

- Initial peak traffic at 39 light and 1 heavy (3% of total traffic) vehicles per hour travelling at 75 km/h (average); and
- Future peak traffic at 53 light and 1 heavy (3% of total traffic) vehicles per hour travelling at 75 km/h (average).
- No screening effect of boundary walls was assessed. It must be noted that most dwellings did have a single/double brick wall surrounding the dwelling/community which will reduce the noise levels at locations where the line of sight is broken by this barrier;
- Topography was not considered;
- No façade corrections was assessed;
- Road texture considered as a bituminous paved surface with a good porosity and/or texture depth (see **Section 4.2.1.5** and **Section 4.2.1.6**);
- The noise rating levels will be on the outside of the building, as the noise levels inside structures will be attenuated with 10 – 30 dB, depending on the construction of the building as well as the number of open windows.



Figure 7-1: Assessed scenario, worst-case scenario

8 MODELLING RESULTS AND IMPACT ASSESSMENT

8.1 MODELLED CONSTRUCTION/OPERATIONAL SCENARIO – WORST-CASE REPRESENTATION: INITIAL AND FUTURE PEAK NOISE CLIMATES

This impact assessment is quite precautionous and is a worst-case representation of potential maximum equivalent (average) noise climate ($L_{\text{Req},1 \text{ h}}$) the receptors could be exposed to at some time.

Measured $L_{\text{Aeq},16/8 \text{ hr (I)}}$ and $L_{\text{Aeq},14/6 \text{ hr (F)}}$ values as well as the Rating Level will be compared to the calculated $L_{\text{Req},T}$ value to estimate the potential noise impact during the various stages. This will help identify any potential noise concerns, impacts (according to legislation and/or guidelines) or requirements for further investigations (refinement of model coefficients, corrections etc.).

Measured $L_{\text{Aeq},16/8 \text{ hr (I)}}$ and $L_{\text{Aeq},14/6 \text{ hr (F)}}$ may be an overestimation for NSD01 and NSD02 as the road traffic may be reduced down this section of route. The probability scale will consider this for these receptors.

8.1.1 Construction Phase

Figure 8-1 illustrates a worst-case construction noise climate in a linear fashion from noise sources under investigation. The construction phase will be short term, linear graph only represents noise climate at a time when equipment will operate adjacent to a receptor at one stage or time. This may be for only a day or even a few hours only, with $L_{\text{Req},T}$ only reflective of an 1 hour period. Construction activities are also only envisaged during the daytime hours.

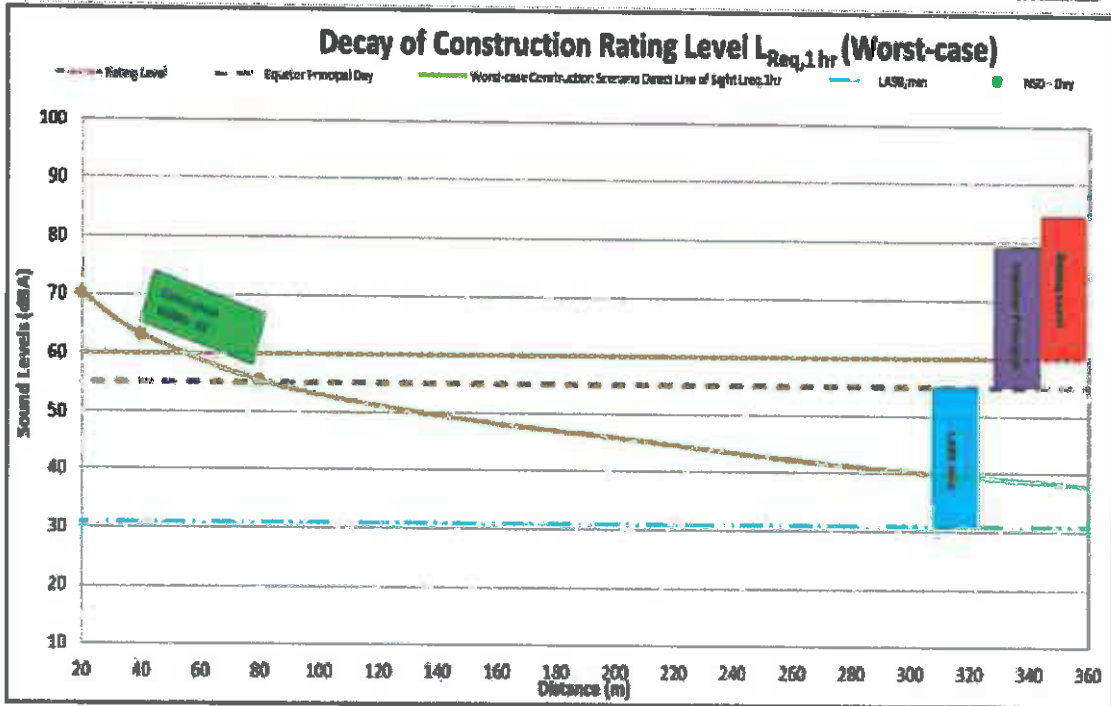


Figure 8-1: Construction noise: Projected construction noise levels as distances increases between NSDs and locations where construction can take place

8.1.2 Operational Phase

Figure 8-2 illustrates the daytime worst-case peak noise climate around the proposed development with **Figure 8-3** illustrating the night-time noise rating levels. This figures Rating Level contours are illustrated from 45 dBA upwards (IFC table night-time Residential - Equator Principle referencing), with contours illustrated in 5 dBA intervals. The mentioned figures indicate the $L_{Req,1h}$ value at a height of approximately 1.5 m above ground level.

Calculated Rating Levels are indicative of the potential noise climate at the outside façade of the dwellings facing the roads. Noise levels inside the dwellings would be lower due to attenuation, which could be anything between 10 and 30 dBA (depending on construction, distance from road and whether there are any openings in the walls). As no boundary wall correction was considered, assessed scenario would be relevant for a single or double storey building.

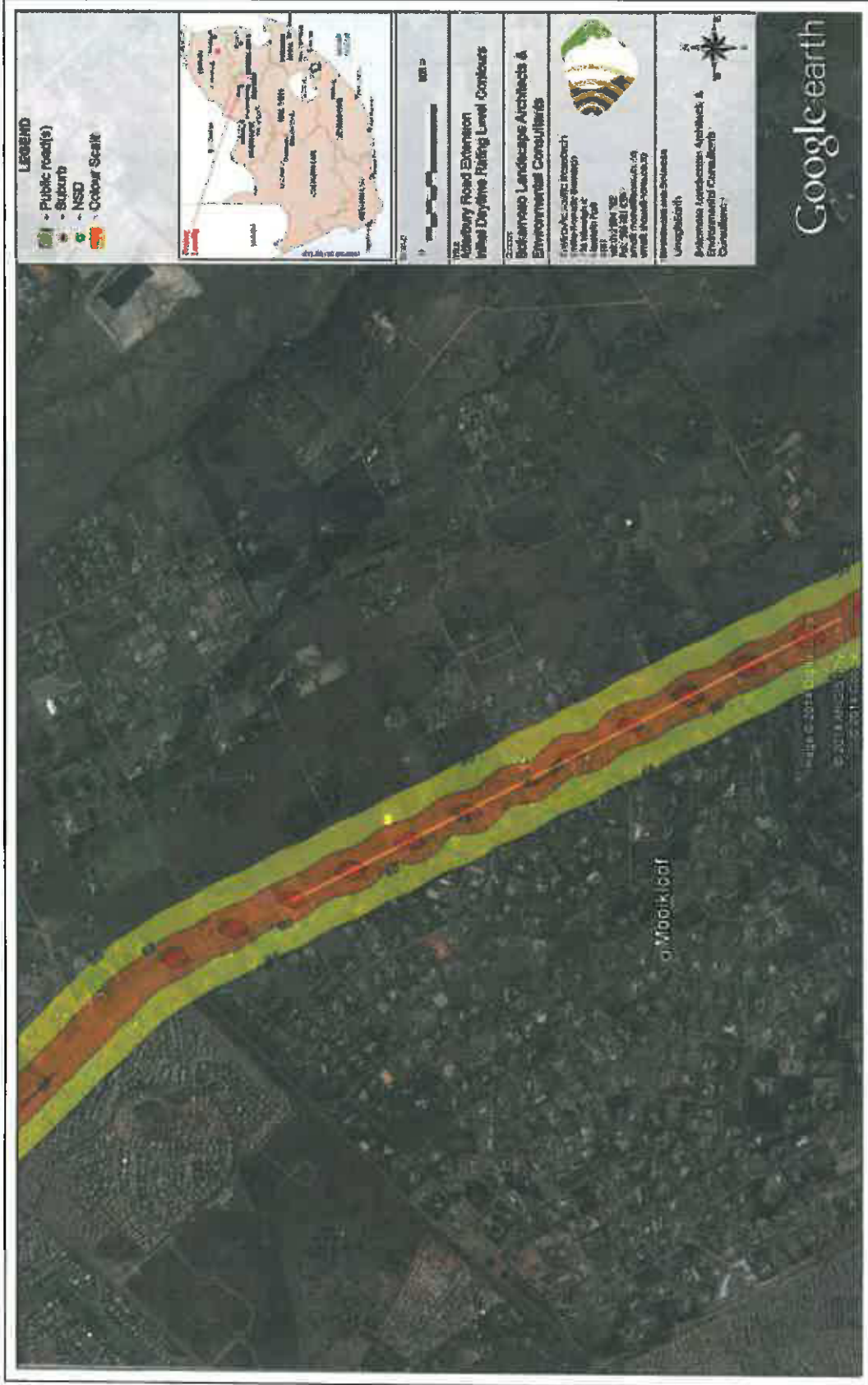


Figure 8-2: Initial projected day-time contours of rating levels

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Figure 8-3: Initial projected night-time+ contours of rating levels

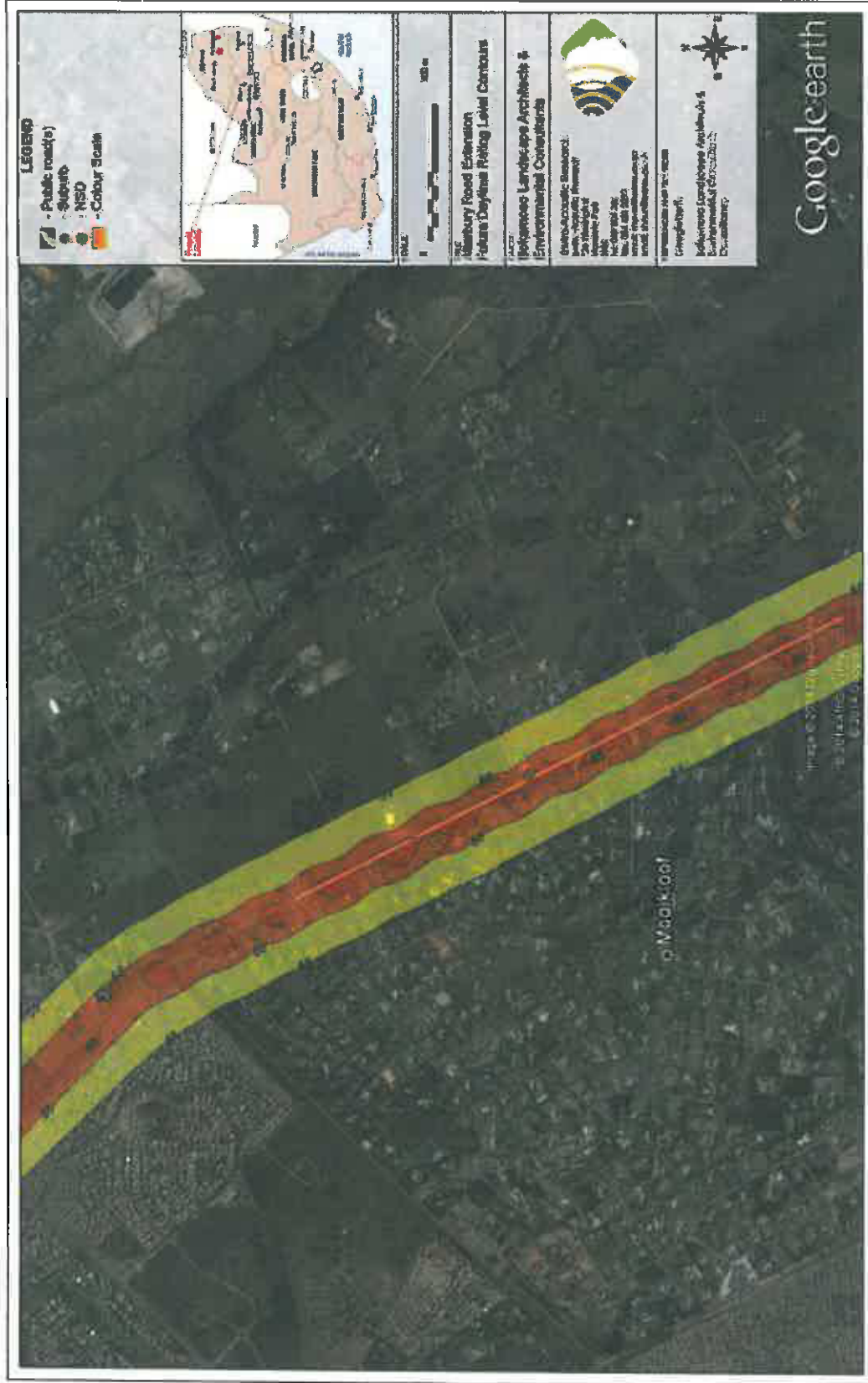


Figure 8-4: Future projected day-time contours of rating levels



Figure 8-5: Future projected night-time+ contours of rating levels

8.2 INITIAL/FUTURE IMPACT ASSESSMENT – RATING LEVELS DUE TO NOISE SOURCE UNDER INVESTIGATION

8.2.1 Construction Phase

The noise impact significance as assessed for conceptual receptors is presented in the tables below. Only the daytime construction scenario will be assessed as construction is envisaged during daylight periods only.

Table 8-1: Modelling results – daytime worst case (also see Table 2-1, Table 5-1, Table 5-7, Table 5-8)

Receptor	Scenario	Estimated Ambient Sound Level (L _{Aeq,16 hr})	Calculated Noise Rating Level (outdoor), Day (L _{Req,1 hr})	Above SANS 10103 Rating Level (outdoor) – 60 dB	Above Equator Principle IFC guideline (outdoor) – 55 dB	Above Noise Control Regulations controlled area	Increase above Ambient Sound Level	Estimated inside noise level day (dBA)	Magnitude of the noise (inside of building, bedroom or education /religious facility)
Conceptual receptors within 40 m	Outdoor, ground floor	60.3	63.2	3.2	8.2	3.2	2.9	43.2	-1.8
Conceptual receptors within 20 m	Outdoor, ground floor	60.3	70.2	10.2	15.2	10.2	9.9	50.2	5.2
NSD03 Evangelies Gereformeerde Kerk	Outdoor, ground floor	60.3	55.4	-4.6	0.4	-4.6	-4.9	35.4	-4.6

Table 8-2: Modelling assessment – daytime worst case (see Table 5-8, Table 5-9, Table 5-10 and Table 5-11 for criteria) – outdoor areas

Defining Significance of Noise Impact (See Section 5)					
Noise-sensitive development	Magnitude (maximum)	Duration	Scale	Probability	Significance
1	8	1	1	3	30
2	10	1	1	3	36
3	2	1	1	3	12

Table 8-3: Impact Assessment: Daytime scenario – worst case

Nature:	Construction that takes place during the daytime hours of (22:00 – 06:00).
Acceptable Rating Level	Daytime Rating Level of 60 dBA – Urban Rating. Use of L _{Req,D} of 60 dBA; and IFC table (Equator Principle) for Residential; institutional and educational. Use of L _{Req,D} of 55 dBA.
Extent	Site (1) – The impacted area extends only as far as the activity, such as footprint occurring within the total site area.
Duration	Short term (1) – Impacts are predicted to be of short duration (portion of construction period) and intermittent/occasional.
Magnitude – (L_{Aeq,D}) > Rating, IFC or Ambient Soundscape	Very High (10) – conceptual NSD’s with dwellings within 20 m: <ul style="list-style-type: none"> • Equivalent calculated rating levels (L_{Aeq,1hr}) will exceed the SANS10103:2008 Rating; • Equivalent calculated rating levels (L_{Aeq,1hr}) will exceed the IFC table (Equator Principle) for Residential areas; and

	<ul style="list-style-type: none"> Equivalent calculated rating levels ($L_{Aeq,1hr}$) will exceed the existing ambient soundscape.
Probability	<p>Likely (3):</p> <ul style="list-style-type: none"> Construction processes are normally temporary to short term in length in comparison to the operational phase; Engagements at receptors dwelling/daily activities may screen noise levels during the daytimes. Certain receptors may be at school, work etc. (e.g. 08:00 – 17:00 working hours); and The potential operations near buildings and facilities where a natural or quiet period is required. E.g. religious, educational and health care and hospitality facilities (game lodges) needs to be considered.
Significance	36 (medium) – for receptors with dwelling facades within 20 m.
Status	Negative.
Reversibility	Not relevant.
Comments	Construction activities are short term.
Can impacts be mitigated?	Yes. Refer to Section 9 .

The tables above identify a noise impact of moderate significance in the area, with the outside noise levels exceeding the ideal urban rating levels (used for residential purposes). This is due to the extent at which construction equipment will operate at one stage or another near a receptors dwelling. $L_{Req,T}$ levels will be short phase as equipment will only operating adjacent to dwellings during certain stages of the construction phase.

8.2.2 Operational Phase – Initial and future

The initial daytime noise impact significance as assessed for conceptual receptors is presented in the Tables below.

Table 8-4: Modelling results – initial daytime peak hours (also see Table 2-1, Table 5-1, Table 5-7, Table 5-8)

Receptor	Scenario	Estimated Ambient Sound Level ($L_{Aeq,20hr}$)	Calculated Noise Rating Level (outdoor), Day ($L_{Aeq,1hr}$)	Above SANS 10103 Rating Level (outdoor) – 60 dB	Above Equator Principle IFC guideline (outdoor) – 55 dB	Above Noise Control Regulation s controlled area	Increase above Ambient Sound Level	Estimated inside noise level day (dBA)	Magnitude of the noise (inside of building, bedroom or education/religious facility)
Conceptual receptors within 40 m	Outdoor, ground floor	60.3	57.9	0	2.9	0	0	37.9	0
Conceptual receptors within 20 m	Outdoor, ground floor	60.3	67.0	7.0	12.0	7.0	6.7	47.0	2.0
NSD03 Evangelies Gereformeerde Kerk	Outdoor, ground floor	60.3	58.5	0	3.5	0	0	38.5	0
	Outdoor, 1 st floor	60.3	59.5	0	4.5	0	0	39.5	0

Table 8-5: Modelling assessment – initial daytime, peak hours (see Table 5-8, Table 5-9, Table 5-10 and Table 5-11 for criteria) – outside areas

Defining Significance of Noise Impact (See Section 5)					
Noise-sensitive development	Magnitude (maximum)	Duration	Scale	Probability	Significance
1	2	4	2	3	24

2	10	4	2	3	48
3	4	4	2	3	30

Table 8-6: Impact Assessment: Initial daytime scenario – peak hours

Nature:	Operational that takes place during the daytime hours of (22:00 – 06:00).
Acceptable Rating Level	Daytime Rating Level of 60 dBA – Urban Rating. Use of L _{Req,D} of 60 dBA; and IFC table (Equator Principle) for Residential; institutional and educational. Use of L _{Req,D} of 55 dBA.
Extent	Local (2) – The impact could affect the local area (within 1,000 m from site).
Duration	Long term (4) – Impacts that will continue for the life of the Project, but ceases when the Project stops operating.
Magnitude -(L_{Req,D}) > Rating, IFC or Ambient Soundscape	Very High (10) –conceptual NSD’s within 20 m from the project: <ul style="list-style-type: none"> • Equivalent calculated rating levels (L_{Aeq,1hr}) will exceed the SANS10103:2008 Rating; • Equivalent calculated rating levels (L_{Aeq,1hr}) will exceed the IFC table (Equator Principle) for Residential areas; • Equivalent calculated rating levels (L_{Aeq,1hr}) will exceed the Noise Control Regulations criteria for a controlled area; and • Equivalent calculated rating levels (L_{Aeq,1hr}) will exceed the existing ambient soundscape.
Probability	Likely (3): <ul style="list-style-type: none"> • Engagements at receptors dwelling/daily activities may screen noise levels during the daytimes. Certain receptors may be at school, work etc. (e.g. 08:00 – 17:00 working hours); and • The potential operations near buildings and facilities where a natural or quiet period is required. E.g. religious, educational and health care and hospitality facilities (game lodges) needs to be considered.
Significance	48 (medium) – receptors with dwelling facades within 20 m
Status	Negative.
Reversibility	Not relevant.
Comments	Construction activities are short term.
Can impacts be mitigated?	Yes. Refer to Section 9 .

Table 8-4 to Table 8-6 identify a noise impact of moderate significance in the area during the daytimes, with the outside noise levels exceeding the ideal urban rating levels (used for residential purposes). It is of importance that the developer considered mitigation measures of receptors within 20 m facades of the road. This would not be applicable to property boundaries within 20 m, but rather the actual dwelling itself where a bedroom or school room (etc.) may be situated. The initial night-time noise impact significance is presented in tables below.

Table 8-7: Modelling results – Initial night-time peak hours (also see Table 2-1, Table 5-1, Table 5-7, Table 5-8)

Receptor	Scenario	Estimated Ambient Sound Level (L _{Aeq,0 hr})	Calculated Noise Rating Level (outdoor), Day (L _{Aeq,1 hr})	Above SANS 10103 Rating Level (outdoor) – 50 dB	Above Equator Principle IFC guideline (outdoor) – 45 dB	Above Noise Control Regulations controlled area	Increase above Ambient Sound Level	Estimated inside noise level day (dBA)	Magnitude of the noise (inside of building, bedroom or education /religious facility)
Conceptual receptors within 40 m	Outdoor, ground floor	51.0	48.2	0	3.2	0	0	28.2	0

Conceptual receptors within 20 m	Outdoor, ground floor	51.0	53.4	3.4	8.4	0	2.4	33.4	0
NSD03 Evangelles Gereformeerde Kerk	Educational and religious facility not applicable during night-times.								

Table 8-8: Modelling assessment – Initial night-time, peak hours (see Table 5-8, Table 5-9, Table 5-10 and Table 5-11 for criteria) – outside areas

Defining Significance of Noise Impact (See Section 5)					
Noise-sensitive development	Magnitude (maximum)	Duration	Scale	Probability	Significance
1	4	4	2	2	20
2	8	4	2	3	42
3	Educational and religious facility not applicable during night-times.				

Table 8-9: Impact Assessment: Initial night-time scenario – peak hours

Nature:	Operational that takes place during the night-time hours of (06:00 – 22:00).
Acceptable Rating Level	Night-time Rating Level of 50 dBA – Urban Rating. Use of $L_{Req,N}$ of 50 dBA; and IFC table (Equator Principle) for Residential; institutional and educational. Use of $L_{Req,D}$ of 45 dBA.
Extent	Local (2) – The impact could affect the local area (within 1,000 m from site).
Duration	Long term (4) – Impacts that will continue for the life of the Project, but ceases when the Project stops operating.
Magnitude $-(L_{Req,N}) > Rating, IFC or Ambient Soundscape$	Very High (10) – conceptual NSD’s within 20 m from the project: <ul style="list-style-type: none"> Equivalent calculated rating levels ($L_{Aeq,1hr}$) will exceed the SANS10103:2008 Rating; Equivalent calculated rating levels ($L_{Aeq,1hr}$) will exceed the IFC table (Equator Principle) for Residential areas; Equivalent calculated rating levels ($L_{Aeq,1hr}$) will exceed the Noise Control Regulations criteria for a controlled area; and Equivalent calculated rating levels ($L_{Aeq,1hr}$) will exceed the existing ambient soundscape.
Probability	Likely (3): <ul style="list-style-type: none"> There is likelihood that single noise events (L_{max}, see Section 2) due to passing vehicles may exceed recommended international guidelines at receptors dwellings. Although currently the measured soundscape indicated many existing L_{max} contributors; Operational activities assessed (night-time) is during a period when a receptor may require rest (night-times).
Significance	42 (medium) – receptors with dwelling facades within 20 m.
Status	Negative.
Reversibility	Not relevant.
Comments	Construction activities are short term.
Can impacts be mitigated?	Yes. Refer to Section 9.

