vehicles	6196	5810	12006
6.2	Estimated average number of axles per truck			4
6.3	Estimated truck mass (Ton/truck)			22
6.4	Estimated average E80/truck			2
6.5	Estimated daily E80 on the road			2587
6.6	Estimated daily E80 in the East direction			1381
6.7	Estimated daily E80 in the West direction			1206
6.8	Estimated daily E80 in the worst East lane			1341
6.9	Estimated daily E80 in the worst West lane			1161
6.10	ASSUMPTION on Axles/Truck (Short:Medium:Long)			(2.2 : 4.3 : 6.5)
6.11	ASSUMPTION on Mass/Truck (Short:Medium:Long)			(7.9 : 22.1 : 37.3)
6.12	ASSUMPTION on E80s/Truck (Short:Medium:Long)			(0.5 : 1.9 : 3.5)

2004 - 2367

Appendix F Sample SIDRA Output

SIDRA INTERSECTION

Movement Summary

R104 and D2236

am peak hour

Two-way stop

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
D2236										
1	L	12	33.3	0.020	13.5	LOS B	1	0.25	0.87	46.0
3	R	4	0.0	0.020	11.4	LOS B	1	0.25	0.89	46.1
Approach		**16**	**25.0**	**0.020**	**13.0**	**LOS B**	**1**	**0.25**	**0.87**	**46.0**
R104(E)										
4	L	3	0.0	0.058	8.2	LOS A	0	0.00	0.67	49.0
5	T	97	6.2	0.058	0.0	LOS A	0	0.00	0.00	60.0
Approach		**100**	**6.0**	**0.058**	**0.2**	**LOS A**		**0.00**	**0.02**	**59.6**
R104(W)										
11	T	50	8.0	0.032	0.4	LOS A	2	0.21	0.00	57.1
12	R	3	0.0	0.032	8.7	LOS A	2	0.21	0.53	47.8
Approach		**53**	**7.5**	**0.032**	**0.8**	**LOS A**	**2**	**0.21**	**0.04**	**56.5**
All Vehicles		**169**	**6.3**	**0.058**	**1.6**	**Not Applicable**	**2**	**0.09**	**0.11**	**57.0**

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: R104 and D2236 am peak hour

Processed Sep 23, 2009 01:43:58PM

B0005, WSP SA Civil & Structural Engineers (Pty) Ltd, Large Office
Produced by SIDRA Intersection 3.2.0.1455
Copyright 2000-2007 Akcelik and Associates Pty Ltd

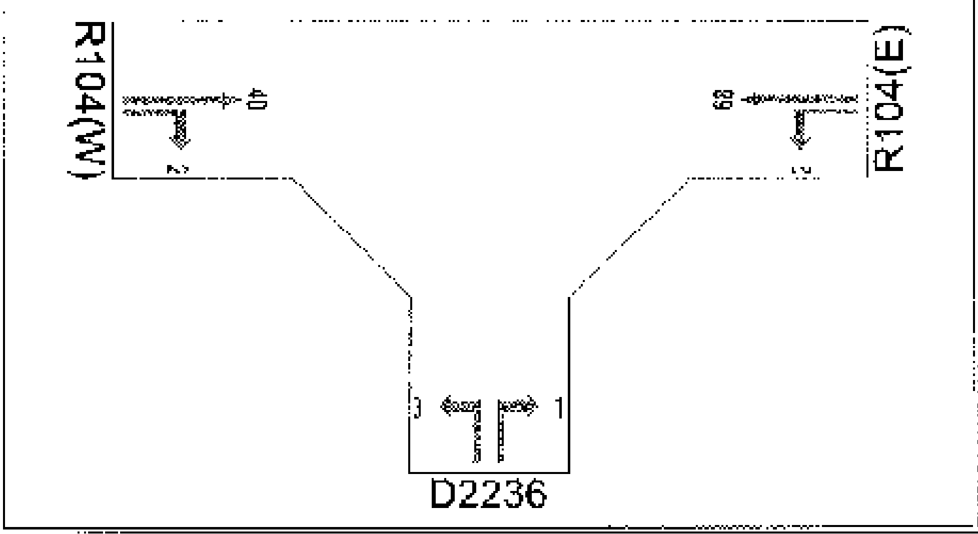
SIDRA INTERSECTION

Input Volumes

Total flow rates as given by the user (veh/60 min)

R104 and D2236

am peak hour



Intersection Type

Two-way stop

No color code in this display

SIDRA SOLUTIONS

Site: R104 and D2236 am peak hour

Processed Sep 23, 2009 01:43:58PM

B0005, WSP SA Civil & Structural Engineers (Pty) Ltd, Large Office
Produced by SIDRA Intersection 3.2.0.1455
Copyright 2000-2007 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