Table 8-7 and Table 8-9 identify a noise impact of moderate significance in the area during the night-times. This is only relevant for receptors with facades within 20 m of the 20 m of the road under investigation. The future daytime noise impact significance as assessed for conceptual receptors is presented in the Tables below.

Table 8-10: Modelling results – daytime peak hours (also see Table 2-1, Table 5-1, Table 5-7, Table 5-8)

Receptor	Scenario	Estimated Ambient	Calculated Noise	Above SANS	Above Equator	Above Noise	Increase above	Estimated inside	Magnitude of the
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		Sound Level ($L_{Aeq,16hr}$)	Rating Level (outdoor), Day ($L_{Req,1hr}$)	10103 Rating Level (outdoor) – 60 dB	Principle IFC guideline (outdoor) – 55 dB	Control Regulation s controlled area	Ambient Sound Level	noise level day (dBA)	noise (inside of building, bedroom or education /religious facility)
Conceptual receptors within 40 m	Outdoor, ground floor	60.3	59.0	0	4.0	0	0	39.0	0
Conceptual receptors within 20 m	Outdoor, ground floor	60.3	68.2	8.2	13.2	8.2	7.9	48.2	3.2
NSD03 Evangelles Gereformeerde Kerk	Outdoor, ground floor	60.3	59.7	0	4.7	0	0	39.7	0
	Outdoor, 1 st floor	60.3	60.7	0.7	5.7	0.7	0.4	40.7	0

Table 8-11: Modelling assessment – daytime, peak hours (see Table 5-8, Table 5-9, Table 5-10 and Table 5-11 for criteria) – outside areas

Defining Significance of Noise Impact (See Section 5)					
Noise-sensitive development	Magnitude (maximum)	Duration	Scale	Probability	Significance
1	4	4	2	3	30
2	10	4	2	3	48
3	4	4	2	3	30

Table 8-12: Impact Assessment: Initial daytime scenario – peak hours

Nature:	Future operations that takes place during the daytime hours of (22:00 – 06:00).
Acceptable Rating Level	Daytime Rating Level of 60 dBA – Urban Rating. Use of $L_{Req,D}$ of 60 dBA; and IFC table (Equator Principle) for Residential; institutional and educational. Use of $L_{Req,D}$ of 55 dBA.
Extent	Local (2) – The impact could affect the local area (within 1,000 m from site).
Duration	Long term (4) – Impacts that will continue for the life of the Project, but ceases when the Project stops operating.
Magnitude – ($L_{Req,D}$) > Rating, IFC or Ambient Soundscape	Very High (10) – conceptual NSD’s within 20 m from the project: <ul style="list-style-type: none"> Equivalent calculated rating levels ($L_{Aeq,1hr}$) will exceed the SANS10103:2008 Rating; Equivalent calculated rating levels ($L_{Aeq,1hr}$) will exceed the IFC table (Equator Principle) for Residential areas; and Equivalent calculated rating levels ($L_{Aeq,1hr}$) will exceed the existing ambient soundscape.
Probability	Likely (3): <ul style="list-style-type: none"> Engagements at receptors dwelling/daily activities may screen noise levels during the daytimes. Certain receptors may be at school, work etc. (e.g. 08:00 – 17:00 working hours); and The potential operations near buildings and facilities where a natural or quiet period is required. E.g. religious, educational and health care and hospitality facilities (game lodges) needs to be considered.
Significance	48 (medium) – receptors with dwelling facades within 20 m
Status	Negative.
Reversibility	Not relevant.
Comments	Construction activities are short term.
Can impacts be mitigated?	Yes. Refer to Section 9 .

The assessed future scenario indicates a similar circumstance to the initial scenario, with a noise impact of moderate significance identified in the area during the night-times.

Table 8-13: Modelling results – night-time peak hours (also see Table 2-1, Table 5-1, Table 5-7, Table 5-8)

Receptor	Scenario	Estimated Ambient Sound Level ($L_{Aeq,8hr}$)	Calculated Noise Rating Level (outdoor), Day ($L_{Req,1hr}$)	Above SANS 10103 Rating Level (outdoor) – 50 dB	Above Equator Principle IFC guideline (outdoor) – 45 dB	Above Noise Control Regulations controlled area	Increase above Ambient Sound Level	Estimated inside noise level day (dBA)	Magnitude of the noise (Inside of building, bedroom or education /religious facility)
Conceptual receptors within 40 m	Outdoor, ground floor	51.0	49.3	0	4.3	0	0	29.3	0
Conceptual receptors within 20 m	Outdoor, ground floor	51.0	56.4	6.4	11.4	0	5.4	36.4	0
NSD03 Evangelies Gereformeerde Kerk	Educational and religious facility not applicable during night-times.								

Table 8-14: Modelling assessment – night-time, peak hours (see Table 5-8, Table 5-9, Table 5-10 and Table 5-11 for criteria) – outside areas

Defining Significance of Noise Impact (See Section 5)					
Noise-sensitive development	Magnitude (maximum)	Duration	Scale	Probability	Significance
1	4	4	2	2	20
2	8	4	2	3	42
3	Educational and religious facility not applicable during night-times				

Table 8-15: Impact Assessment: Initial night-time scenario – peak hours

Nature:	Future operations that takes place during the night-time hours of (06:00 – 22:00).
Acceptable Rating Level	Night-time Rating Level of 50 dBA – Urban Rating. Use of $L_{Req,N}$ of 50 dBA; and IFC table (Equator Principle) for Residential; institutional and educational. Use of $L_{Req,D}$ of 45 dBA.
Extent	Local (2) – The impact could affect the local area (within 1,000 m from site).
Duration	Long term (4) – Impacts that will continue for the life of the Project, but ceases when the Project stops operating.
Magnitude $-(L_{Req,N}) > Rating, IFC or Ambient Soundscape$	Very High (10) –conceptual NSD’s within 20 m from the project: <ul style="list-style-type: none"> Equivalent calculated rating levels ($L_{Aeq,1hr}$) will exceed the SANS10103:2008 Rating; Equivalent calculated rating levels ($L_{Aeq,1hr}$) will exceed the IFC table (Equator Principle) for Residential areas; Equivalent calculated rating levels ($L_{Aeq,1hr}$) will exceed the Noise Control Regulations criteria for a controlled area; and Equivalent calculated rating levels ($L_{Aeq,1hr}$) will exceed the existing ambient soundscape.
Probability	Likely (3): <ul style="list-style-type: none"> There is likelihood that single noise events (L_{max}, see Section 2) due to passing vehicles may exceeded recommended international guidelines at receptors dwellings. Although currently the measured soundscape indicated many existing L_{max} contributors; Operational activities assessed (night-time) is during a period when a receptor may require rest (night-times).



Significance	42 (medium) – receptors with dwelling facades within 20 m
Status	Negative.
Reversibility	Not relevant.
Comments	Construction activities are short term.
Can impacts be mitigated?	Yes. Refer to Section 9 .

9 POTENTIAL MITIGATION OPTIONS

If the Atterbury Road is to be implemented within 20 m of a property façade (building) mitigation options should be considered by the developer. Mitigation options listed for further consideration include management and technical changes.

9.1 PRE-PLANNING STAGE

9.1.1 Road design & specifications

Mitigation options in this sections focuses on potential technical changes to the road design. The change to the road design would only applicable if the road would traverse directly adjacent to a dwelling façade within 20 m. This would not be applicable to property boundaries within 20 m, but rather the actual dwelling itself where a bedroom or school room (etc.) may be situated. Technical options to reduce the noise impact during the construction phase include:

- Land use planning play an important role when considering future development in an area. The implementation of an industrial zone that may make use of the Atterbury Road as a night-time haul route must consider their contribution to the ambient soundscape;
- Although speed does play a role in road traffic noise, it is not the most important correction in the calculation of noise levels from a road. It would be advisable from an acoustical propagation perspective to keep road traffic speeds to between 60 and 80 km/h on the road.
- The developer could consider designing acoustical performance roads. Such roads are designed in the Netherlands in busy interstate areas. Design specifications include:
 - Rubberised asphalt where rubber is added to a bituminous mix;
 - The implementation of a 6.7 or 13.2 mm Ultra-Thin Friction Course (see **Section 4.2.1**) of road sections where NSD's dwelling facades may be within 20 m of the road;
 - Average texture depths of 0.4 mm to 0.8 mm have proven favorable for noise reduction of car tyres and at least 1.0 mm for heavy vehicle tyres.⁶⁵ Texture of aggregate should be negative instead of positive (i.e. sharp edged aggregate undesirable);

⁶⁵ SILVIA. "Guidance Manual for the Implementation of Low Noise Road Surface". 2nd ed. P.g 19.

- The road should be smooth rolled with as little irregularities and bumps as possible. Road should be maintained frequently. Aggregate size smaller than 8 mm should be considered to improve rolling noise;
- Increasing the porosity of the surface layer may reduce rolling noise etc. Open layers (air void over 19%) which are porous layers could be considered; and
- A twin layer asphalt could be selected with the top layer acting as an acoustical performance road, and the underlayer would be good for drainage. The upper layer would be a 2.5 cm layer with aggregate smaller than 8 mm, while the underlying layer a larger aggregate rubberized binder mixes.

As mentioned, acoustics is not the only environmental and/or engineer discipline considered in the design and manufacturing of road paving. Other factors to play an important role in the prefeasibility stage of road construction, including

- how well the road handles (i.e. skid resistance etc.),
- how resistant it may be on tyre wear,
- costs involved in manufacturing and maintaining etc.

Therefore all factors must be considered, including the cost involved in implementing an acoustical performance road.

9.2 CONSTRUCTION PHASE

9.2.1 Mitigation Options: Mitigation at Receptors

The following optional possibilities can be considered by the developer at receptors dwelling:

- When noisy processes are to take place very close to potentially sensitive receptors (this could include smaller scale construction activities such as construction of boundary fencing, digging of trenches for cabling or development of access routes within 500 meters from a receptor), co-ordinate the working time with periods when the receptors are likely not at home. An example would be to work within the 8 am to 2 pm time-slot to minimise the significance of the impact due to:
 - Potentially receptors are most likely at school or at work, minimizing the probability of an impact happening. During the construction phase it would be advisable that the construction management consider limiting heavy

construction directly adjacent to the School (refer to receptor NSD03 or Evangelies Gereformeerde Kerk);

- If Sunday work is to be conducted, the construction management could coordinate Sunday working times with the Evangelies Gereformeerde Kerk if work is to take place adjacent to this place of worship; and
- Normal daily activities will generate other noises that would most likely mask construction noises, minimizing the probability of an impact happening. If feasible construction activities should occur during daytime hours.

9.3 OPERATIONAL PHASE

9.3.1 Mitigation Options: Mitigation at Receptors

The developer must note the following:

- Good public relations are essential with potential buyers and the developer should consider the information in this document during a potential property purchase in the area. The information presented to stakeholders should be factual and should not set unrealistic expectations. It is unrealistic to suggest that the noise sources will be inaudible, or that noise levels at night will reduce significantly, as this may not always be true, as maximum noises in the area is a source of annoyance to the local community.

10 CONCLUSIONS

A noise assessment was done as required by the Gauteng Noise Control Regulations which states that: (Clause 3a):

“No person shall-

build a road or change an existing road, or alter the speed limit on a road, if it shall in the opinion of the local authority concerned cause an increase in noise in or near residential areas, or office, church, hospital or educational buildings, unless noise control measures have been taken in consultation with the local authority concerned to ensure that the land in the vicinity of such road shall not be designated as a controlled area.”

Subsequent investigations indicated that there is a risk of a noise impact of medium significance during the daytime construction phase, and a noise impact of moderate significance during the day and night-times operational phase. This was assessed making use of SANS 10103:2008 guideline and International Finance Corporation noise limits for residential areas. This moderate impact is only applicable if a dwelling façade structure (such as a bedroom, school facility room etc.) is within 20 m from the proposed road. Construction and operational related mitigation options are highlighted in this document for the developer to consider.

It should be noted that this does not suggest that the sound from the road traffic should not be inaudible under all circumstances, this is an unrealistic expectation that is not required or expected from any other agricultural, commercial, industrial or other transportation related noise source, but rather that the sound due to the road traffic should be at a reasonable level in relation to the ambient sound levels as per regulations.

If the layout of the road changes significantly (or assumptions change) as used in this report, this Environmental Noise Impact Assessment should be reviewed with the appropriate information supplied by the mine, including:

- Locality of the noise source;
- Operational time of the noise source; and
- If possible specifications regarding the noise source.

11 THE AUTHOR

The author of this report, M. de Jager (B. Ing (Chem), UP) graduated in 1998 from the University of Pretoria. He has been interested in acoustics as from school days, doing projects mainly related to loudspeaker enclosure design. Interest in the matter brought him into the field of Environmental Noise Measurement, Prediction and Control. As from 2007 he has been involved with the following projects:

Wind Energy Facilities	Zen (Savannah Environmental – SE), Goereesoe (SE), Springfontein (SE), Garob (SE), Project Blue (SE), ESKOM Kleinzee (SE), iNca Gouda (Aurecon SA), Kangnas (Aurecon), Walker Bay (SE), Oyster Bay (SE), Hidden Valley (SE), Happy Valley (SE), Deep River (SE), Saldanha WEF (Terramanzi), Loeriesfontein (SiVEST), Noupoot (SiVEST), Prieska (SiVEST), Plateau East and West (Aurecon), Saldanha (Aurecon), Veldrift (Aurecon), Tsitsikamma (SE), AB (SE), West Coast One (SE), Namakwa Sands (SE), Dorper (SE), VentuSA Gouda (SE), Amakhala Emoyeni (SE), Klipheuwel (SE), Cookhouse (SE), Cookhouse II (SE), Canyon Springs (Canyon Springs), Rhebokfontein (SE), Suurplaat (SE), Karoo Renewables (SE), Outeniqua (Aurecon), Koningaas (SE), Eskom Aberdene (SE), Spitskop (SE), Rhenosterberg (SiVEST), Bannf (Vidigenix), Wolf WEF (Aurecon)
Mining and Industry	BECSA – Middelburg (Golder Associates), Kromkrans Colliery (Geovicon Environmental), SASOL Borrow Pits Project (JMA Consulting), Lesego Platinum (AGES), Tweefontein Colliery (Cleanstream), Evraz Vametco Mine and Plant (JMA), Goedehoop Colliery (Geovicon), Hacra Project (Prescali Environmental), Der Brochen Platinum Project (J9 Environment), Delft Sand (AGES), Brandbach Sand (AGES), Verkeerdepant Extension (CleanStream), Dwaalboom Limestone (AGES), Jagdlust Chrome (MENCO), WPB Coal (MENCO), Landau Expansion (CleanStream), Otjikoto Gold (AurexGold), Klipfontein Colliery (MENCO), Imbabala Coal (MENCO), ATCOM East Expansion (Jones and Wagner), IPP Waterberg Power Station (SE), Kangra Coal (ERM), Schoongesicht (CleanStream), EastPlats (CleanStream), Chapudi Coal (Jacana Environmental), Generaal Coal (JE), Mopane Coal (JE), Boshhoek Chrome (JMA), Langpan Chrome (PE), Vlakpoort Chrome (PE), Sekoko Coal (SE), Frankford Power (REMIG), Strahrae Coal (Ferret Mining), Transalloys Power Station (Savannah), Pan Palladium Smelter, Iron and PGM Complex (Prescali)
Road and Railway	K220 Road Extension (Urbansmart), Boskop Road (MTO), Sekoko Mining (AGES), Davel-Swaziland-Richards Bay Rail Link (Aurecon), Mcloto Transport Corridor Status Quo Report and Pre-Feasibility (SiVEST), Postmasburg Housing Development (SE), Tshwane Rapid Transport Project, Phase 1 and 2 (NRM Consulting/City of Tshwane)
Airport	Oudtshoorn Noise Monitoring (AGES), Sandton Heliport (Alpine Aviation), Tete Airport Scoping
Noise monitoring	Peerboom Colliery (EcoPartners), Thabametsi (Digby Wells), Doxa Deo (Doxa Deo), Harties Dredging (Rand Water), Xstrata Coal – Witbank Regional, Sephaku Delmas (AGES), Amakhala Emoyeni WEF (Windlab Developments), Oyster Bay WEF (Renewable Energy Systems), Tsitsikamma WEF (Cennergi)

Small Noise Impact Assessments	<p><i>and SE), Hopefield WEF (Umoya), Wesley WEF (Innowind), Ncora WEF (Innowind), Boschmanspoort (Jones and Wagner), Nqamakwe WEF (Innowind), Dassiesfontein WEF Noise Analysis (BioTherm), Transnet Noise Analysis (Aurecon)</i></p>
Project reviews and amendment reports	<p><i>TCTA AMD Project Baseline (AECOM), NATREF (Nemai Consulting), Christian Life Church (UrbanSmart), Kosmosdale (UrbanSmart), Louwlandia K220 (UrbanSmart), Richards Bay Port Expansion (AECOM), Babalegi Steel Recycling (AGES), Safika Slag Milling Plant (AGES), Arcelor Mittal WEF (Aurecon), RVM Hydroplant (Aurecon), Grootvlei PS Oil Storage (SiVEST), Rhenosterberg WEF, (SiVEST), Concerto Estate (BPTrust), Ekuseni Youth Centre (MENCO), Kranskop Industrial Park (Cape South Developments), Pretoria Central Mosque (Noman Shaikh), Soshanguve Development (Maluleke Investments), Seshego-D Waste Disposal (Enviroxcellence), Zambesi Safari Equipment (Owner), Noise Annoyance Assessment due to the Operation of the Gautrain (Thornhill and Lakeside Residential Estate), Upington Solar (SE), Ilangaletu Solar (SE), Pofadder Solar (SE), Flagging Trees WEF (SE), Uyekraal WEF (SE), Ruuki Power Station (SE), Richards Bay Port Expansion (AECOM), Babalegi Steel Recycling (AGES), Safika Ladium (AGES), Safika Cement Isando (AGES), Natref (NEMAI), RareCo (SE), Struisbaai WEF (SE)</i></p> <p><i>Loperberg (Savannah), Dorper (Savannah), Penhoek Pass (Savannah), Oyster Bay (RES), Tsitsikamma (Cennergji), Amakhala Emoyeni (Windlab), Spreeukloof (Savannah), Spinning Head (Savannah), Kangra Coal (ERM), West Coast One (Moyeng Energy), Rheboksfontein (Moyeng Energy)</i></p>

The author is an independent consultant to the project and Velocity Town Planning & Management. He,

- does not and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations
- have and will not have no vested interest in the proposed activity proceeding
- have no and will not engage in conflicting interests in the undertaking of the activity
- undertake to disclose all material information collected, calculated and/or findings, whether favourable to the mine or not
- will ensure that all information containing all relevant facts be included in this report.

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APPENDIX A

Glossary of Acoustic Terms, Definitions and General Information

1/3-Octave Band	A filter with a bandwidth of one-third of an octave representing four semitones, or notes on the musical scale. This relationship is applied to both the width of the band, and the centre frequency of the band. See also definition of octave band.
A – Weighting	An internationally standardised frequency weighting that approximates the frequency response of the human ear and gives an objective reading that therefore agrees with the subjective human response to that sound.
Air Absorption	The phenomena of attenuation of sound waves with distance propagated in air, due to dissipative interaction within the gas molecules.
Alternatives	A possible course of action, in place of another, that would meet the same purpose and need (of proposal). Alternatives can refer to any of the following, but are not limited hereto: alternative sites for development, alternative site layouts, alternative designs, alternative processes and materials. In Integrated Environmental Management the so-called “no go” alternative refers to the option of not allowing the development and may also require investigation in certain circumstances.
Ambient	The conditions surrounding an organism or area.
Ambient Noise	The all-encompassing sound at a point being composed of sounds from many sources both near and far. It includes the noise from the noise source under investigation.
Ambient Sound	The all-encompassing sound at a point being composite of sounds from near and far.
Ambient Sound Level	Means the reading on an integrating impulse sound level meter taken at a measuring point in the absence of any alleged disturbing noise at the end of a total period of at least 10 minutes after such a meter was put into operation. In this report the term Background Ambient Sound Level will be used.
Amplitude Modulated Sound	A sound that noticeably fluctuates in loudness over time.
Anthropogenic	Human impact on the environment or anthropogenic impact on the environment includes impacts on <u>biophysical environments</u> , biodiversity and other resources
Applicant	Any person who applies for an authorisation to undertake a listed activity or to cause such activity in terms of the relevant environmental legislation.
Assessment	The process of collecting, organising, analysing, interpreting and communicating data that is relevant to some decision.
Attenuation	Term used to indicate reduction of noise or vibration, by whatever method necessary, usually expressed in decibels.
Audible frequency Range	Generally assumed to be the range from about 20 Hz to 20,000 Hz, the range of frequencies that our ears perceive as sound.
Ambient Sound Level	The level of the ambient sound indicated on a sound level meter in the absence of the sound under investigation (e.g. sound from a particular noise source or sound generated for test purposes). Ambient sound level as per Noise Control Regulations.
Best Practices	A best practice is a method or technique that has consistently shown results superior to those achieved with other means, and that is used as a benchmark. In addition, a “best” practice can evolve to become better as improvements are discovered.
Broadband Noise	Spectrum consisting of a large number of frequency components, none of which is individually dominant.
C-Weighting	This is an international standard filter, which can be applied to a pressure signal or to a <i>SPL</i> or <i>PWL</i> spectrum, and which is essentially a pass-band filter in the frequency range of approximately 63 to 4000 Hz. This filter provides a more constant, flatter, frequency response, providing significantly less adjustment than the A-scale filter for frequencies less than 1000 Hz.
dB(A)	Sound Pressure Level in decibel that has been A-weighted, or filtered, to match the response of the human ear.

Decibel (db)	A logarithmic scale for sound corresponding to a multiple of 10 of the threshold of hearing. Decibels for sound levels in air are referenced to an atmospheric pressure of 20 μ Pa.
Diffraction	The process whereby an acoustic wave is disturbed and its energy redistributed in space as a result of an obstacle in its path, Reflection and refraction are special cases of diffraction.
Direction of Propagation	The direction of flow of energy associated with a wave.
Disturbing noise	Means a noise level that exceeds the zone sound level or, if no zone sound level has been designated, a noise level that exceeds the ambient sound level at the same measuring point by 7 dBA or more.
Echolocation	Echo locating animals emit calls out to the environment and listen to the <u>echoes</u> of those calls that return from various objects near them. They use these echoes to locate and identify the objects. Echolocation is used for <u>navigation</u> and for foraging (or hunting) in various environments.
Environment	The external circumstances, conditions and objects that affect the existence and development of an individual, organism or group; these circumstances include biophysical, social, economic, historical, cultural and political aspects.
Environmental Control Officer	Independent Officer employed by the applicant to ensure the implementation of the Environmental Management Plan (EMP) and manages any further environmental issues that may arise.
Environmental impact	A change resulting from the effect of an activity on the environment, whether desirable or undesirable. Impacts may be the direct consequence of an organisation's activities or may be indirectly caused by them.
Environmental Impact Assessment	An Environmental Impact Assessment (EIA) refers to the process of identifying, predicting and assessing the potential positive and negative social, economic and biophysical impacts of any proposed project, plan, programme or policy that requires authorisation of permission by law and that may significantly affect the environment. The EIA includes an evaluation of alternatives, as well as recommendations for appropriate mitigation measures for minimising or avoiding negative impacts, measures for enhancing the positive aspects of the proposal, and environmental management and monitoring measures.
Environmental issue	A concern felt by one or more parties about some existing, potential or perceived environmental impact.
Equivalent continuous A-weighted sound exposure level ($L_{Aeq,T}$)	The value of the average A-weighted sound pressure level measured continuously within a reference time interval T , which have the same mean-square sound pressure as a sound under consideration for which the level varies with time.
Equivalent continuous A-weighted rating level ($L_{Req,T}$)	The Equivalent continuous A-weighted sound exposure level ($L_{Aeq,T}$) to which various adjustments has been added. More commonly used as ($L_{Req,d}$) over a time interval 06:00 – 22:00 ($T=16$ hours) and ($L_{Req,n}$) over a time interval of 22:00 – 06:00 ($T=8$ hours). It is a calculated value.
F (fast) time weighting	(1) Averaging detection time used in sound level meters. (2) Fast setting has a time constant of 125 milliseconds and provides a fast reacting display response allowing the user to follow and measure not too rapidly fluctuating sound.
Footprint area	Area to be used for the construction of the proposed development, which does not include the total study area.
Free Field Condition	An environment where there is no reflective surfaces.
Frequency	The rate of oscillation of a sound, measured in units of Hertz (Hz) or kiloHertz (kHz). One hundred Hz is a rate of one hundred times per second. The frequency of a sound is the property perceived as pitch: a low-frequency sound (such as a bass note) oscillates at a relatively slow rate, and a high-frequency sound (such as a treble note) oscillates at a relatively high rate.
Green field	A parcel of land not previously developed beyond that of agriculture or forestry

Appendix A: Glossary of Acoustical Terms, Definitions and General Information

	use; virgin land. The opposite of Greenfield is Brownfield, which is a site previously developed and used by an enterprise, especially for a manufacturing or processing operation. The term Brownfield suggests that an investigation should be made to determine if environmental damage exists.
<i>G-Weighting</i>	An International Standard filter used to represent the infrasonic components of a sound spectrum.
<i>Harmonics</i>	Any of a series of musical tones for which the frequencies are integral multiples of the frequency of a fundamental tone.
<i>I (impulse) time weighting</i>	(1) Averaging detection time used in sound level meters as per South African standards and Regulations. (2) Impulse setting has a time constant of 35 milliseconds when the signal is increasing (sound pressure level rising) and a time constant of 1,500 milliseconds while the signal is decreasing.
<i>Impulsive sound</i>	A sound characterized by brief excursions of sound pressure (transient signal) that significantly exceed the ambient sound level.
<i>Infrasound</i>	Sound with a frequency content below the threshold of hearing, generally held to be about 20 Hz. Infrasonic sound with sufficiently large amplitude can be perceived, and is both heard and felt as vibration. Natural sources of infrasound are waves, thunder and wind.
<i>Integrated Development Plan</i>	A participatory planning process aimed at developing a strategic development plan to guide and inform all planning, budgeting, management and decision-making in a Local Authority, in terms of the requirements of Chapter 5 of the Municipal Systems Act, 2000 (Act 32 of 2000).
<i>Integrated Environmental Management</i>	IEM provides an integrated approach for environmental assessment, management, and decision-making and to promote sustainable development and the equitable use of resources. Principles underlying IEM provide for a democratic, participatory, holistic, sustainable, equitable and accountable approach.
<i>Interested and affected parties</i>	Individuals or groups concerned with or affected by an activity and its consequences. These include the authorities, local communities, investors, work force, consumers, environmental interest groups and the general public.
<i>Key issue</i>	An issue raised during the Scoping process that has not received an adequate response and that requires further investigation before it can be resolved.
<i>Listed activities</i>	Development actions that is likely to result in significant environmental impacts as identified by the delegated authority (formerly the Minister of Environmental Affairs and Tourism) in terms of Section 21 of the Environment Conservation Act.
<i>L_{AMin} and L_{AMax}</i>	Is the RMS (root mean squared) minimum or maximum level of a noise source.
<i>Loudness</i>	The attribute of an auditory sensation that describes the listener's ranking of sound in terms of its audibility.
<i>Magnitude of impact</i>	Magnitude of impact means the combination of the intensity, duration and extent of an impact occurring.
<i>Masking</i>	The raising of a listener's threshold of hearing for a given sound due to the presence of another sound.
<i>Mitigation</i>	To cause to become less harsh or hostile.
<i>Natural Sounds</i>	Are sounds produced by natural sources in their normal soundscape.
<i>Negative impact</i>	A change that reduces the quality of the environment (for example, by reducing species diversity and the reproductive capacity of the ecosystem, by damaging health, or by causing nuisance).
<i>Noise</i>	a. Sound that a listener does not wish to hear (unwanted sounds). b. Sound from sources other than the one emitting the sound it is desired to receive, measure or record. c. A class of sound of an erratic, intermittent or statistically random nature.
<i>Noise Level</i>	The term used in lieu of sound level when the sound concerned is being measured or ranked for its undesirability in the contextual circumstances.
<i>Noise-sensitive</i>	developments that could be influenced by noise such as:

<i>development</i>	<p>a) districts (see table 2 of SANS 10103:2008)</p> <ol style="list-style-type: none"> 1. rural districts, 2. suburban districts with little road traffic, 3. urban districts, 4. urban districts with some workshops, with business premises, and with main roads, 5. central business districts, and 6. industrial districts; <p>b) educational, residential, office and health care buildings and their surroundings;</p> <p>c) churches and their surroundings;</p> <p>d) auditoriums and concert halls and their surroundings;</p> <p>e) recreational areas; and</p> <p>f) nature reserves.</p> <p>In this report Noise-sensitive developments is also referred to as a Potential Sensitive Receptor</p>
<i>Octave Band</i>	A filter with a bandwidth of one octave, or twelve semi-tones on the musical scale representing a doubling of frequency.
<i>Positive impact</i>	A change that improves the quality of life of affected people or the quality of the environment.
<i>Property</i>	Any piece of land indicated on a diagram or general plan approved by the Surveyor-General intended for registration as a separate unit in terms of the Deeds Registries Act and includes an erf, a site and a farm portion as well as the buildings erected thereon
<i>Public Participation Process</i>	A process of involving the public in order to identify needs, address concerns, choose options, plan and monitor in terms of a proposed project, programme or development
<i>Reflection</i>	Redirection of sound waves.
<i>Refraction</i>	Change in direction of sound waves caused by changes in the sound wave velocity, typically when sound wave propagates in a medium of different density.
<i>Reverberant Sound</i>	The sound in an enclosure which results from repeated reflections from the boundaries.
<i>Reverberation</i>	The persistence, after emission of a sound has stopped, of a sound field within an enclosure.
<i>Significant Impact</i>	An impact can be deemed significant if consultation with the relevant authorities and other interested and affected parties, on the context and intensity of its effects, provides reasonable grounds for mitigating measures to be included in the environmental management report. The onus will be on the applicant to include the relevant authorities and other interested and affected parties in the consultation process. Present and potential future, cumulative and synergistic effects should all be taken into account.
<i>S (slow) time weighting</i>	<p>(1) Averaging times used in sound level meters.</p> <p>(2) Time constant of one [1] second that gives a slower response which helps average out the display fluctuations.</p>
<i>Sound Level</i>	The level of the frequency and time weighted sound pressure as determined by a sound level meter, i.e. A-weighted sound level.
<i>Sound Power</i>	Of a source, the total sound energy radiated per unit time.
<i>Sound Pressure Level (SPL)</i>	Of a sound, 20 times the logarithm to the base 10 of the ratio of the RMS sound pressure level to the reference sound pressure level. International values for the reference sound pressure level are 20 micropascals in air and 100 millipascals in water. SPL is reported as L_p in dB (not weighted) or in various other weightings.
<i>Soundscape</i>	Sound or a combination of sounds that forms or arises from an immersive environment. The study of soundscape is the subject of acoustic ecology. The idea of soundscape refers to both the natural acoustic environment, consisting of natural sounds, including animal vocalizations and, for instance, the sounds of weather and other natural elements; and environmental sounds created by humans, through musical composition, sound design, and other ordinary human activities including conversation, work, and sounds of mechanical origin

Appendix A: Glossary of Acoustical Terms, Definitions and General Information

		resulting from use of industrial technology. The disruption of these acoustic environments results in noise pollution.
<i>Study area</i>		Refers to the entire study area encompassing all the alternative routes as indicated on the study area map.
<i>Sustainable Development</i>		Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of "needs", in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and the future needs (Brundtland Commission, 1987).
<i>Tone</i>		Noise can be described as tonal if it contains a noticeable or discrete, continuous note. This includes noises such as hums, hisses, screeches, drones, etc. and any such subjective description is open to discussion and contradiction when reported.
<i>Zone of Potential Influence</i>	<i>of</i>	The area defined as the radius about an object, or objects beyond which the noise impact will be insignificant.
<i>Zone Level</i>	<i>Sound</i>	Means a derived dBA value determined indirectly by means of a series of measurements, calculations or table readings and designated by a local authority for an area. This is similar to the Rating Level as defined in SANS 10103:2008.

APPENDIX B

Site Investigation – Photos of measurement locations

Photos B.1: A01 measurement location





Photos B.2: Construction measurement location



APPENDIX C

Measurement Locations

Table C.1: Locations of identified noise-sensitive receptors (Datum type: WGS84, decimal degrees)

Noise-sensitive development	Location latitude	Location longitude
1	-25.828659°	28.345410°
2	-25.832522°	28.348427°
3	-25.814599°	28.337830°

Table C.2: Point Measurement location (Datum type: WGS84, decimal degrees)

Point name	Location X Co-ordinate	Location Y Co-ordinate
A01	-25.815266°	28.338061°

End of Report

Appendix G₄: Traffic Memorandum



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PROPOSED ATTERBURY ROAD EXTENSION: MEMORANDUM

1. INTRODUCTION

Atterbury Road is an existing class 3 road that runs in a north western-south eastern direction. This road is currently surfaced up to Jollify Main Road, access to the Mooikloof Estate. It is a gravel road south of this access (towards the south-east). The developer of The Hills Extensions intends to surface Atterbury Road from Jollify Main Road up to its junction with the proposed K147.

The extension of Atterbury Road will be a single carriage-way road with one lane per direction and will serve the surrounding developments. The proposed extension will therefore improve the capacity along Garstfontein Road since a portion of The Hills development traffic will be able to access the west via Atterbury Road.

2. CAPACITY

2.1 Introduction

The capacity of a two-lane highway according to the 2010 Highway Capacity Manual under base conditions is 1 700 passenger cars per hour in one direction with a limit of 3 200 passenger cars for the total of the two directions.

When a capacity of 1 700 passenger cars per hour is reached in one direction, the maximum opposing flow would be limited to 1 500 passenger cars. Capacity conditions are rarely observed, except in short sections. The service quality deteriorates at relatively low demand flow rates. Most two-lane highways are upgraded before demand approaches capacity.

2.2 Atterbury Road

Atterbury Road will have a steep gradient towards the Swavelpoortspruit at its junction with the proposed K147. It will be approximately 900 m long at a 10% gradient. This steep section will determine the capacity of the road.

The following assumptions are made:

- Peak hour factor of 0.95;
- 30% no passing zones;
- 3% heavy vehicles in the peak hour; and
- Access point density of 1.9/km (3/mile).

A one directional volume of 825 veh/h will operate at a volume/capacity ratio of 0.51 and level of service D. The level of service is determined by the percent-time-following. In this case, 81% of the vehicles will be following. The threshold value between level of service D and E is 85%. The two-way volume will therefore be 1 100 veh/h.

It is expected that 400 veh/h will use Atterbury Road in three (3) years' time. The volume will then increase to 1 100 veh/h in the next seven (7) years.

Trips to be generated in excess of 1 100 veh/h have to use Garstfontein Road or Atterbury Road has to be doubled.

3. CONCLUSION

The proposed extension of Atterbury Road will have a maximum capacity of 1 100 veh/h in both directions during the peak hours in the next seven (7) years. Atterbury Road will have to be dcubled if the anticipated trips are in excess of 1 100 veh/h or alternatively the trips will have to use Garstfontein Road.



**JJ POTGIETER
CIVIL CONCEPTS (PTY) LTD**

28 October 2014

Appendix G₅: Conceptual Design



Century Property Developments

C1906 – Atterbury Extension

Conceptual Design: Municipal Roadway

Design Report

13/08/2014

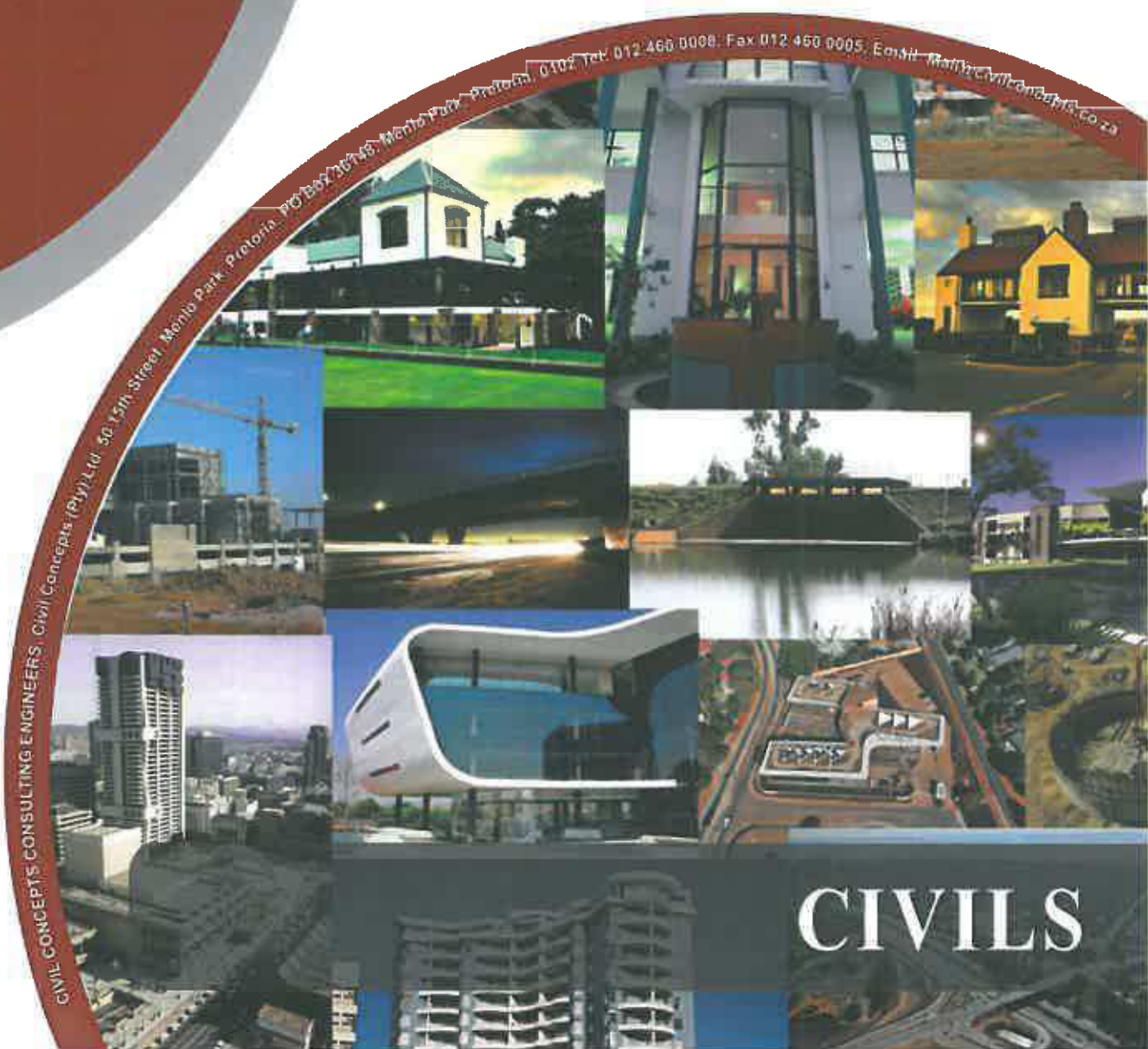


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1. BACKGROUND

This report deals with the concept design of Atterbury road extension. Currently Atterbury road is constructed up to the entrance of Mooikloof Township, with a gravel/ unsealed road providing access to various land owners situated to the south and east thereof. This area was part of the previous Kungwini Municipality but has since been incorporated into City of Tshwane Metropolitan Municipality. Because of large developments over the years but insufficient road network upgrading the current road system is under pressure, adding to this is the interest by developers to utilise the space available.

To help solve this problem Century Property Developments (Pty) Ltd asked Civil Concepts to investigate the extension of Atterbury road up to the future intersection with the K147 Provincial roadway. This report summarises the basic design principles, project specific requirements and municipal requirements

2. ROAD MASTER PLAN

Considering the Road Master layout for the area - Atterbury extension will be situated between the K54 to the north and K147 on the south. Garsfontein road runs parallel but to the west of Atterbury Extension. The current land use of properties adjoining the site is mostly Subdivided Agricultural Holdings. Refer to Plan C1324-K147-910-001 Rev A for the Road Master Layout of the area.

3. HORIZONTAL ALIGNMENT

The proposed Atterbury Extension follows an existing 25m wide road reserve running along the northern Mooikloof Township boundary and The Hills Township boundary. Refer to Plan C1906-M910-001 Rev B and C1324-M910-002 Rev C for the proposed horizontal alignment. The alignment is straight from the tie in with existing Atterbury Road up to the future intersection with K147 roadway.

The horizontal alignment follows a heading of 331°50'10" from the tie in at Mooikloof Township gate up to the intersection with K147, there are no horizontal curves in the alignment. The road reserve has been proclaimed and no expropriation will be required to construct Atterbury Extension.

4. VERTICAL ALIGNMENT

The terrain is fairly mountainous with steep descents, climbs and natural streams in the low points. Refer to Plans C1324-M910-005 to C1324-M910-009 Rev B for the proposed vertical alignment. The road follows the terrain for the most part with a rolling alignment from the starting chainage up to chainage 1240.00 where after it gradually descends to a steep gradient of +/- 12% between chainages 1940.00 and 2360.00.

A new bridge will have to be constructed between chainages 2360.00 and 2420.00 to cross the Zwavelpoort Spruit. After the bridge the road follows an 8.2 % gradient up to the intersection with K147.

Of note is fairly high fill embankments and/ or deep cut embankments over two different sections, this will have to be catered for outside the normal municipal specifications.

5. CROSS-SECTION

The final roadway to be constructed will be a Class 4a District Distributor, 14.8m wide in a 25m road reserve. A chamber profile with a gradient of 2% will be used along with 500mm sloping kerbs and 2m wide sidewalks. But for the purpose of this design the road will be constructed as set out in Table 1 below:

Table 1 Atterbury Extension Lane width

Chainage	High-lying side width	Low-lying side width
0.00 to 1120.00	2 x 3.7m = 7.4m	-
1120.00 to 2210.00 (Climbing Lane)	2 x 3.7m = 7.4m	1 x 3.7m = 3.7m
2210.00 to 2800.00	2 x 3.7m = 7.4m	-

Refer to Plans C1324-M910-010 to C1324-M910-014 Rev B for proposed cross-sections of the roadway.

Tapers of 1:20 at the top of the hill and 1:40 near the bridge will be used respectively for the climbing lane. Because of very high fill/ cut for embankments along the roadway retaining walls will be constructed at all deep cut or high fill areas. All other items will be according to Municipal Standards.

6. INTERSECTIONS AND ACCESSES

The following existing/ proposed future intersections and accesses will be situated on the Atterbury Extension:

- A new intersection with the proposed K147 will be situated at chainage 2800.00.
- An existing access is situated at chainage 1160.00, this will become the future T-junction with Saints Street.

Refer to Plan C1906-M910-002 Rev B for more information.

7. DRAINAGE

A complete piped/ subsurface drainage system is proposed along the roadway, municipal design principles will be followed, with the roadway acting as channel for overland flows and kerb inlets situated along the roadway at 150m intervals or as required.

A subsurface 450mm dia pipe network will collect water from the various catchpits and convey this to specific outlets at natural low points or existing systems.

Stormwater drainage pipes is proposed between CH 120 and CH 780 connecting to a cut of system at CH 780, as well as between CH 1920 and CH 2360 with a standard outlet at CH 2360.

A complete Stormwater Master Plan was compiled and results used to determine proposed pipe sizing, refer to Plan SMP/OLYMAH/2/001 and Report SMP_OLYMAH_TYPAH_2_REP compiled by Civil Concepts for more information.

Final horizontal and vertical alignment of the stormwater will be completed with detailed design. The road cross-section will have a gradient of 2% to allow sufficient capacity for surface flow, longitudinal gradients will vary according to vertical design.

8. STRUCTURES

A new bridge will be required to cross the Zwavelpoort Spruit, two alternatives are currently under investigation, firstly a reinforced concrete bridge structure and secondly a concrete box culvert option. The bridge concept design can be obtained from ARQ (Pty) Ltd, also refer to ARQ Plans 7077-01 to 7077-04 for more information.

The expected dimensions of the bridge structure is summarised below:

- Length: +/- 40m long, deck +/- 23m long
- Width: 11.4m wide deck, situated on top of fill material
- Height: +/- 9m high
- Fill: Reinforced earth retaining walls

Expected detail of the culvert option is summarised below:

- 3 x 7000 x 3500 mm concrete box culverts
- Length: +/- 20m long
- Fill: Reinforced earth retaining walls

9. NEW SERVICES

Positioning of all new services will be according to City of Tshwane Standard Construction Details and Design Standards for Roads and Stormwater Drainage Infrastructure, Plan PLN001 Sheet 1 of 4 Services Layout. Also refer to Plan C1906-M910-002 Rev C for the expected services and positioning.

Provision is made for the following services:

- Water
- Stormwater
- Special Services (Telecommunication and Data Services)
- Electrical Overhead
- Electrical Street lights
- Electrical Underground
- Sewerage

10. WALLS, FENCING AND SERVITUDES

Existing boundary walls along the proposed route consist mainly of approximately 2.0m high, double brick walls. Fences consist mainly of 2.0m – 2.4m high palisade fencing. Refer to Plan C1890-M910-002 Rev C for detail of the positioning of walls and fences along the proposed route.

The proposed route is situated inside an existing road reserve, thus no servitudes are crossed along the way.

11. PAVEMENT STRUCTURAL DESIGN

With expected traffic levels, climatic conditions and material available the following road structure is proposed at this point in time:

- Surfacing: 30mm Medium grade, Continuously grade Asphalt
- Base: 150mm Graded Crushed Stone (G1 material) Compacted to 88% Apparent Density
- Subbase: 150mm Cemented Natural Gravel (G5 material), Stabilised with 3% Cement and Compacted to 95% MDD
- Selected: 150mm Selected Natural Gravel (G6 material) Compacted to 93% MDD
- Roadbed: 150mm Natural Gravel/Soil (G9 material) Rip and Recompact to 90% MDD

We trust the contents of this report will suffice and satisfies the project objectives.

Yours faithfully



W STANDER Pr Eng

For CIVIL CONCEPTS (PTY) LTD

ANNEXURE A
C1324-K147-910-001

NOTES AND SPECIFICATIONS

- GENERAL**
1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE STATED. VERIFY THE DIMENSIONS OF THE SITE BEFORE COMMENCING WORK.
 2. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE STATED. VERIFY THE DIMENSIONS OF THE SITE BEFORE COMMENCING WORK.
 3. DO NOT SCALE FROM THESE DRAWINGS.
 4. ALL DIMENSIONS MUST BE CHECKED AND APPROVED ON SITE.
 5. ALL DIMENSIONS TO BE AS SHOWN IN ACCORDANCE WITH THE STANDARD CONSTRUCTION CODES AND THE STANDARD CONSTRUCTION CODES AND THE STANDARD CONSTRUCTION CODES.
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 8. THE DRAWING MUST BE READ IN CONJUNCTION WITH THE SPECIFICATIONS.
 9. THE DRAWING MUST BE READ IN CONJUNCTION WITH THE SPECIFICATIONS.
 10. FINAL DIMENSIONS TO BE DETERMINED ON SITE.