SIDRA INTERSECTION

Movement Summary

R104 and D2236

pm peak hour

Two-way stop

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
D2236										
1	L	8	0.0	0.024	11.3	LOS B	1	0.16	0.89	46.1
3	R	13	16.7	0.024	12.3	LOS B	1	0.16	0.91	46.2
Approach		**20**	**10.0**	**0.024**	**11.9**	**LOS B**	**1**	**0.16**	**0.90**	**46.1**
R104(E)										
4	L	4	25.0	0.021	9.4	LOS A	0	0.00	0.67	49.0
5	T	32	6.2	0.021	0.0	LOS A	0	0.00	0.00	60.0
Approach		**36**	**8.3**	**0.021**	**1.0**	**LOS A**		**0.00**	**0.07**	**58.5**
R104(W)										
11	T	43	6.8	0.030	0.2	LOS A	2	0.13	0.00	58.2
12	R	5	20.0	0.030	9.5	LOS A	2	0.13	0.64	48.2
Approach		**49**	**8.2**	**0.030**	**1.1**	**LOS A**	**2**	**0.13**	**0.07**	**57.0**
All Vehicles		**105**	**8.6**	**0.030**	**3.1**	**Not Applicable**	**2**	**0.09**	**0.23**	**55.0**

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: R104 and D2236 pm peak hour

Processed Sep 23, 2009 01:48:08PM

A0005, WSP SA Civil & Structural Engineers (Pty) Ltd, Large Office
Produced by SIDRA Intersection 3.2.0.1455
Copyright 2000-2007 Akcelik and Associates Pty Ltd

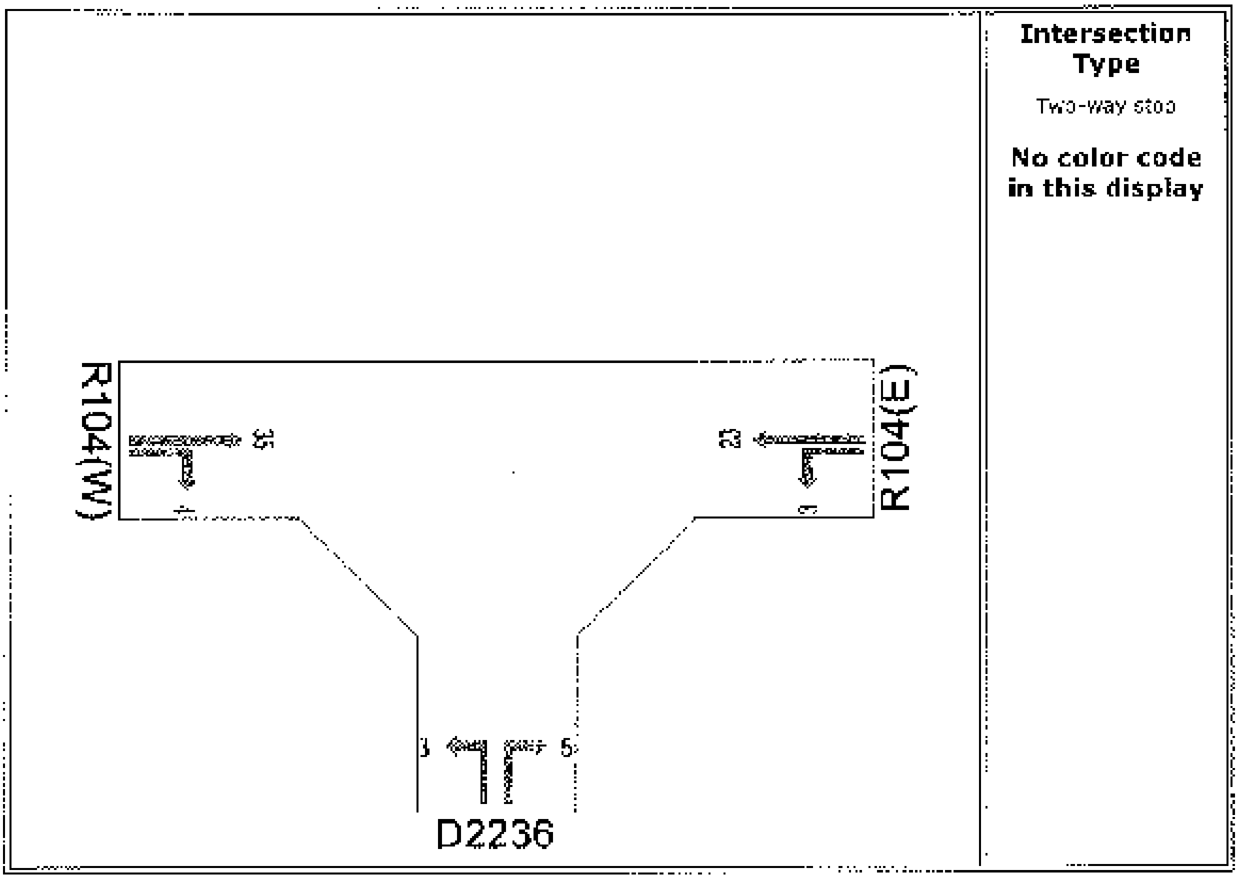
SIDRA INTERSECTION

Input Volumes

Total flow rates as given by the user (veh/60 min)

R104 and D2236

pm peak hour



SIDRA SOLUTIONS

Site: R104 and D2236 pm peak hour

Processed Sep 23, 2009 01:48:08PM

A3005, WSP SA Civil & Structural Engineers (Pty) Ltd, Large Office
Produced by SIDRA Intersection 3.2.0.1455
Copyright 2000-2007 Akcelik and Associates Pty Ltd
www.sidrasolutions.com