- LEGEND:**
- TOWNSHIP BOUNDARY - THE HILLS
 - OPTION No. 1
 - OPTION No. 2
 - OPTION No. 3
 - OPTION No. 4
 - OPTION No. 5
 - OPTION No. 6
 - OPTION No. 7
 - OPTION No. 8
 - OTHER BOUNDARIES CLASS AS BOUNDARIES
 - OTHER BOUNDARIES CLASS AS BOUNDARIES

NO.	DESCRIPTION	DATE	BY
1	ISSUED FOR TENDER		
2	AS SHOWN		

PROJECT STATUS	DATE	BY
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

AMENDMENTS	DATE	BY	REASON

CONSULTING CIVIL AND STRUCTURAL ENGINEERS

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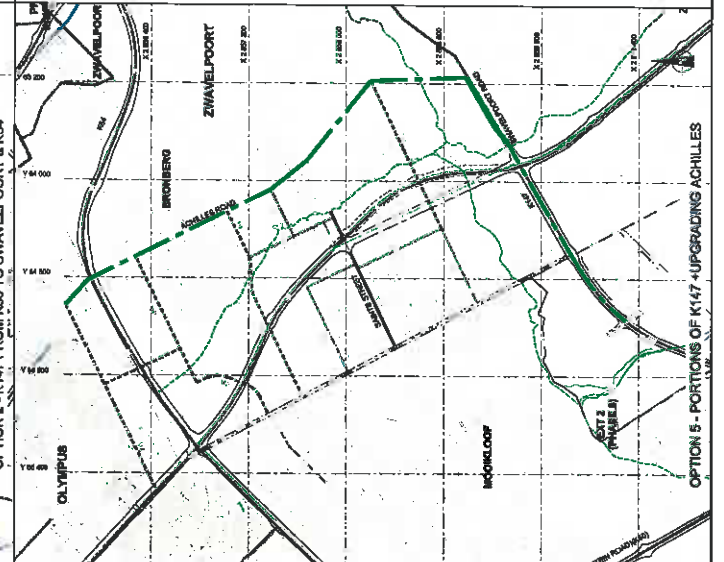
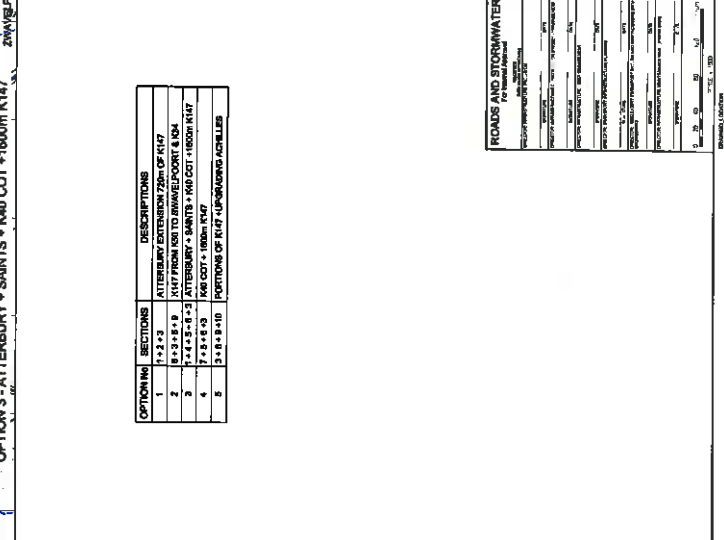
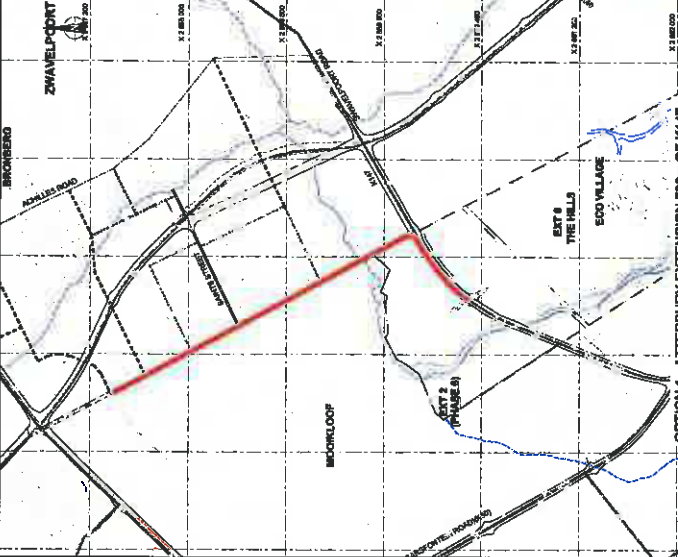
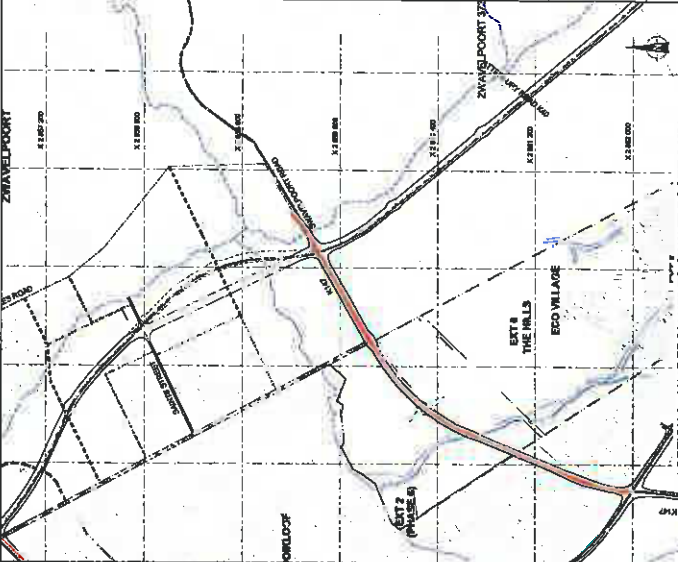
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TRANSPORT DEPARTMENT

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THE HILLS

EXTERNAL ROAD NETWORK
PROPOSED MASTER LAYOUT
OPTION 1 TO OPTION 5

PROJECT	NO.	DATE	BY



OPTIONING	SECTIONS	DESCRIPTIONS
1	1.1 - 1.2	ATTERBURY EXTENSION 720M OF K147
2	2.1 - 2.2	K147 FROM K50 TO SWAVELPOORT & K34
3	3.1 - 3.2	ATTERBURY + SAINTS + K40 COT + 1800M K147
4	4.1 - 4.2	K40 COT + 1800M K147
5	5.1 - 5.2	PORTIONS OF K147 UPGRADING ACHILLES

ROADS AND WATERWAYS

1. ROAD NAME: K147

2. ROAD TYPE: LOCAL ROAD

3. ROAD CLASSIFICATION: LOCAL ROAD

4. ROAD WIDTH: 12M

5. ROAD GRADE: 1:100

6. ROAD SURFACE: ASPHALT

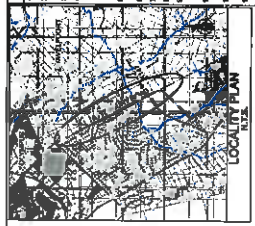
7. ROAD MATERIALS: ASPHALT

8. ROAD DRAINAGE: ASPHALT

9. ROAD SIGNAGE: ASPHALT

10. ROAD LIGHTING: ASPHALT

ANNEXURE B
C1906-M910-001



NOTES AND SPECIFICATIONS

- 1. ALL DIMENSIONS SHALL BE IN METERS UNLESS OTHERWISE SHOWN.
- 2. ALL DIMENSIONS SHALL BE TAKEN FROM THE CENTERLINE OF THE ROAD UNLESS OTHERWISE SPECIFIED.
- 3. ALL DIMENSIONS SHALL BE TAKEN FROM THE CENTERLINE OF THE ROAD UNLESS OTHERWISE SPECIFIED.
- 4. ALL DIMENSIONS SHALL BE TAKEN FROM THE CENTERLINE OF THE ROAD UNLESS OTHERWISE SPECIFIED.
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- 9. ALL DIMENSIONS SHALL BE TAKEN FROM THE CENTERLINE OF THE ROAD UNLESS OTHERWISE SPECIFIED.
- 10. ALL DIMENSIONS SHALL BE TAKEN FROM THE CENTERLINE OF THE ROAD UNLESS OTHERWISE SPECIFIED.

LEGEND:

- TEMPORARY BOUNDARY FRAMES
- PROPOSED FINISH
- PROPOSED PAVEMENT
- PROPOSED CHANNELS
- PROPOSED FENCES

AUMENTOS

NO.	DESCRIPÇÃO	DATA
1

PROJECT STATUS

PREPARED BY: J.P. VIEIRA
 CHECKED BY: W. ESTERHO
 APPROVED BY: ...

CONSULTANT DETAIL

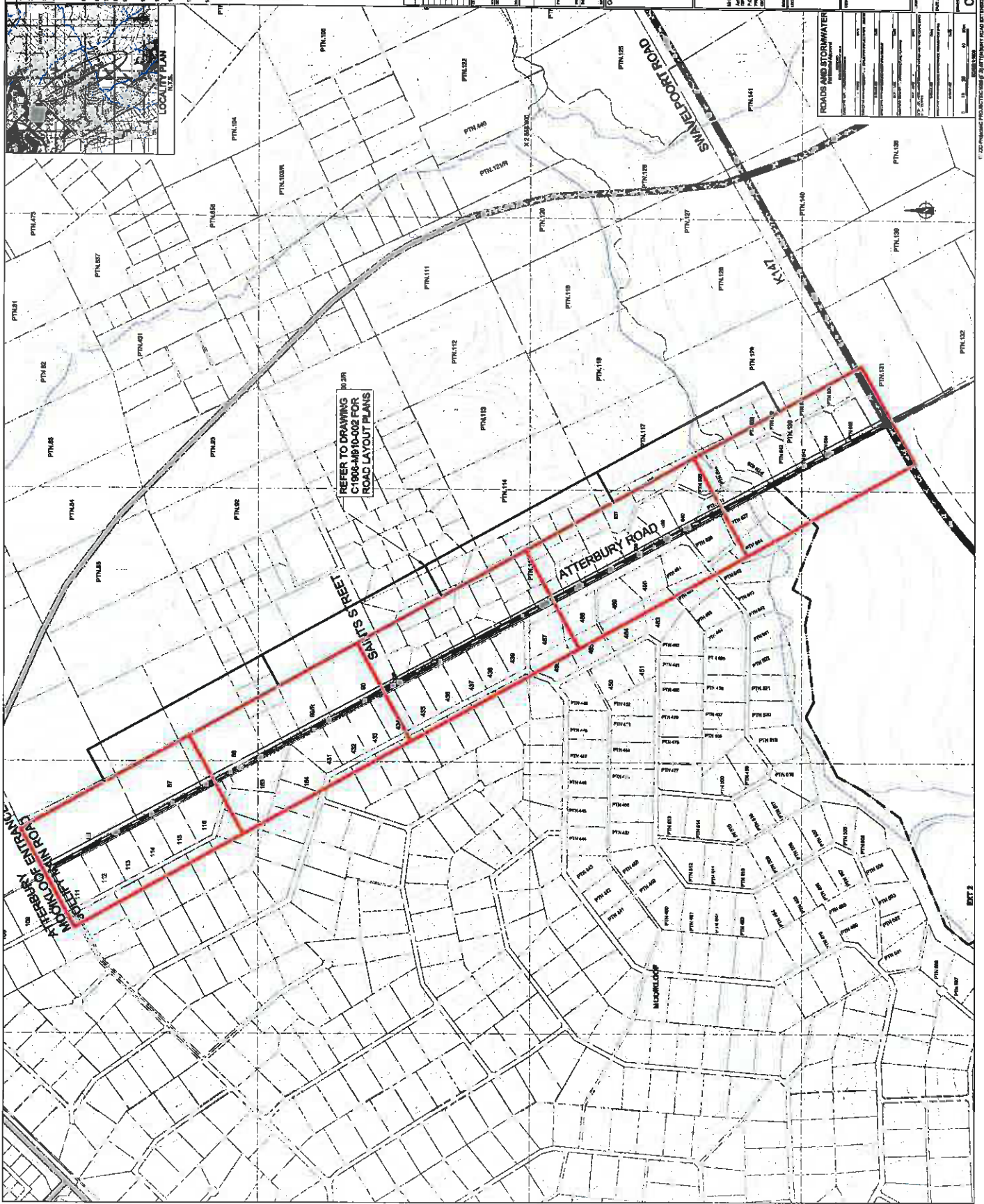
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ATTERBURY ROAD EXTENSION
 MASTER ROAD LAYOUT

PROJECT INFORMATION

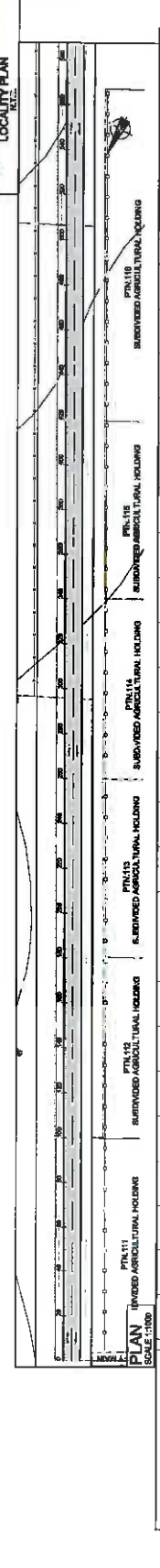
PROJECT NO: C1906-MB10-001
 DRAWN BY: ...
 DATE: JULY 2014
 SCALE: 1:2500



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ANNEXURE C
C1906-M910-002

ANNEXURE D
C1906-M910-005 to 009



Station	Ground Level (m)	Proposed Grade (m)
18360	1836.00	1836.00
18370	1837.00	1837.00
18380	1838.00	1838.00
18390	1839.00	1839.00
18400	1840.00	1840.00
18410	1841.00	1841.00
18420	1842.00	1842.00
18430	1843.00	1843.00
18440	1844.00	1844.00
18450	1845.00	1845.00
18460	1846.00	1846.00
18470	1847.00	1847.00
18480	1848.00	1848.00
18490	1849.00	1849.00
18500	1850.00	1850.00
18510	1851.00	1851.00
18520	1852.00	1852.00
18530	1853.00	1853.00

Station	Proposed Grade (m)	Ground Level (m)
18360	1836.00	1836.00
18370	1837.00	1837.00
18380	1838.00	1838.00
18390	1839.00	1839.00
18400	1840.00	1840.00
18410	1841.00	1841.00
18420	1842.00	1842.00
18430	1843.00	1843.00
18440	1844.00	1844.00
18450	1845.00	1845.00
18460	1846.00	1846.00
18470	1847.00	1847.00
18480	1848.00	1848.00
18490	1849.00	1849.00
18500	1850.00	1850.00
18510	1851.00	1851.00
18520	1852.00	1852.00
18530	1853.00	1853.00

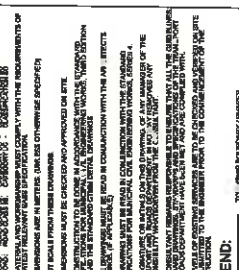
Station	Left offset (m)	Center (m)	Right offset (m)
18360	0.00	0.00	0.00
18370	0.00	0.00	0.00
18380	0.00	0.00	0.00
18390	0.00	0.00	0.00
18400	0.00	0.00	0.00
18410	0.00	0.00	0.00
18420	0.00	0.00	0.00
18430	0.00	0.00	0.00
18440	0.00	0.00	0.00
18450	0.00	0.00	0.00
18460	0.00	0.00	0.00
18470	0.00	0.00	0.00
18480	0.00	0.00	0.00
18490	0.00	0.00	0.00
18500	0.00	0.00	0.00
18510	0.00	0.00	0.00
18520	0.00	0.00	0.00
18530	0.00	0.00	0.00

Station	Grade (%)
18360	0.00
18370	0.00
18380	0.00
18390	0.00
18400	0.00
18410	0.00
18420	0.00
18430	0.00
18440	0.00
18450	0.00
18460	0.00
18470	0.00
18480	0.00
18490	0.00
18500	0.00
18510	0.00
18520	0.00
18530	0.00

Station	Ground Level (m)	Prop. Grade (m)	Vertical Curve Data
18360	1836.00	1836.00	0.000 0.000 0.000 0.000
18370	1837.00	1837.00	0.000 0.000 0.000 0.000
18380	1838.00	1838.00	0.000 0.000 0.000 0.000
18390	1839.00	1839.00	0.000 0.000 0.000 0.000
18400	1840.00	1840.00	0.000 0.000 0.000 0.000
18410	1841.00	1841.00	0.000 0.000 0.000 0.000
18420	1842.00	1842.00	0.000 0.000 0.000 0.000
18430	1843.00	1843.00	0.000 0.000 0.000 0.000
18440	1844.00	1844.00	0.000 0.000 0.000 0.000
18450	1845.00	1845.00	0.000 0.000 0.000 0.000
18460	1846.00	1846.00	0.000 0.000 0.000 0.000
18470	1847.00	1847.00	0.000 0.000 0.000 0.000
18480	1848.00	1848.00	0.000 0.000 0.000 0.000
18490	1849.00	1849.00	0.000 0.000 0.000 0.000
18500	1850.00	1850.00	0.000 0.000 0.000 0.000
18510	1851.00	1851.00	0.000 0.000 0.000 0.000
18520	1852.00	1852.00	0.000 0.000 0.000 0.000
18530	1853.00	1853.00	0.000 0.000 0.000 0.000

NOTES AND SPECIFICATIONS

1. ALL DIMENSIONS SHALL BE IN MILLIMETERS UNLESS OTHERWISE STATED.
2. ALL DIMENSIONS SHALL BE TAKEN FROM THE CENTERLINE OF THE ROAD UNLESS OTHERWISE STATED.
3. ALL DIMENSIONS SHALL BE TAKEN FROM THE CENTERLINE OF THE ROAD UNLESS OTHERWISE STATED.
4. ROAD CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE SPECIFICATIONS FOR ROAD CONSTRUCTION AS SET OUT IN THE STANDARD SPECIFICATIONS FOR ROAD CONSTRUCTION AND THE ROAD CONSTRUCTION MANUAL.
5. ALL DIMENSIONS SHALL BE TAKEN FROM THE CENTERLINE OF THE ROAD UNLESS OTHERWISE STATED.
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9. ALL DIMENSIONS SHALL BE TAKEN FROM THE CENTERLINE OF THE ROAD UNLESS OTHERWISE STATED.
10. ALL DIMENSIONS SHALL BE TAKEN FROM THE CENTERLINE OF THE ROAD UNLESS OTHERWISE STATED.



NO.	DATE	DESCRIPTION	BY	CHECKED
1	15/07/2014	ISSUED FOR TENDER	J. VAN DER MERWE	P. VAN DER MERWE
2	15/07/2014	ISSUED FOR TENDER	J. VAN DER MERWE	P. VAN DER MERWE
3	15/07/2014	ISSUED FOR TENDER	J. VAN DER MERWE	P. VAN DER MERWE
4	15/07/2014	ISSUED FOR TENDER	J. VAN DER MERWE	P. VAN DER MERWE
5	15/07/2014	ISSUED FOR TENDER	J. VAN DER MERWE	P. VAN DER MERWE
6	15/07/2014	ISSUED FOR TENDER	J. VAN DER MERWE	P. VAN DER MERWE
7	15/07/2014	ISSUED FOR TENDER	J. VAN DER MERWE	P. VAN DER MERWE
8	15/07/2014	ISSUED FOR TENDER	J. VAN DER MERWE	P. VAN DER MERWE
9	15/07/2014	ISSUED FOR TENDER	J. VAN DER MERWE	P. VAN DER MERWE
10	15/07/2014	ISSUED FOR TENDER	J. VAN DER MERWE	P. VAN DER MERWE

PROJECT STATUS

PROJECT NO.: 18360/18530
 PROJECT NAME: ATTARBURY ROAD EXTENSION
 PROJECT LOCATION: ATTARBURY ROAD EXTENSION
 PROJECT DATE: 15/07/2014

CONSULTANT DETAILS

CONSULTANT NAME: TSHWANE CONSULTING CIVIL AND STRUCTURAL ENGINEERS
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 CONSULTANT EMAIL: info@tshwane.co.za

CITY OF TSHWANE
 TRANSPORT DEPARTMENT
 MUNICIPAL ENGINEER: L. VAN DER MERWE
 MUNICIPAL ENGINEER: L. VAN DER MERWE
 MUNICIPAL ENGINEER: L. VAN DER MERWE

ATTARBURY ROAD EXTENSION

LONG SECTION (SHEET 1 OF 5)

PROJECT NO.: 18360/18530
 PROJECT NAME: ATTARBURY ROAD EXTENSION
 PROJECT DATE: 15/07/2014
 PROJECT SCALE: 1:1000

C1908-M9 10-005

PROJECT NO.: 18360/18530
 PROJECT NAME: ATTARBURY ROAD EXTENSION
 PROJECT DATE: 15/07/2014
 PROJECT SCALE: 1:1000

ANNEXURE E
C1906-M910-010 to 014

NOTES AND SPECIFICATIONS

1. ALL DIMENSIONS MUST BE IN UNLESS OTHERWISE SPECIFIED.
2. THE ROADWAY SHALL BE CONSTRUCTED TO THE CENTERLINE OF THE ROADWAY.
3. ALL DIMENSIONS AND EACH INDICATED ARE ON THE CENTERLINE OF THE ROADWAY.
4. PAVEMENT CLASSIFICATION:
 - TYPE: ASPHALT
 - THICKNESS: 150mm
 - BASE: 150mm
 - SUB-BASE: 150mm
 - FINISH: 20mm
5. THE PAVEMENT SHALL BE CONSTRUCTED TO THE CENTERLINE OF THE ROADWAY.
6. ALL DIMENSIONS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
7. ALL DIMENSIONS ARE FROM THE CENTERLINE.
8. ALL DIMENSIONS ARE TO BE CHECKED AND APPROVED ON SITE.
9. THE ROADWAY SHALL BE CONSTRUCTED TO THE CENTERLINE OF THE ROADWAY.
10. THE ROADWAY SHALL BE CONSTRUCTED TO THE CENTERLINE OF THE ROADWAY.
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18. THE ROADWAY SHALL BE CONSTRUCTED TO THE CENTERLINE OF THE ROADWAY.
19. THE ROADWAY SHALL BE CONSTRUCTED TO THE CENTERLINE OF THE ROADWAY.
20. THE ROADWAY SHALL BE CONSTRUCTED TO THE CENTERLINE OF THE ROADWAY.

NO.	DATE	DESCRIPTION	BY	CHECKED
1	15/07/2014	ISSUED FOR TENDER	R. WATKINS	
2	15/07/2014	REVISED	R. WATKINS	
3	15/07/2014	REVISED	R. WATKINS	
4	15/07/2014	REVISED	R. WATKINS	

NO.	DATE	DESCRIPTION	BY	CHECKED
1	15/07/2014	ISSUED FOR TENDER	R. WATKINS	
2	15/07/2014	REVISED	R. WATKINS	
3	15/07/2014	REVISED	R. WATKINS	
4	15/07/2014	REVISED	R. WATKINS	

NO.	DATE	DESCRIPTION	BY	CHECKED
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2	15/07/2014	REVISED	R. WATKINS	
3	15/07/2014	REVISED	R. WATKINS	
4	15/07/2014	REVISED	R. WATKINS	

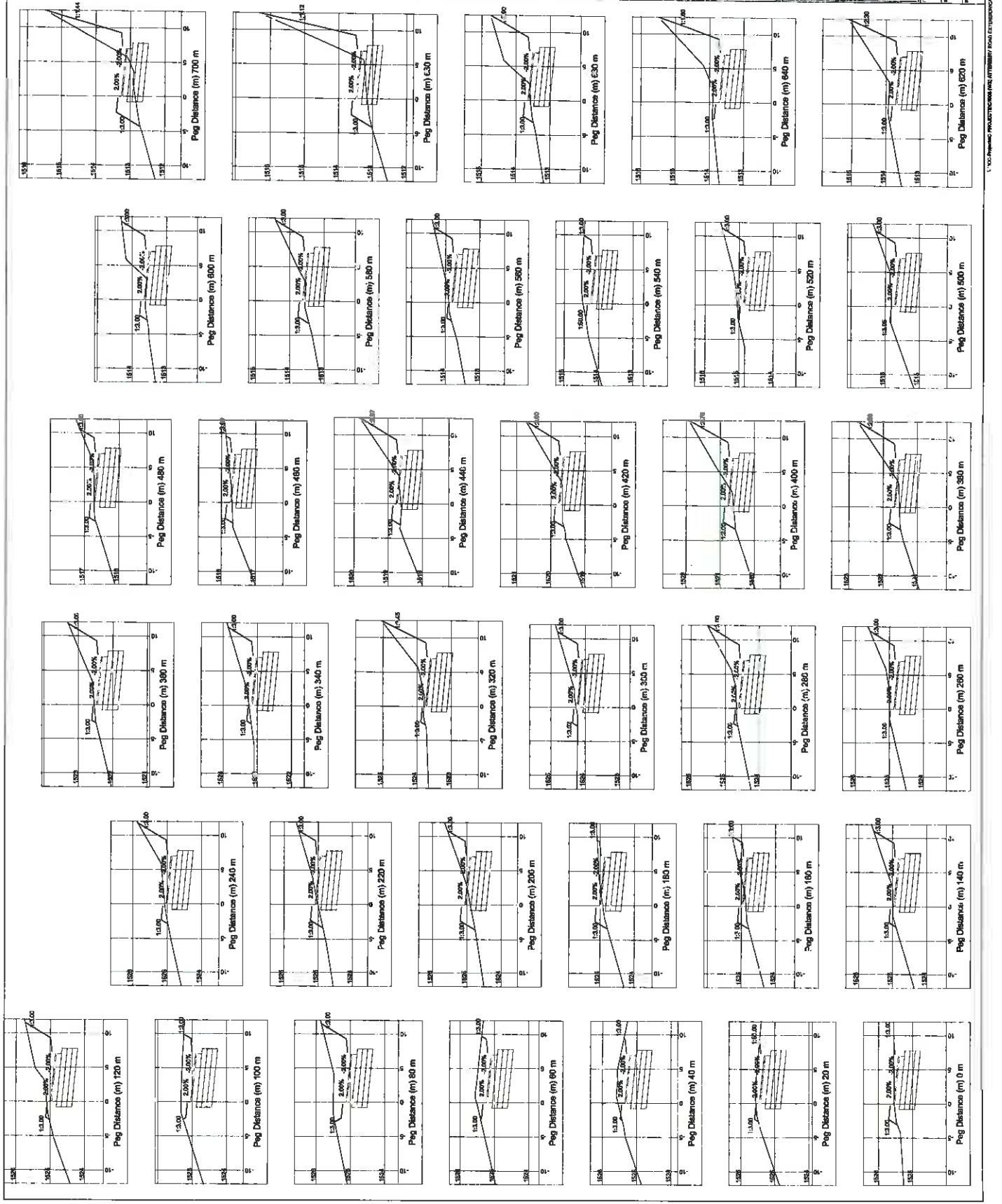
CONSULTING CIVIL AND STRUCTURAL ENGINEERS
 P.O. BOX 97148, JARDINE PARK QLD 4072
 TEL: (07) 5500 0000
 FAX: (07) 5500 0000
 WWW: WWW.CSSENG.COM

CITY OF TSHWANE
 TRANSPORT DEPARTMENT
 MUNICIPAL ENGINEER
 MUNICIPAL ENGINEER
 MUNICIPAL ENGINEER

ATTERBURY ROAD EXTENSION

CROSS SECTIONS (SHEET 1 OF 5)

NO.	DATE	DESCRIPTION	BY	CHECKED
1	15/07/2014	ISSUED FOR TENDER	R. WATKINS	
2	15/07/2014	REVISED	R. WATKINS	
3	15/07/2014	REVISED	R. WATKINS	
4	15/07/2014	REVISED	R. WATKINS	



NOTES AND SPECIFICATIONS

1. ALL MATERIALS AND METHODS TO BE USED SHALL BE IN ACCORDANCE WITH THE SPECIFICATIONS AND STANDARDS OF THE ROAD AND TRANSPORT DEPARTMENT.
2. ALL DIMENSIONS SHALL BE IN METERS UNLESS OTHERWISE SPECIFIED.
3. ALL DIMENSIONS SHALL BE TO THE CENTERLINE OF THE ROAD UNLESS OTHERWISE SPECIFIED.
4. ALL DIMENSIONS SHALL BE TO THE CENTERLINE OF THE ROAD UNLESS OTHERWISE SPECIFIED.
5. ALL DIMENSIONS SHALL BE TO THE CENTERLINE OF THE ROAD UNLESS OTHERWISE SPECIFIED.
6. ALL DIMENSIONS SHALL BE TO THE CENTERLINE OF THE ROAD UNLESS OTHERWISE SPECIFIED.
7. DO NOT SCALE FROM THESE DRAWINGS.
8. ALL DIMENSIONS SHALL BE TO THE CENTERLINE OF THE ROAD UNLESS OTHERWISE SPECIFIED.
9. ALL DIMENSIONS SHALL BE TO THE CENTERLINE OF THE ROAD UNLESS OTHERWISE SPECIFIED.
10. ALL DIMENSIONS SHALL BE TO THE CENTERLINE OF THE ROAD UNLESS OTHERWISE SPECIFIED.
11. ALL DIMENSIONS SHALL BE TO THE CENTERLINE OF THE ROAD UNLESS OTHERWISE SPECIFIED.
12. ALL DIMENSIONS SHALL BE TO THE CENTERLINE OF THE ROAD UNLESS OTHERWISE SPECIFIED.
13. ALL DIMENSIONS SHALL BE TO THE CENTERLINE OF THE ROAD UNLESS OTHERWISE SPECIFIED.
14. ALL DIMENSIONS SHALL BE TO THE CENTERLINE OF THE ROAD UNLESS OTHERWISE SPECIFIED.

NO.	DATE	DESCRIPTION	BY	CHECKED
1	15/07/2014	ISSUED FOR TENDER	A.P. MULLER	A.P. MULLER
2	15/07/2014	ISSUED FOR TENDER	A.P. MULLER	A.P. MULLER
3	15/07/2014	ISSUED FOR TENDER	A.P. MULLER	A.P. MULLER

PROJECT STATUS

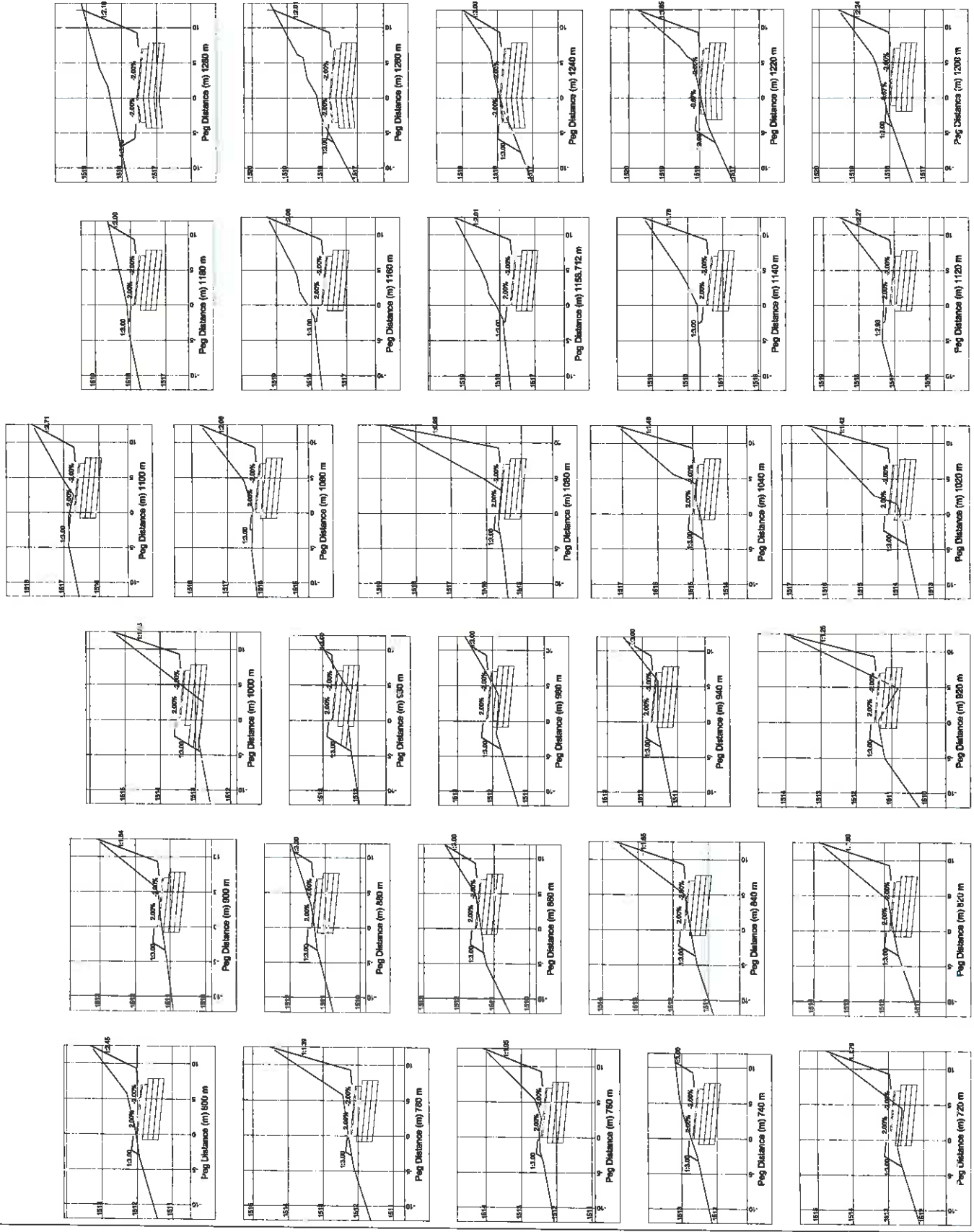
CONSULTANT: **CONCRETE CONSULTANTS**
 CONSULTANT ADDRESS: 10001 100th Ave, Richmond, BC V6V 1K2
 TEL: 604-273-1111
 FAX: 604-273-1112
 WWW.CONCRETECONSULTANTS.COM

CITY OF TSHWANE
 TRANSPORT DEPARTMENT
 ADDRESS: 10001 100th Ave, Richmond, BC V6V 1K2
 TEL: 604-273-1111
 FAX: 604-273-1112
 WWW.CITYOF.TSHWANE.GOV.ZA

ATTERBURY ROAD EXTENSION

CROSS SECTIONS (SHEET 2 OF 5)

DATE: JULY 2014
 SCALE: 1:1000
 SHEET NO: AT
 PROJECT NO: C-1906-M910-011



NOTES AND SPECIFICATIONS

1. ALL DIMENSIONS SHALL BE IN UNLESS OTHERWISE SHOWN.
2. THE ROAD CROSS-SECTION SHALL BE IN ACCORDANCE WITH THE CROSS-SECTION SHOWN.
3. ALL DIMENSIONS SHALL BE IN ACCORDANCE WITH THE CROSS-SECTION SHOWN.
4. ROAD CLASSIFICATION:
 - CLASSIFICATION: LOCAL ROAD
 - DESIGN SPEED: 30 KM/H
 - DESIGN LIFE: 10 YEARS
 - DESIGN VOLUME: 1000 CARS PER DAY
5. ALL DIMENSIONS SHALL BE IN ACCORDANCE WITH THE CROSS-SECTION SHOWN.
6. ALL DIMENSIONS SHALL BE IN ACCORDANCE WITH THE CROSS-SECTION SHOWN.
7. ALL DIMENSIONS SHALL BE IN ACCORDANCE WITH THE CROSS-SECTION SHOWN.
8. ALL DIMENSIONS SHALL BE IN ACCORDANCE WITH THE CROSS-SECTION SHOWN.
9. ALL DIMENSIONS SHALL BE IN ACCORDANCE WITH THE CROSS-SECTION SHOWN.
10. ALL DIMENSIONS SHALL BE IN ACCORDANCE WITH THE CROSS-SECTION SHOWN.
11. ALL DIMENSIONS SHALL BE IN ACCORDANCE WITH THE CROSS-SECTION SHOWN.

AMENDMENTS

NO.	DESCRIPTION	DATE
1	ISSUED FOR TENDER	20/07/2014
2	ISSUED FOR TENDER	20/07/2014
3	ISSUED FOR TENDER	20/07/2014
4	ISSUED FOR TENDER	20/07/2014
5	ISSUED FOR TENDER	20/07/2014

PROJECT STATUS

DESIGNER: CONSULTANTS

CLIENT: CITY OF TSHWANE

DATE: 20/07/2014

SCALE: 1:1000

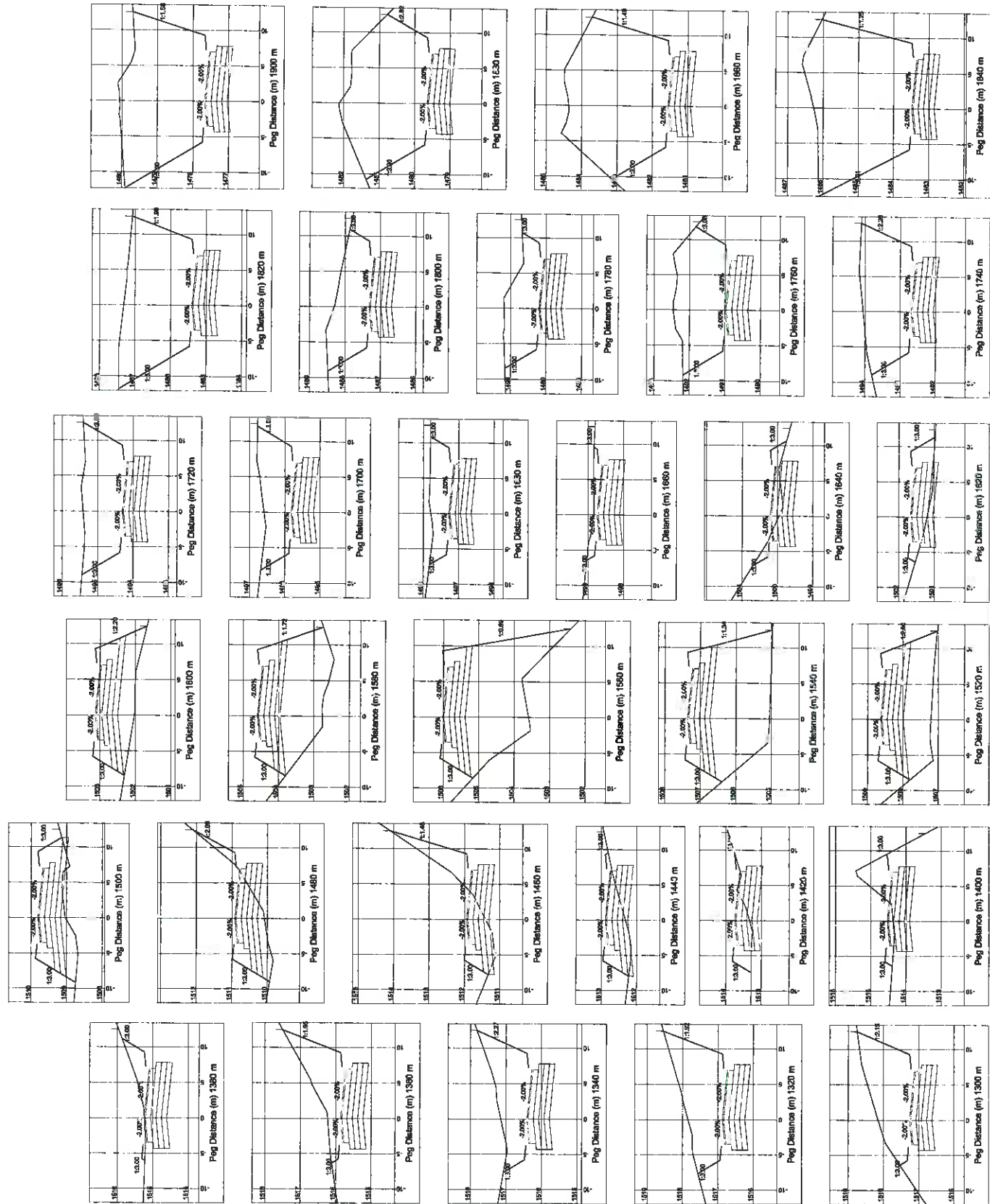
CONSULTING CIVIL AND STRUCTURAL ENGINEERS
P.O. BOX 26189, MIDVALE, JOHANNESBURG
TEL: 011 799 5511, FAX: 011 799 5512
WWW.CONSULTANTS.CO.ZA

CITY OF TSHWANE
TRANSPORT DEPARTMENT
INFRASTRUCTURE DIVISION
CROSS SECTION

ATTERBURY ROAD EXTENSION

CROSS SECTIONS (SHEET 3 OF 5)

PROJECT NO: C1906-M910-012
DATE: JULY 2014
SCALE: 1:1000



NOTES AND SPECIFICATIONS

1. ALL ELEVATIONS SHOWN TO BE IN METERS UNLESS OTHERWISE SHOWN.
2. ALL DIMENSIONS AND SPACING TO BE IN METERS UNLESS OTHERWISE SHOWN.
3. P.L. COORDINATES AND STATIONING ARE BY THE CONTINENTAL SYSTEM OF THE ROAD.
4. ALL DIMENSIONS AND SPACING TO BE IN METERS UNLESS OTHERWISE SHOWN.
5. ALL DIMENSIONS AND SPACING TO BE IN METERS UNLESS OTHERWISE SHOWN.
6. ALL DIMENSIONS AND SPACING TO BE IN METERS UNLESS OTHERWISE SHOWN.
7. DO NOT SCALE FROM THESE DRAWINGS.
8. ALL DIMENSIONS MUST BE CHECKED AND APPROVED ON SITE.
9. ALL CONSTRUCTION TO BE DONE IN ACCORDANCE WITH THE SPECIFICATIONS FOR ROADWORK AND THE STANDARD SPECIFICATIONS FOR ROADWORK.
10. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS AND APPROVALS FROM THE RELEVANT AUTHORITIES.
11. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS AND APPROVALS FROM THE RELEVANT AUTHORITIES.
12. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS AND APPROVALS FROM THE RELEVANT AUTHORITIES.
13. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS AND APPROVALS FROM THE RELEVANT AUTHORITIES.
14. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS AND APPROVALS FROM THE RELEVANT AUTHORITIES.
15. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS AND APPROVALS FROM THE RELEVANT AUTHORITIES.
16. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS AND APPROVALS FROM THE RELEVANT AUTHORITIES.
17. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS AND APPROVALS FROM THE RELEVANT AUTHORITIES.
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19. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS AND APPROVALS FROM THE RELEVANT AUTHORITIES.
20. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS AND APPROVALS FROM THE RELEVANT AUTHORITIES.

NO.	DESCRIPTION	DATE	BY	CHECKED
1	ISSUED FOR TENDER	15/07/2014	J.P. VILJOEN	
2	REVISED	15/07/2014	J.P. VILJOEN	
3	REVISED	15/07/2014	J.P. VILJOEN	
4	REVISED	15/07/2014	J.P. VILJOEN	
5	REVISED	15/07/2014	J.P. VILJOEN	
6	REVISED	15/07/2014	J.P. VILJOEN	
7	REVISED	15/07/2014	J.P. VILJOEN	
8	REVISED	15/07/2014	J.P. VILJOEN	
9	REVISED	15/07/2014	J.P. VILJOEN	
10	REVISED	15/07/2014	J.P. VILJOEN	
11	REVISED	15/07/2014	J.P. VILJOEN	
12	REVISED	15/07/2014	J.P. VILJOEN	
13	REVISED	15/07/2014	J.P. VILJOEN	
14	REVISED	15/07/2014	J.P. VILJOEN	
15	REVISED	15/07/2014	J.P. VILJOEN	
16	REVISED	15/07/2014	J.P. VILJOEN	
17	REVISED	15/07/2014	J.P. VILJOEN	
18	REVISED	15/07/2014	J.P. VILJOEN	
19	REVISED	15/07/2014	J.P. VILJOEN	
20	REVISED	15/07/2014	J.P. VILJOEN	

PROJECT STATUS

DESIGN ONLY
 DESIGN AND CONSTRUCTION
 CONSTRUCTION ONLY
 DESIGN AND CONSTRUCTION AND MAINTENANCE

DESIGN ONLY
 DESIGN AND CONSTRUCTION
 CONSTRUCTION ONLY
 DESIGN AND CONSTRUCTION AND MAINTENANCE

DESIGN ONLY
 DESIGN AND CONSTRUCTION
 CONSTRUCTION ONLY
 DESIGN AND CONSTRUCTION AND MAINTENANCE

CONSULTING CIVIL AND STRUCTURAL ENGINEERS

101 ROSS STREET, SUITE 101
 ROSSBUSH, JOHANNESBURG 2001
 TEL: 011 462 4000
 FAX: 011 462 4000
 WWW.CIVILSOCIETY.CO.ZA

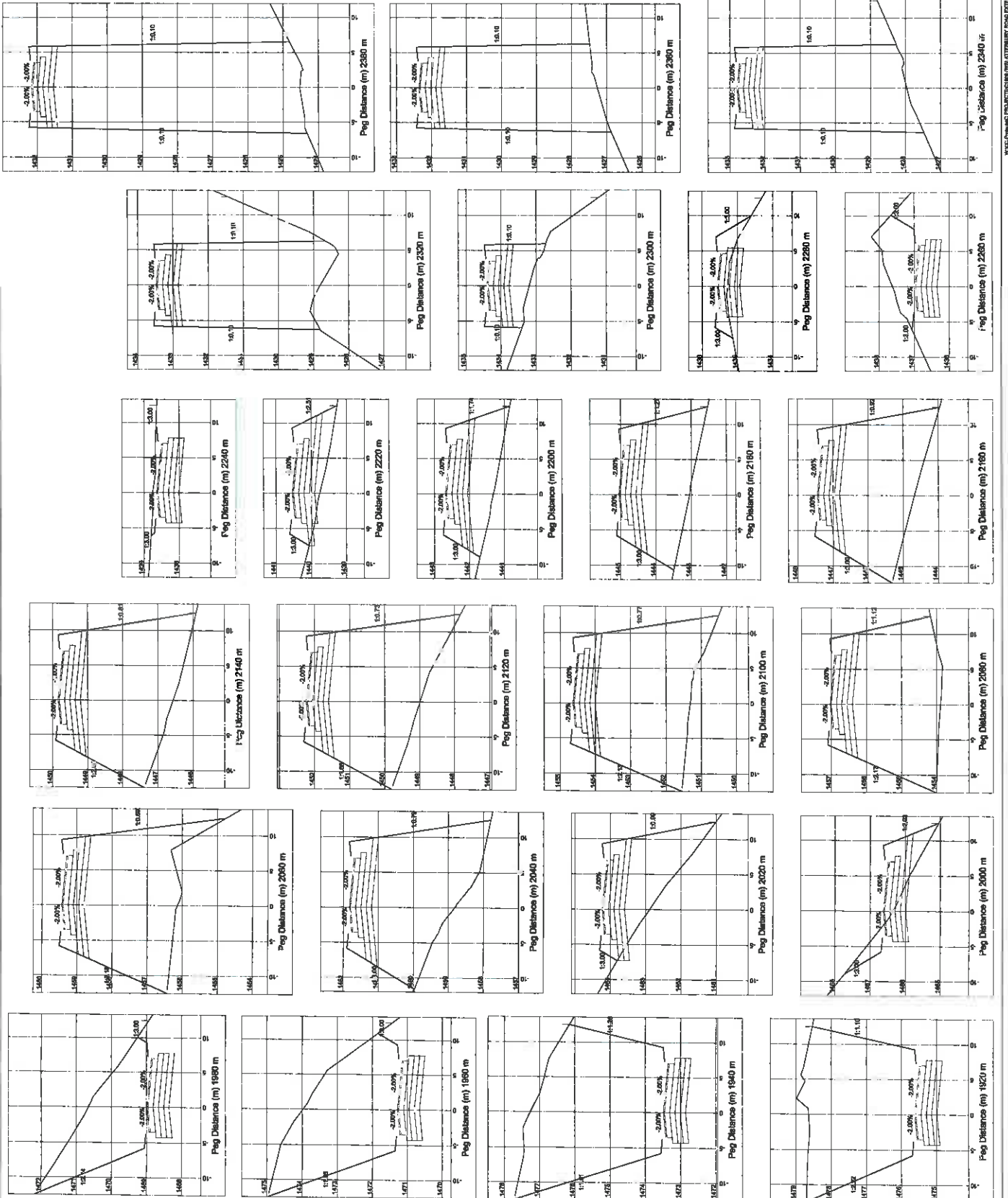
CITY OF TSHWANE

TRANSPORT DEPARTMENT
 ROAD ENGINEERING SECTION
 PROJECT MANAGER: [Name]
 PROJECT NO.: [Number]

ATTERBURY ROAD EXTENSION

CROSS SECTIONS (SHEET 4 OF 5)

DATE:	15/07/2014	SCALE:	1:1 000	REVISION:	A/1
PROJECT NO.:	C1906-M910-013				



NOTES AND SPECIFICATIONS

- 1. ALL DIMENSIONS SHALL BE IN METERS UNLESS OTHERWISE SHOWN.
- 2. ALL DIMENSIONS SHALL BE TO THE CENTRELINE OF THE ROAD.
- 3. P.1. COORDINATE AND MARK INDICATED ARE ON THE CENTRELINE OF THE ROAD.
- 4. ROAD CLASIFICATION:
 A. CLASSIFICATION: ROADWAY
 B. ROAD TYPE: ROADWAY
 C. ROAD CLASSIFICATION: ROADWAY
 D. ROAD TYPE: ROADWAY
 E. ROAD CLASSIFICATION: ROADWAY
- 5. THE ROADWAY SHALL BE CONSTRUCTED TO THE DIMENSIONS OF THE ROADWAY AS SHOWN ON THESE DRAWINGS.
- 6. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SPECIFIED.
- 7. DISTANCES FROM THESE POINTS SHALL BE AS SHOWN ON THE DRAWINGS.
- 8. ALL DIMENSIONS SHALL BE TO THE CENTRELINE OF THE ROAD.
- 9. ALL DIMENSIONS SHALL BE TO THE CENTRELINE OF THE ROAD.
- 10. ALL DIMENSIONS SHALL BE TO THE CENTRELINE OF THE ROAD.
- 11. THE DIMENSIONS OF THE ROADWAY SHALL BE AS SHOWN ON THESE DRAWINGS.
- 12. THE DIMENSIONS OF THE ROADWAY SHALL BE AS SHOWN ON THESE DRAWINGS.
- 13. THE DIMENSIONS OF THE ROADWAY SHALL BE AS SHOWN ON THESE DRAWINGS.
- 14. THE DIMENSIONS OF THE ROADWAY SHALL BE AS SHOWN ON THESE DRAWINGS.
- 15. THE DIMENSIONS OF THE ROADWAY SHALL BE AS SHOWN ON THESE DRAWINGS.
- 16. THE DIMENSIONS OF THE ROADWAY SHALL BE AS SHOWN ON THESE DRAWINGS.
- 17. THE DIMENSIONS OF THE ROADWAY SHALL BE AS SHOWN ON THESE DRAWINGS.
- 18. THE DIMENSIONS OF THE ROADWAY SHALL BE AS SHOWN ON THESE DRAWINGS.
- 19. THE DIMENSIONS OF THE ROADWAY SHALL BE AS SHOWN ON THESE DRAWINGS.
- 20. THE DIMENSIONS OF THE ROADWAY SHALL BE AS SHOWN ON THESE DRAWINGS.

NO.	DATE	DESCRIPTION	BY	CHECKED
1	15/07/2014	ISSUED FOR TENDER	J.P. VERMA	J.P. VERMA
2	15/07/2014	REVISED TO SHOW PROPOSED	J.P. VERMA	J.P. VERMA
3	15/07/2014	REVISED TO SHOW PROPOSED	J.P. VERMA	J.P. VERMA
4	15/07/2014	REVISED TO SHOW PROPOSED	J.P. VERMA	J.P. VERMA

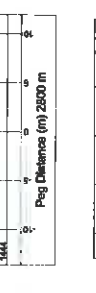
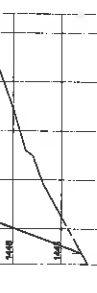
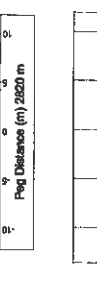
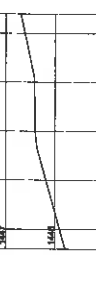
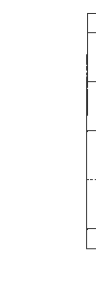
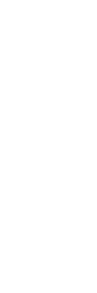
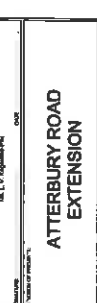
PROJECT STATUS
 PROPOSED
 CONTRACT NO. C1906-M9/10-014
 CONTRACT VALUE: R200 000 000.00
 PROJECT START DATE: 15/07/2014
 PROJECT END DATE: 15/07/2014

CONSULTANT DETAIL
 CONSULTING CIVIL AND STRUCTURAL ENGINEERS
 P.O. BOX 8518 NORTON PARK 012
 2013
 TEL: 012 240 6000
 FAX: 012 240 6000
 E-MAIL: info@tshwane.co.za

CITY OF TSHWANE
 TRANSPORT DEPARTMENT
 M.P. LESAME
 P.O. BOX 9518 NORTON PARK 012
 2013
 TEL: 012 240 6000
 FAX: 012 240 6000
 E-MAIL: info@tshwane.co.za

ATTORBERY ROAD EXTENSION
 CROSS SECTIONS
 (SHEET 5 OF 5)

DATE: JULY 2014
 SCALE: 1:1000
 DRAWING NUMBER: C1906-M9/10-014
 SHEET NO. 5



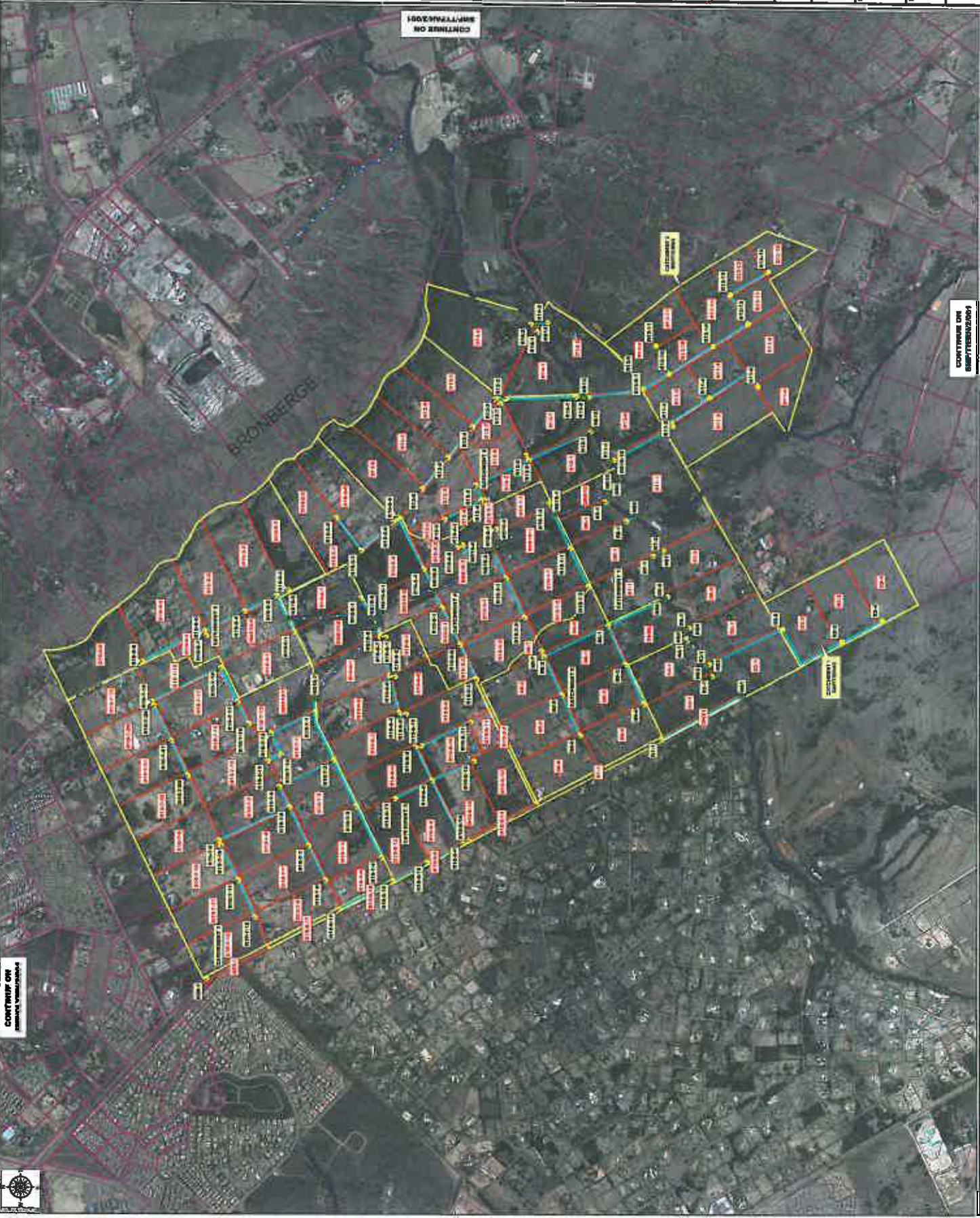
ANNEXURE F
SMP/OLYMAH/2/001

NOTES:
 1. RUN-OFF CALCULATION PERFORMED WITH HYDRUSM COMPUTER PROGRAM, USING THE FOLLOWING CONSTANTS:

- a) RETURN PERIODS:
 - MAJOR SYSTEM : 25 YR
 - MINOR SYSTEM : 2 YR
- b) MAP = 600 mm
- c) % IMPERVIOUSNESS:
 - LIGHT RESIDENTIAL : 25%
 - OPEN SPACES : 15%
 - ROADS : 80%

LEGEND

- BASIN CATCHMENT
- BASIN CATCHMENTS
- ADJACENCY BASIN CATCHMENTS
- NATURAL STREAM NODES
- STORMWATER NODES
- STORMWATER RIVERS
- STORMWATER ROUTES
- NATURAL LOW POINT



CONTINUE ON SHEPHERD

CONTINUE ON SHEPHERD

CONTINUE ON SHEPHERD



CITY OF TSHWANE UNITED COLLECTOR	CONSULTING CIVIL & STRUCTURAL ENGINEERS 100 RAY 2440 100 RAY 2440 Sandton, 2008 T. 011 551 2000 F. 011 551 2000 www.tshwane.gov.za
PROJECT TSHWANE STORMWATER MASTER PLANNING PART 2: NETWORK MODELLING	TOWNSHIP OLYMPIUS AGRICULTURAL HOLDINGS
DESIGNER NO DPH18726	DESIGNED BY W. STANIER
DRAWING NO SPP/OLYMPIUS/2001	CHECKED BY T. VAN DER MERWE
SCALE 1:10 000	DATE 15/05/2008

REVISION 1 10/05/2002 (REVISION 1) 0 15/05/2007 (FIRST ISSUE)
CADRY

ANNEXURE G
SMP_OLYMAH_TYPAH_2_REP



**CITY OF TSHWANE
METROPOLITAN MUNICIPALITY
TRANSPORTATION DEPARTMENT**

**STORMWATER MASTER PLANNING (SMP)
PART 2
REPORT NO. SMP / OLYMA_TYPAH / 2 / REP**

JUNE 2012

**OLYMPUS AGRICULTURAL HOLDINGS
TYGERPOORT AGRICULTURAL
HOLDINGS**

**REFER TO SEPARATE
REPORT**

Prepared by:

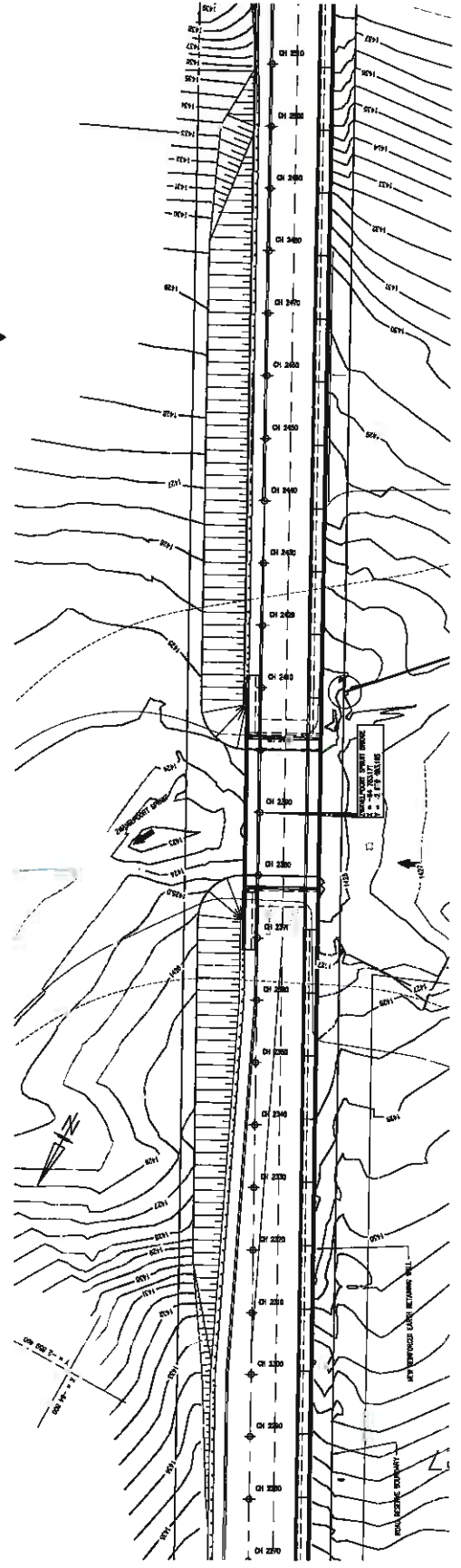
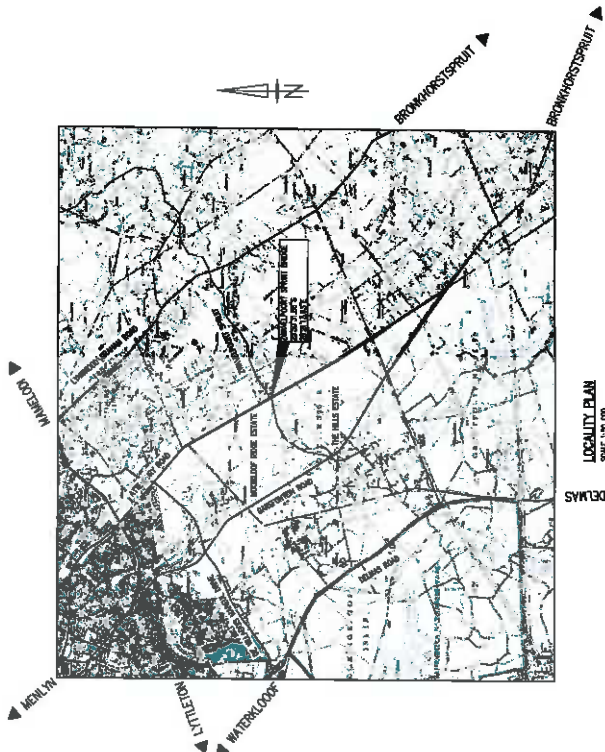
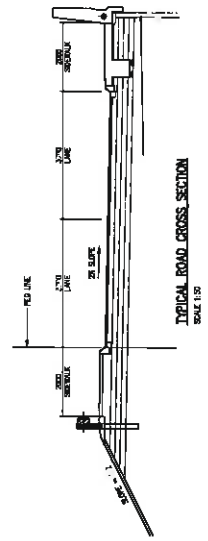
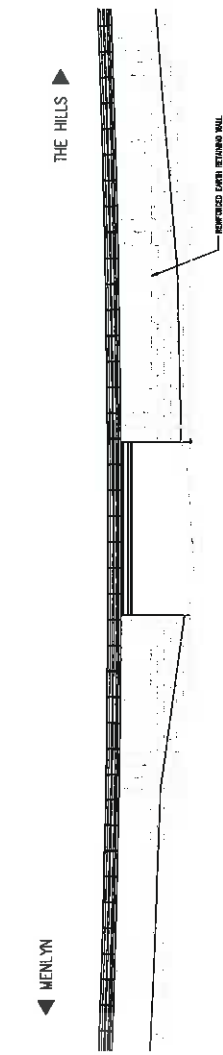


CIVIL CONCEPTS (PTY) LTD

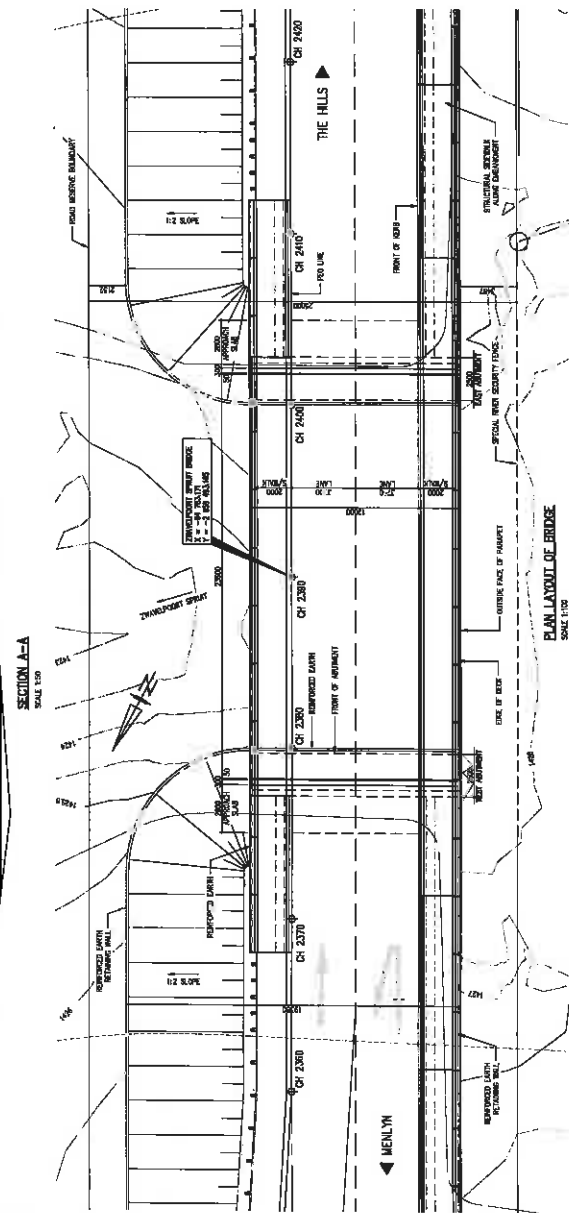
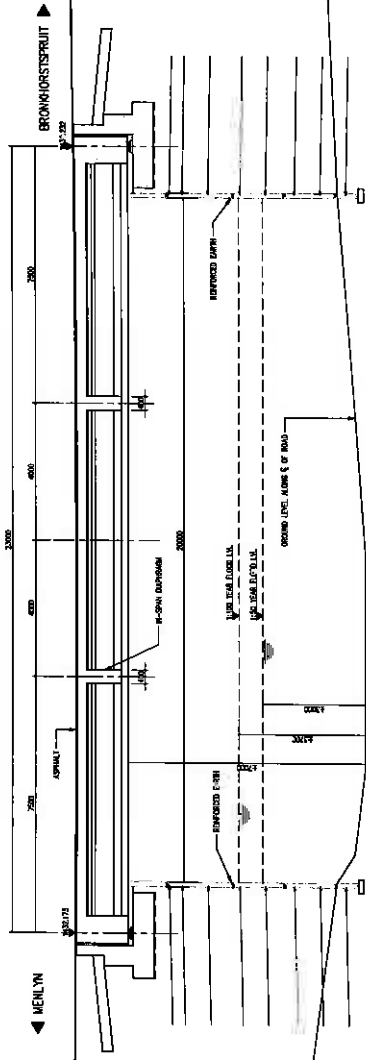
**PO BOX 36148
MENLO PARK, 0102**

**TEL: 012 365 1414
FAX: 012 365 1192
EMAIL: mail@civilconcepts.co.za**

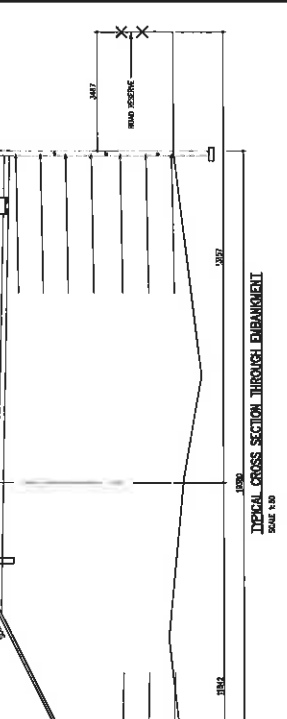
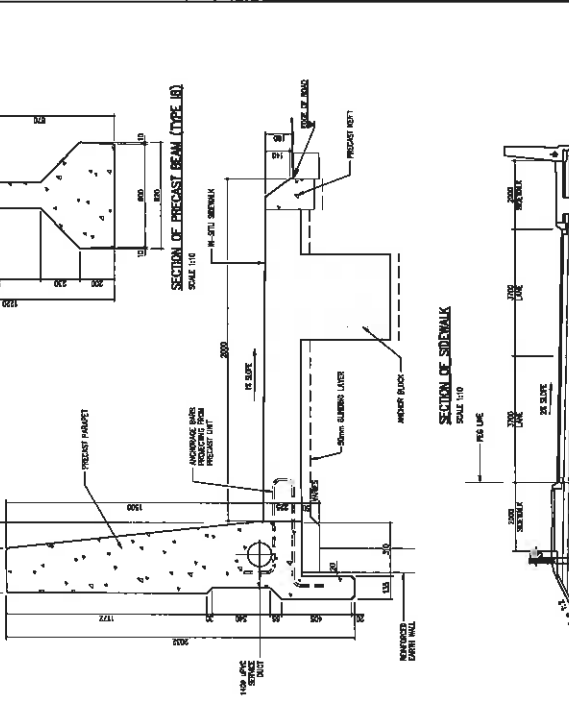
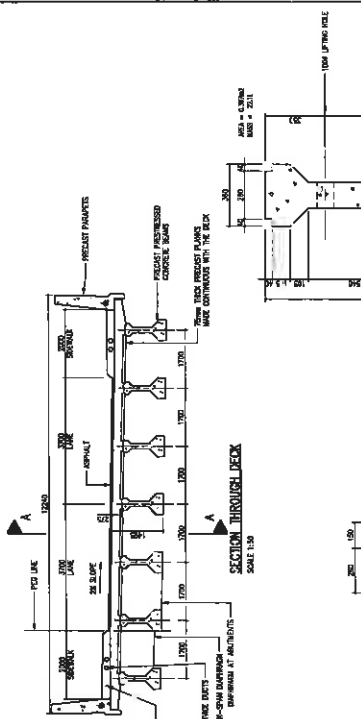
ANNEXURE H
ARQ PLANS 7077-01 to 04



<p>ARQ (PTY) LTD PO BOX 2674 LANSBURG ROAD DURBAN 4001 TEL: 031 251 1111 FAX: 031 251 1111 WWW.ARQ.CO.ZA</p>		<p>PROJECT: ATTURBURY ROAD EXTENSION TITLE: ATTURBURY ROAD OVER ZWAKELOOPT SPRUIT BRIDGE OPTION SITE PLAN</p>		<p>DRAWING NUMBERS REVISED IN: DATE: 2007/01</p>	
DATE:	DATE:	DATE:	DATE:	DATE:	DATE:
DESIGNED FOR APPROVAL:	DESIGNED:	CHECKED:	APPROVED:	DATE:	DATE:
DESIGNED:	CHECKED:	APPROVED:	DATE:	DATE:	DATE:

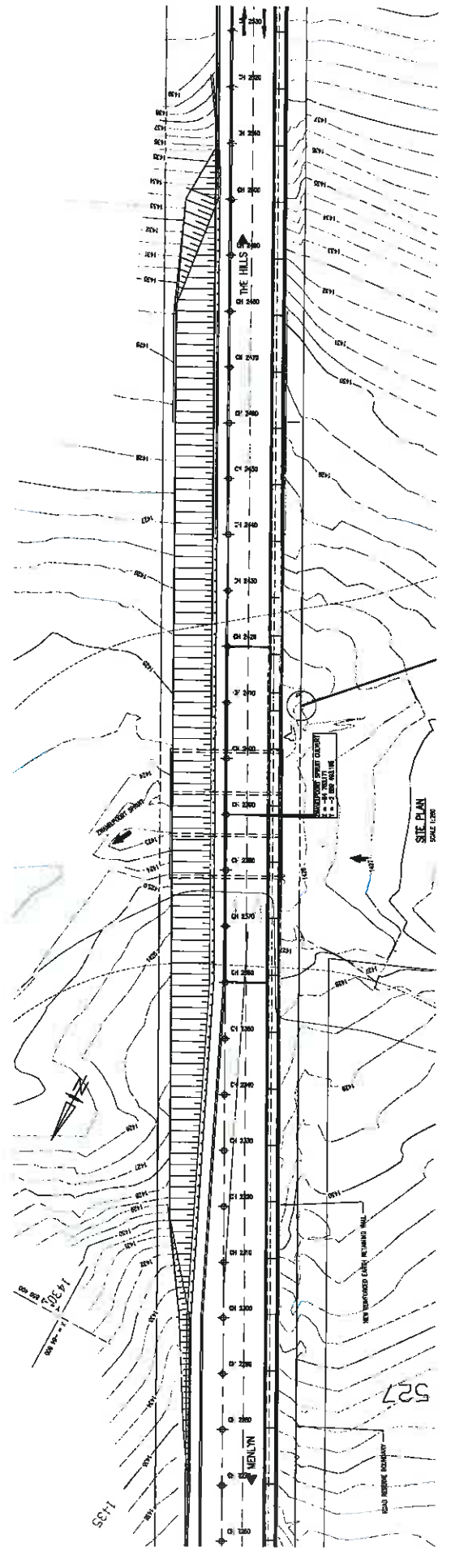
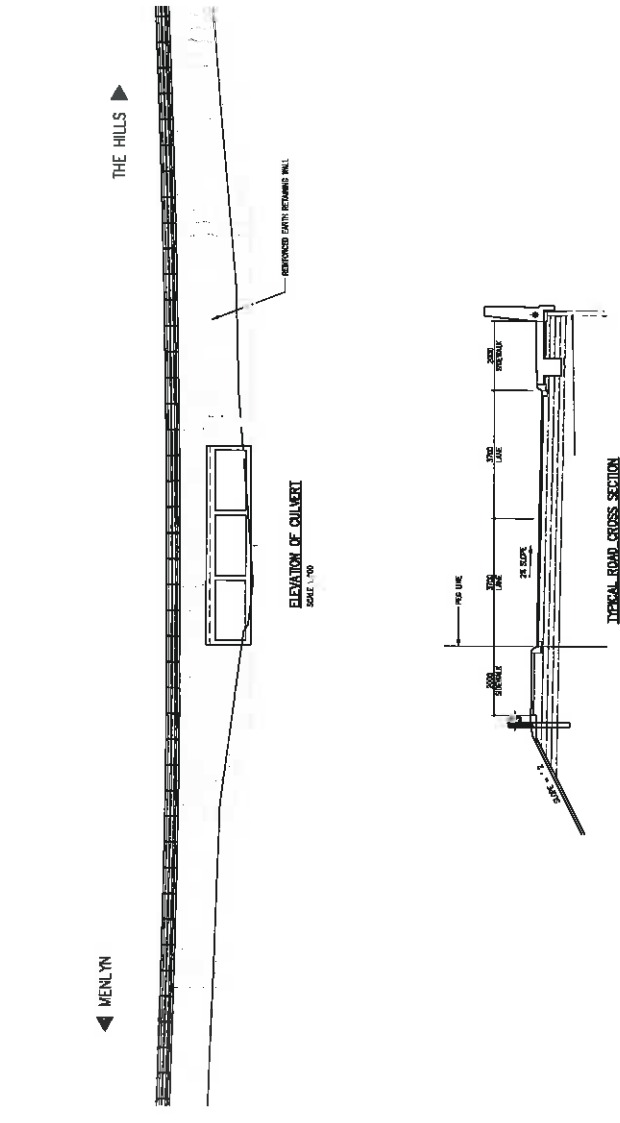
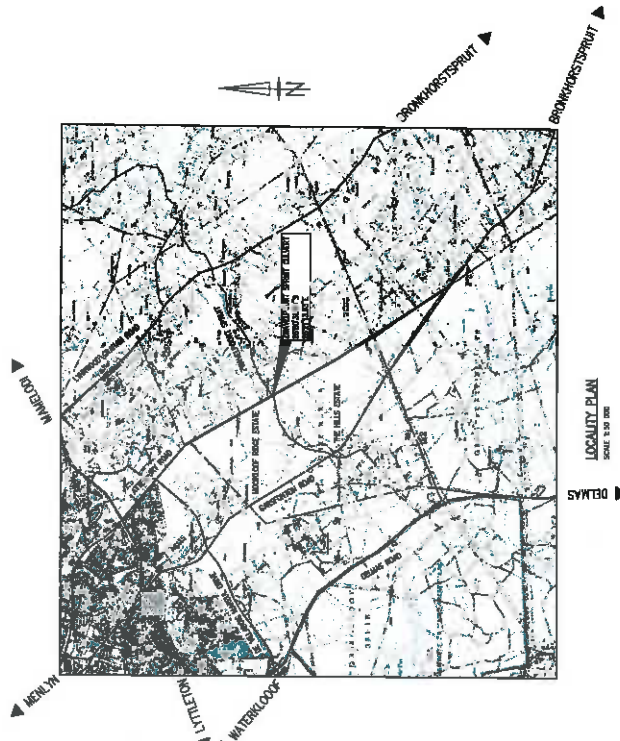


- DESIGN NOTES**
1. MATERIALS AND CONSTRUCTION:
 - a. REINFORCED CONCRETE - CLASS M20
 - b. PRECAST CONCRETE - CLASS M20
 - c. STRUCTURAL STEEL - S275
 2. DIMENSIONS:
 - a. ALL DIMENSIONS IN METERS
 - b. DIMENSIONS IN BRACKETED TYPEFACE ARE NOMINAL
 3. FINISHES:
 - a. REINFORCED CONCRETE SURFACES TO BE FINISHED WITH 10mm SAND
 - b. PRECAST CONCRETE SURFACES TO BE FINISHED WITH 10mm SAND
 - c. ROAD SURFACES TO BE FINISHED WITH 10mm SAND
 4. PROTECTIVE COATINGS:
 - a. ALL STEEL TO BE PAINTED WITH ANTI-RUST PAINT
 - b. ALL STEEL TO BE PAINTED WITH ANTI-RUST PAINT
 5. CONNECTIONS:
 - a. ALL STEEL CONNECTIONS TO BE WELDED
 - b. ALL STEEL CONNECTIONS TO BE WELDED
 6. LOADS AND STRESSES:
 - a. DESIGN LOADS TO BE AS PER SANS 1016
 - b. DESIGN LOADS TO BE AS PER SANS 1016
 7. MATERIALS:
 - a. ALL MATERIALS TO BE AS PER SANS 1016
 - b. ALL MATERIALS TO BE AS PER SANS 1016
 8. FINISHES:
 - a. ALL FINISHES TO BE AS PER SANS 1016
 - b. ALL FINISHES TO BE AS PER SANS 1016
 9. CONNECTIONS:
 - a. ALL CONNECTIONS TO BE AS PER SANS 1016
 - b. ALL CONNECTIONS TO BE AS PER SANS 1016
 10. DIMENSIONS:
 - a. ALL DIMENSIONS TO BE AS PER SANS 1016
 - b. ALL DIMENSIONS TO BE AS PER SANS 1016
 11. FINISHES:
 - a. ALL FINISHES TO BE AS PER SANS 1016
 - b. ALL FINISHES TO BE AS PER SANS 1016
 12. CONNECTIONS:
 - a. ALL CONNECTIONS TO BE AS PER SANS 1016
 - b. ALL CONNECTIONS TO BE AS PER SANS 1016
 13. DIMENSIONS:
 - a. ALL DIMENSIONS TO BE AS PER SANS 1016
 - b. ALL DIMENSIONS TO BE AS PER SANS 1016
 14. FINISHES:
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 - b. ALL FINISHES TO BE AS PER SANS 1016
 15. CONNECTIONS:
 - a. ALL CONNECTIONS TO BE AS PER SANS 1016
 - b. ALL CONNECTIONS TO BE AS PER SANS 1016
 16. DIMENSIONS:
 - a. ALL DIMENSIONS TO BE AS PER SANS 1016
 - b. ALL DIMENSIONS TO BE AS PER SANS 1016
 17. FINISHES:
 - a. ALL FINISHES TO BE AS PER SANS 1016
 - b. ALL FINISHES TO BE AS PER SANS 1016
 18. CONNECTIONS:
 - a. ALL CONNECTIONS TO BE AS PER SANS 1016
 - b. ALL CONNECTIONS TO BE AS PER SANS 1016
 19. DIMENSIONS:
 - a. ALL DIMENSIONS TO BE AS PER SANS 1016
 - b. ALL DIMENSIONS TO BE AS PER SANS 1016
 20. FINISHES:
 - a. ALL FINISHES TO BE AS PER SANS 1016
 - b. ALL FINISHES TO BE AS PER SANS 1016



DRAWING NUMBERS		PROJECT	CITY OF TSHWANE THE HILLS CIVIL CONCEPTS	CLIENT	DATE	SCALE	PROJECT NO.
7077/02			ATTERBERY ROAD EXTENSION ATTERBERY ROAD OVER ZWAMELOORT SPRUIT BRIDGE OPTION GENERAL ARRANGEMENT				
DRAWN BY		CHECKED BY		APPROVED BY		DATE	

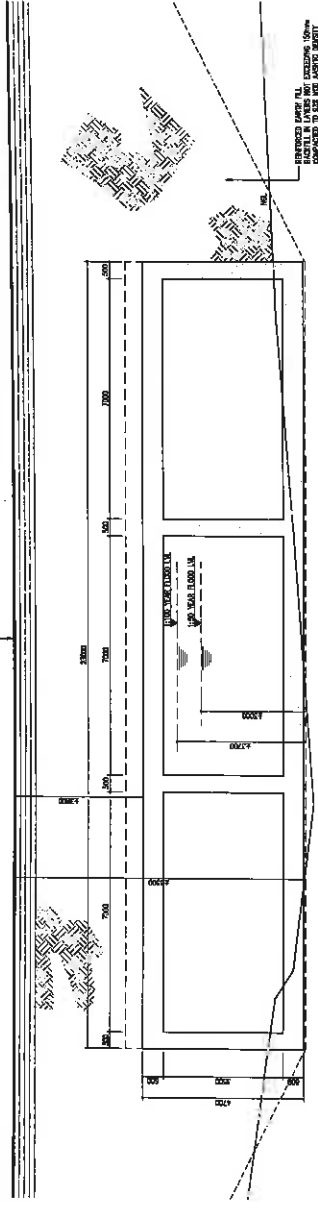




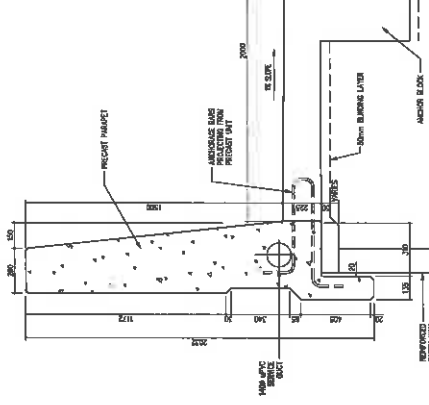
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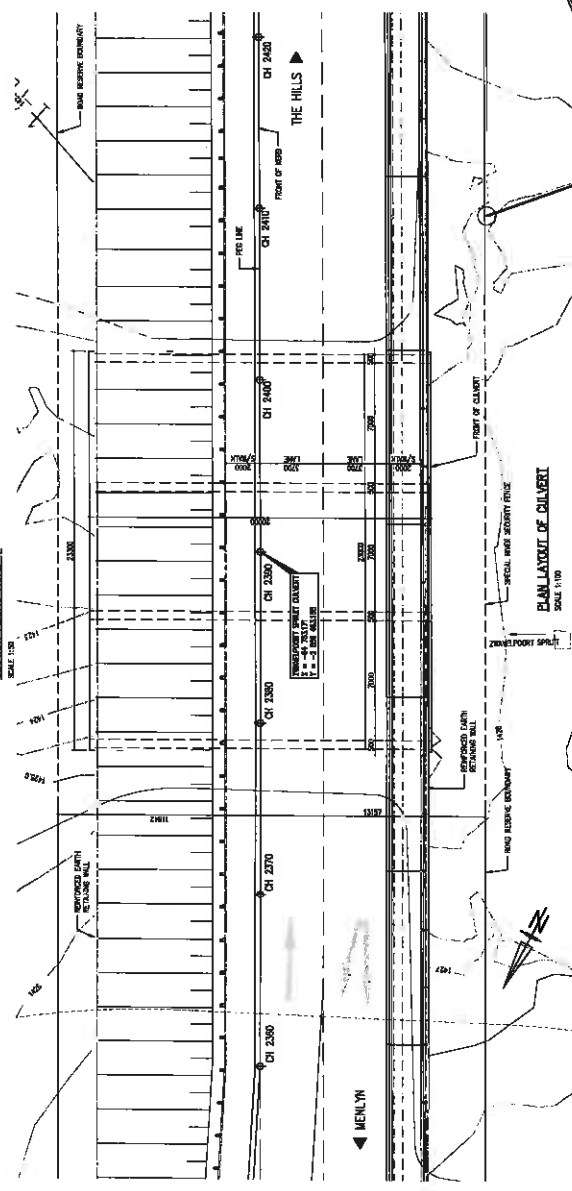
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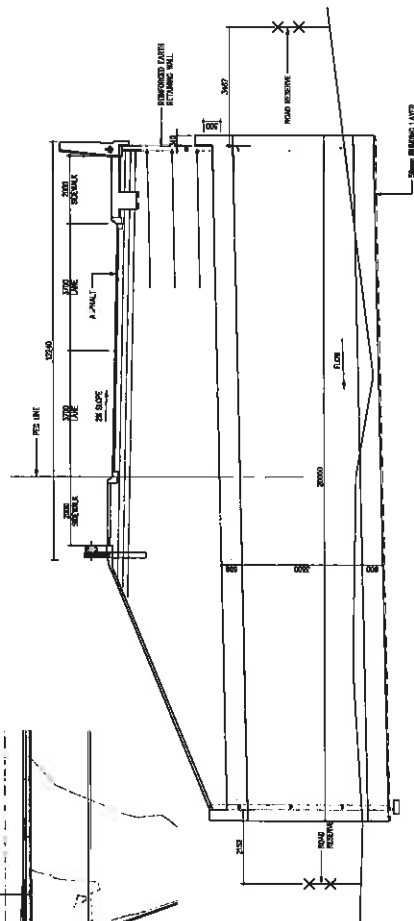
SECTION ALONG ROAD. §
SCALE 1:50



SECTION OF SIDEWALK
SCALE 1:10



PLAN LAYOUT OF CULVERT
SCALE 1:100



TYPICAL CROSS SECTION THROUGH CULVERT
SCALE 1:50

- DESIGN NOTES**
- GENERAL NOTES
 - REVISIONS OF STRUCTURE - (SEE DRAWING FOR CHANGES)
 - THE WORK HAS BEEN DONE BY THE CONTRACTOR AND CHECKED AT THE SITE.
 - THE ROAD HAS BEEN OPENED BY ACCORDANCE WITH THE ROAD ACT AND THE ROAD ACT AND THE ROAD ACT.
 - THE DRAWINGS HAVE BEEN DRAWN TO THE BEST OF OUR KNOWLEDGE AND BELIEF.
 - CONCRETE - ALL CONCRETE SHALL BE CLASS 30/40 CONCRETE.
 - REINFORCING - ALL REINFORCING SHALL BE CLASS 400.
 - ROOFING - ALL ROOFING SHALL BE CLASS 1/2 BRICK.
 - PAVING - ALL PAVING SHALL BE CLASS 1/2 BRICK.
 - LANDSCAPING - ALL LANDSCAPING SHALL BE CLASS 1/2 BRICK.
 - UTILITIES - ALL UTILITIES SHALL BE CLASS 1/2 BRICK.
 - FINISHES - ALL FINISHES SHALL BE CLASS 1/2 BRICK.
 - COLOURS - ALL COLOURS SHALL BE CLASS 1/2 BRICK.
 - PLANTS - ALL PLANTS SHALL BE CLASS 1/2 BRICK.
 - ACCESSORIES - ALL ACCESSORIES SHALL BE CLASS 1/2 BRICK.
 - OTHER - ALL OTHER SHALL BE CLASS 1/2 BRICK.

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Appendix G₆: Stormwater Master Plan



**CITY OF TSHWANE
METROPOLITAN MUNICIPALITY
TRANSPORTATION DEPARTMENT**

**STORMWATER MASTER PLANNING (SMP)
PART 2
REPORT NO. SMP / OLYMA_TYPAH / 2 / REP**

JUNE 2012

**OLYMPUS AGRICULTURAL HOLDINGS
TYGERPOORT AGRICULTURAL
HOLDINGS**

Prepared by:

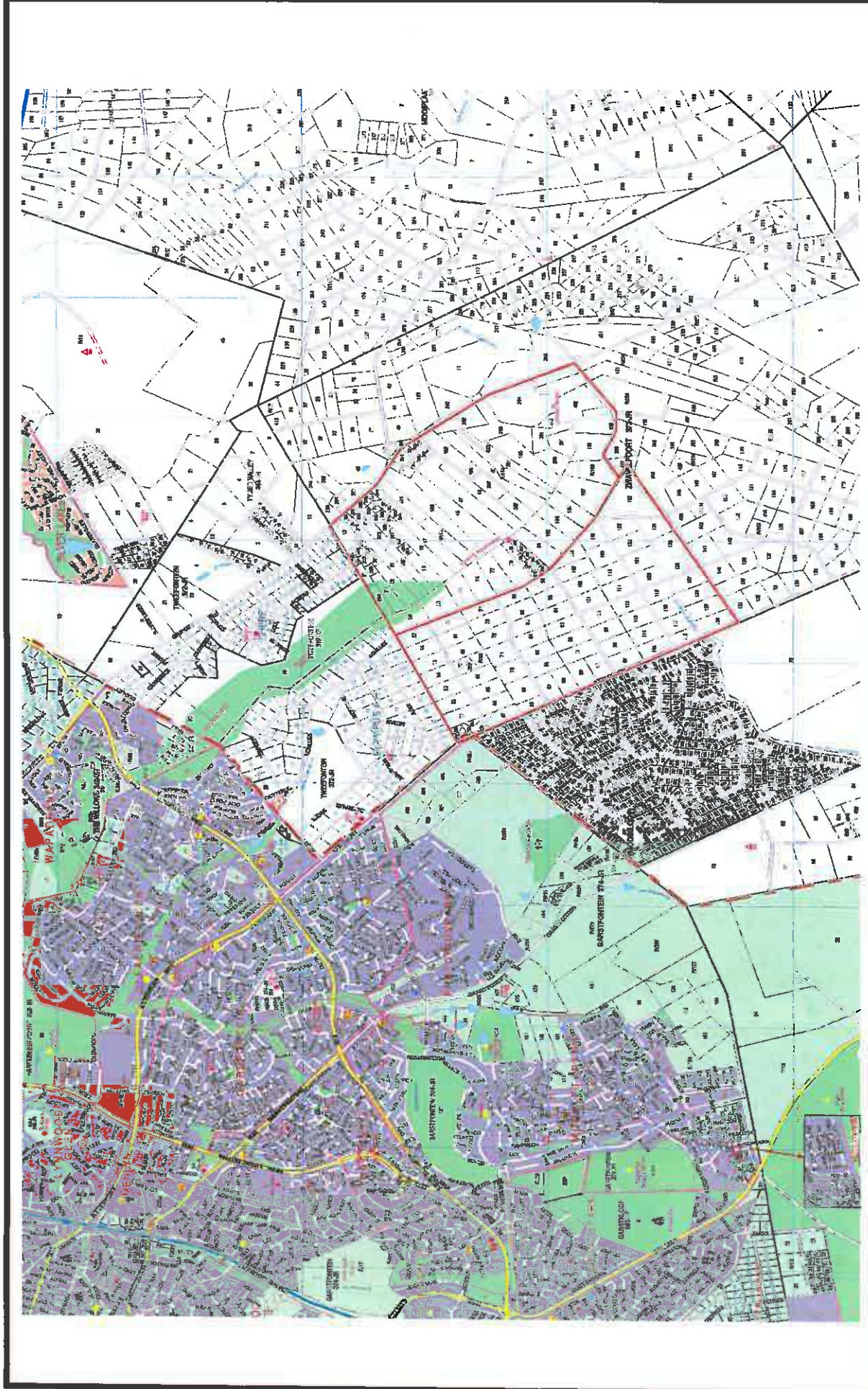


CIVIL CONCEPTS (PTY) LTD

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MENLO PARK, 0102**

**TEL: 012 365 1414
FAX: 012 365 1192
EMAIL: mail@civilconcepts.co.za**

DRAFT

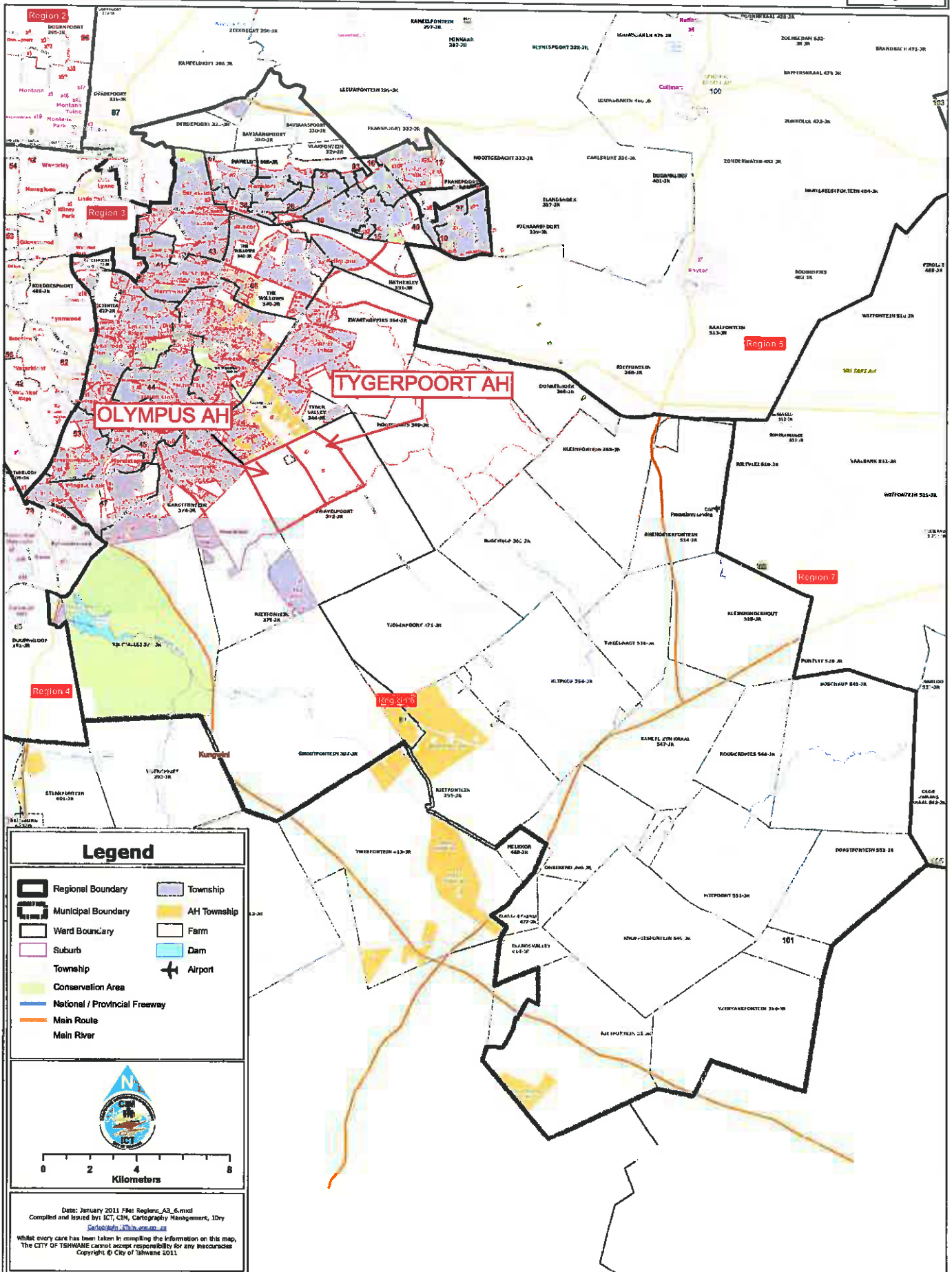
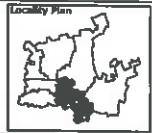


**LOCALITY PLAN
OLYMPUS AGRICULTURAL HOLDINGS
TYGERPOORT AGRICULTURAL HOLDINGS**



CITY OF TSHWANE

REGION 6



Legend

- Regional Boundary
- Municipal Boundary
- Ward Boundary
- Suburb
- Township
- Conservation Area
- National / Provincial Freeway
- Main Route
- Main River
- Township
- AH Township
- Farm
- Dam
- Airport



Date: January 2011 File: Region_02_6.mxd
 Compiled and issued by: ICT, CIM, Cartography Management, IDry
[CityofTshwane ICT@cityof.tshwane.gov.za](http://www.cityof.tshwane.gov.za)
 Whilst every care has been taken in compiling the information on this map,
 The CITY OF TSHWANE cannot accept responsibility for any inaccuracies.
 Copyright © City of Tshwane 2011.



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4. Development of Formal Drainage Systems	2
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1. INTRODUCTION

The City of Tshwane Metropolitan Municipality have appointed Messrs Civil Concepts (Pty) Ltd to assist with aspects for stormwater management in the Tshwane catchment, as well as the extended catchments of Nokeng, Kungwini and Moretele.

Certain areas in the Greater Tshwane Municipality are prone to development and densification. In order to address the township establishment or rezoning applications accurately, the Infrastructure Planning and Management – Roads and Stormwater Division requires Stormwater Master Plans that incorporates new developments to the stormwater network. Current undeveloped agricultural holdings also converts to townships and will required formalised stormwater systems.

Olympus AH and Tygerpoort AH were identified areas that required a SMP. Typical developments for the Olympus AH area are residential developments of stands in excess of 5000 m², community facilities, and churches. Tygerpoort AH is a combination of commercial and residential developments.

For the SMP Part 1 and 2, the major and minor drainage routes were identified and the run-off magnitudes were calculated. The findings have been presented on plans, SMP/OLYMAH/2/001 and SMP/TYPAH/2/001 (Refer **Annexure A**). This report should be read in conjunction with SMP/ZWAP/2/REP.

The costing of the networks have also been completed and is provided with the simulation results and proposed sizing in **Annexure B**.

This report describes the investigation, methodology and results of the SMP Part 1 and 2 - Major and Minor Stormwater Networks.

2. STUDY AREA

The drainage area is located in Region 6 of Tshwane and covers the Olympus AH and Tygerpoort AH areas. Refer to the locality plan in the front of the report.

The townships fall into the Swavelpoort Spruit, DPN19735 drainage area.

The size of the study area is approximately 1349 ha and is bordered by:

- K34 Lynnwood to the east;
- Swavelpoort Spruit to the south;
- Extension of Atterbury Road to the west;
- Ajax Street to the North in Olympus AH and Arthur Road in Tygerpoort AH.

The Bronberg Mountain range forms a watershed and separation between Olympus AH and Tygerpoort AH.

3. GENERAL DRAINAGE

Olympus AH situated on the western side of the Bronberg watershed, drains in a southern direction from the watershed formed by Ajax street towards the Swavelpoort Spruit. A natural low point runs through the centre of the catchment. Drainage occurs from the respective watersheds, namely Atterbury Road and the Bronberg Mountains towards the low point and eventually the spruit.

Tygerpoort AH is on the eastern side of the Bronberg Mountains. The catchment is separated by a natural high point to form a northern and southern part. No natural drainage routes exist for the northern part and the general drainage direction is easterly towards a natural low point on the east outside of the study area of the K34 provincial route. The upper parts of the southern catchment drains in similar manner, while the lower laying areas drain towards a natural low point and the Swavelpoort Spruit.

The topography of the Olympus AH area is steep and the average natural ground slope is 6.2 %, while the Tygerpoort AH is a combination of steep mountain slopes that flattens out to an average of 4.0%.

4. DEVELOPMENT OF FORMAL DRAINAGE SYSTEMS

The current land use is predominantly agricultural holdings and the existing infrastructure is substandard if compared to Tshwane's municipal standards. The roads and stormwater constructed are sub standard in terms of road width, geometry, pavement design, edging or kerbing, stormwater elements, the sizing thereof, stormwater inlets, etc.

In order to comply with municipal standards, any township has to connect to the municipal stormwater system with an underground connecting pipe or box culvert. With the SMP data available the Stormwater division can then indicate for each proposed development the stormwater connection point to a major network, as well as the downstream system required until an existing system or natural drainage route.

Consequently as development occurs, bulk services will be upgraded or provided which will include for surfaced roads on municipal standard and major stormwater systems.

There is limited stormwater constructed in the study area. Consequently, all proposed major networks are considered new systems. Natural drainage routes are utilised where possible and it was assumed that it will remain in the natural state. Hence no sizing was determined for channelisation of the natural routes.

5. SITE VERIFICATION

Site visits were conducted to verify the extent of the drainage problems and to identify stormwater routes.

6. CITY OF TSHWANE STORMWATER DESIGN PRINCIPLES

For the purpose of this study the design principles of the City of Tshwane were incorporated to determine the conduit sizes:

- All major and minor systems within road reserves must be a closed system in the form of pipe or box culverts.
- The major systems are a combination of street capacity and an underground system.
- A maximum flow depth of 100 mm may be used for calculating street capacity
- All townships must have an underground pipe connection to a municipal stormwater network
- The design flow is determined with the difference between the 1: 20 year run-off and the road capacity.
- A minimum 1: 2 year run-off connection must be provided
- If no road capacity is available, i.e. midblock or Class 3 roads, a 1: 20 year run-off connection must be provided
- The minimum pipe diameter in road reserves is 450 mm \varnothing .

7. SMP DESIGN APPROACH

This SMP consists of major and minor stormwater drainage networks. The design of the network is based on the following steps:

Major Networks:

- Selection of appropriate design standards.
- Determination of the major catchment for the area.
- Capturing of topographical data for each catchment i.e. slope, size, imperviousness percentage, and overland flow length.
- Determination of an anticipated stormwater drainage network and physical properties i.e. length and slope.
- Determination of the required types and sizes of the drainage network elements through hydrological modelling using Hydrosim V Software.

For this particular SMP a stormwater node or connection had to be provided for each individual property in order to comply with minimum standards.

All systems were considered major networks to accommodate the 1:20 year run-off for each property. The road capacity was included assuming roadways are 7,4 m wide with mountable kerbing. The pipe or box culvert size was determined according to the total flow less the flow in the road.

The information provided is however sufficient to enable the Roads and Stormwater department to comment on new township applications. Both the 1: 2 and 1: 20 year run-offs can be provided with an anticipated size of elements.

It is each applicant's prerogative to conduct a detail design to determine if only a 1:2 year connection can be provided or will a 1: 20 year be necessary. Utilizing the road capacity must also be investigated. The final sizing of elements will depend on the actual slope, road capacity and location.

Potential Attenuation Opportunities

Attenuation sites have been investigated, but due to loss of valuable property, potential developable land and loss of residential opportunities, none of the sites were further investigated.

Localised studies can be undertaken during feasibility stage.

8. RUN-OFF CALCULATION

The run-offs were calculated using Hydrosim V software. The following constants were used in the calculations:

- | | | |
|-----------------------------------|---|------------------------------------|
| • Mean annual precipitation | - | 690 mm |
| • Hydrograph type | - | Triangular |
| • Time to peak ratio | - | 0.35 |
| • Minimum storm duration | - | 30 minutes |
| • Percentage imperviousness | - | Residential 60% |
| | - | Light residential Large Erven 35 % |
| | - | Street and hard open surfaces 80% |
| | - | Open spaces 5 % |
| • Run-off length for calculations | - | Actual lengths of each catchment |

- Infiltration routine - Horton = 0,00139

Comparative calculations were done using deterministic methods like the Rational Method and Alternative Rational Method.

Parameters for the calculation were:

C factor = 0.352

Overland r factor = 0,05

MAP = 690

The average results indicated that the HSM5 results are fairly high in comparison to the deterministic methods. With the latter being the most commonly used - it is considered more realistic to adjust the HSM5 results by applying an area reduction factor (ARF).

The ARF of 0,85 gave a final outflow result similar to the deterministic methods and will be used for the final results.

The run-off for both the 1:2 and 1:20 year frequency were then calculated with the ARF discussed above. A design flow and applicable size were then determined based on a 2 year flow for minor systems and 20 year flow for major systems. Indicative sizing and cost estimates are shown on the result tables. (Refer Annexure B).

9. COSTING AND UNIT RATES

Each network's estimated construction cost was determined for budget purposes. The calculation methods are described in the clauses hereunder.

9.1 Pipes and Rectangular Culverts

A unit rate per metre for the various required culvert sizes was determined. Where applicable, the inlet and outlet structure cost varying between R5 500 and R6 500 per structure was also added. Each culvert size was determined and its cost was calculated by multiplying the unit rate and length.

9.2 Summary of Costing

The following allowances were added to the cost of each network in order to calculate the total cost of a network:

- Preliminary and General costs = 10 %.
- Contingencies = 10 %.
- Professional fees and other costs = 15 %.
- VAT = 14 %.

10. CATCHMENT AREAS AND DRAINAGE PROPOSALS

Refer to the diagram below for the general layout of the study area and catchment areas.



10.1 Olympus Agricultural Holdings

The sub catchments are mostly undeveloped agricultural holdings with single residential dwellings. Larger Agricultural Holdings are subdivided into large erven as densification occurs. For simulation purposes it was assumed to be low density residential areas and commercial areas where applicable.

Catchment 1

The catchment is situated in the northern part of the study area. Drainage routes are shown along property boundaries and roads.

The general drainage direction is towards the centre of the catchment where a collector networks is proposed to drain towards the origin of the natural low point.

Drainage elements vary from 450 mm \emptyset to 1800 mm \emptyset pipe culverts including a 2.2 x 1.7 m box culvert.

Catchment 2.

Catchment 2 consists of runoff from the Bronberg Mountain watershed towards Archilles road. A collector network is then proposed along the road to drain eventually to a smaller tributary of the natural low point.

Drainage elements vary from 450 mm \emptyset to 1350 mm \emptyset pipe culverts.

Catchment 3

Situated immediately south of Catchment 1 is Catchment 3. It is bounded by Atterbury Road extension to the west and the natural low point to the east.

Drainage from Atterbury road drains towards a low point on the western boundary. A network is then proposed from the low point to follow the property boundaries eastwards along the low point towards the natural drainage system.

Drainage elements vary from 450 mm \emptyset to 1500 mm \emptyset pipe culverts.

Catchment 4

Catchment 4 is formed around the natural low point running in a north to south direction. Several drainage routes are proposed along property boundaries until it reaches the natural low point.

Drainage elements vary from 450 mm \emptyset to 1200 mm \emptyset pipe culverts.

Catchment 5

Catchment 5 is situated on the south eastern part of the study area and drain as from the Atterbury road extension in an easterly direction towards the low point. A collector network is proposed to drain south until the outlet in the Swavelpoort Spruit.

Drainage elements vary from 450 mm \emptyset to 1200 mm \emptyset pipe culverts.

Catchment 6

The most south eastern part of the study area where drainage occurs from the Bronberg Mountain in a westerly direction towards the natural low point.

Two networks are proposed, one along Achilles road and the second following a natural low point.

Drainage elements vary from 450 mm \emptyset to 1350 mm \emptyset pipe culverts.

Catchment 7

Catchment 7 is the remainder sub catchments adjacent to the Swavelpoort Spruit. No collector networks will be required as drainage outlets will be directly to the spruit.

10.2 Tygerpoort Agricultural Holdings

Catchment 1

Catchment 1 is on the northern boundary of the study area with Bronberg Mountains on the western side and the K34 on the eastern boundary.

A third of the catchment consists of mountainous areas and is most probably non developable. The lower lying portions are existing agricultural holdings to be developed in higher density residential.

Drainage occurs mostly with collector networks in an easterly direction towards existing culverts under the K34 – Lynnwood road. The systems will continue until a natural low point on the Eastern side of the study area.

Catchments lying in the mountainous area were defined along property boundaries. Each property should then be provided with a connection point to drain runoff. An alternative combined catchment with a cut off system can also be considered to drain to node R27-6 and then east along Arthur road.

This will substantially decrease elements within the developable area, but increase the proposed element, size along Arthur road.

For the purpose of this study the worst case scenario are shown and is also the closest simulation of the existing scenario. A cut off system will require additional servitudes and negotiations. The proposed alternative can be investigated as development occurs.

Existing drainage structures under the K34 have to be upgraded to accommodate the increased runoff.

Drainage elements vary from 450 mm \emptyset to 1800 mm \emptyset pipe culverts as well as 2.2 x 1.7 m box culverts.

Catchment 2

Catchment 2 is similar to Catchment 1 with the Bronberg Mountains forming the western boundary and the eastern drainage direction towards the K34 and the natural low point further down.

This catchment mainly consists of an existing quarry and adjacent commercial properties. Impervious factors will be adjusted to high impervious characteristics.

Alternatives can also be considered for runoff from the mountain areas to combine drainage routes and minimise internal systems downstream.

Drainage elements vary from 450 mm \emptyset to 1650 mm \emptyset pipe culverts including a 2.5 x 1.8 m box culvert.

Catchment 3

A natural high point separates Catchment 3 from 2. It is mostly larger properties with potential subdivision and densification to residential and commercial.

Drainage occurs as for Catchments 1 and 2 from the Bronberg Mountains east under the K34 towards the natural low point.

Drainage elements vary from 450 mm \emptyset to 1800 mm \emptyset pipe culverts.

Catchment 4

Catchment 4 is bounded by the Swavelpoort Spruit on the southern side. It consists mainly of larger properties with potential subdivision and densification to residential.

Two drainage directions are proposed. The one is a natural low point draining runoff from the Bronberg Mountain in a southern direction towards the spruit. The second is a drainage network with a collector network along the K34 in a southern direction until it reaches the spruit.

Drainage elements vary from 450 mm \emptyset to 1350 mm \emptyset pipe culverts.

Summary of Drainage Proposals

A total number of 258 drainage nodes, including natural stream nodes, have been used for the analysis of the stormwater proposals in the study area of 1349 ha.

Refer to **Annexure B** for a summary of all systems, with design flows, proposed sizing and cost estimates for both scenarios, include or exclude road capacity. Also refer to **Annexure C** for Sub-Catchment Details.

The total cost of all networks is R 186 171 000 (including Road Capacity).

11. CONCLUSION

The SMP Part 1 and 2 were completed simultaneously which addresses both the major and minor stormwater systems. There were several major drainage routes identified for the total of 11 catchments.

The type and size of each element can be determined during detail design phases, as well as the impact of the road capacity.

The total cost of all proposed networks as per this study is R 186 171 000 (including Road Capacity).



W STANDER
for CIVIL CONCEPTS



SMP / OLYMAH _ TYPAH / 2 / REP

ANNEXURE A

STORMWATER MASTER PLANS – PART 2

SMP/OLYMAH/2/001

SMP/TYPAH/2/001

NOTES:

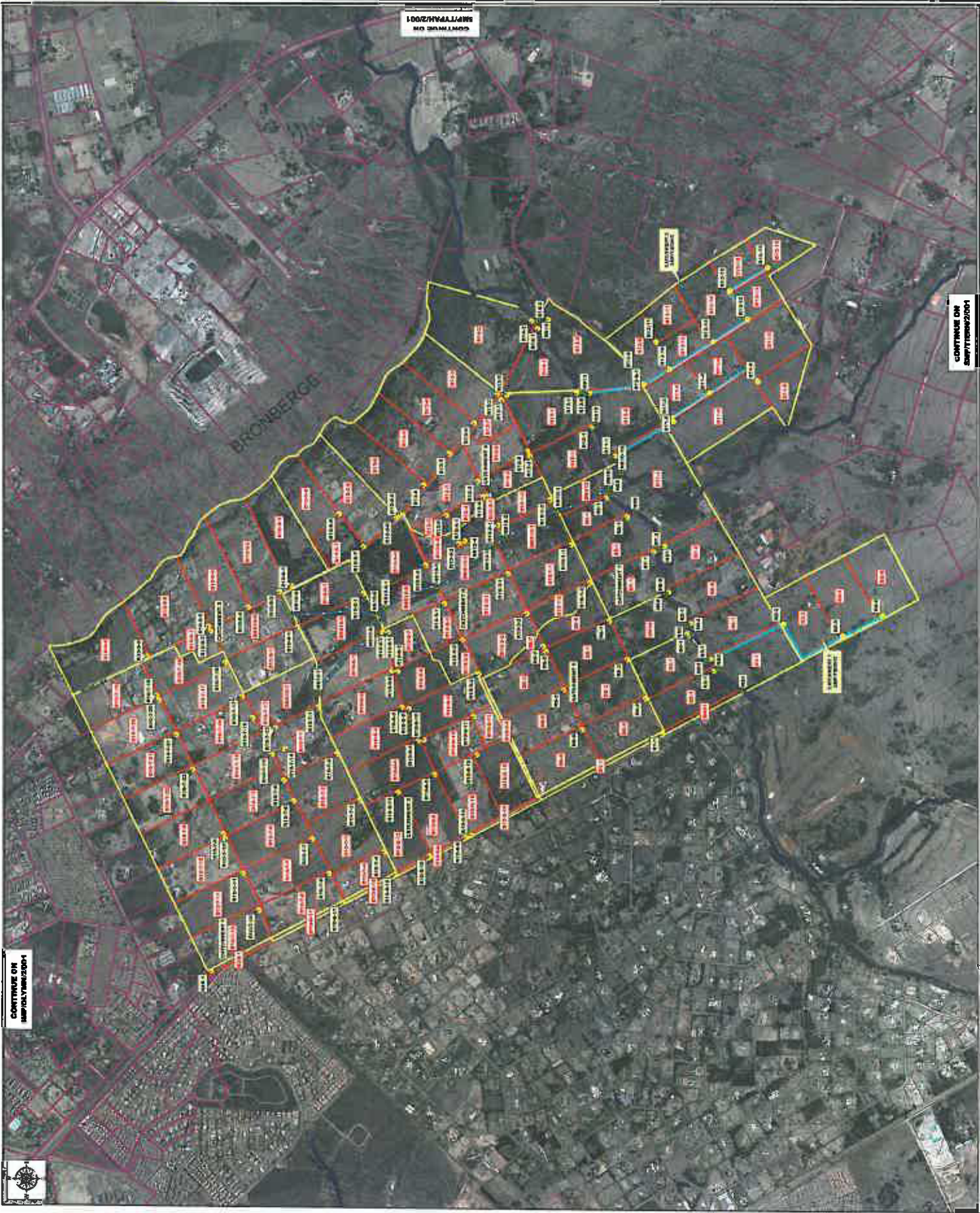
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- a) RETURN PERIOD : 24 YR
 - MAJOR SYSTEM : 2 YR
 - MINOR SYSTEM : 2 YR
- b) MAP = 600 mm
- c) % IMPERVIOUSNESS:
 - LIGHT RESIDENTIAL : 25%
 - LIGHT COMMERCIAL : 40%
 - ROADS : 80%

LEGEND

- MAIN CATCHMENT
- BUS CATCHMENTS
- ADJACENT BUS CATCHMENTS
- NATURAL STREAM NODES
- STORMWATER NODES
- TSHWANE RIVERS
- STORMWATER ROUTES
- NATURAL LOW POINT

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REVISION		
CLIENT		
 CITY OF TSHWANE LEADING EXCELLENCE		
CONSULTING CIVIL & STRUCTURAL ENGINEERS PO BOX 8114 Mera Park, 1182 Edull. Tel: 012 386-416 Fax: 012 386-1182 email: info@tshwane.co.za		
PROJECT	TSHWANE STORMWATER MASTER PLAN/NO. 1 PART 2 : NETWORK MODELLING	
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DRAWING NO	SMP/OLY/HA/2/001	
DESIGNED	W. STANDE	
DRAWN	T. VAN RENSK	
CHECKED	T. STANDE	
SCALE	1:10 000	



CONTINUE ON SMP/OLY/HA/2/001

CONTINUE ON SMP/OLY/HA/2/001

NOTES:

1. RUNOFF CALCULATION PERFORMED WITH HYDRO3M COMPUTER PROGRAM USING THE FOLLOWING CONSTANTS:

- a) RETURN PERIODS:
 - MAJOR SYSTEM / 20 YR.
 - MINOR SYSTEM / 2 YR.

b) MAP = 600 mm

- c) % IMPERVIOUSNESS:
 - RESIDENTIAL : 60%
 - OPEN SPACES : 5%
 - ROADS : 80%

LEGEND

- MAIN CATCHMENT
- SUB CATCHMENTS
- ADJACENT SUB CATCHMENTS
- NATURAL STREAM NODES
- STORMWATER NODES
- TOWNWATER RIVERS
- STORMWATER ROUTES
- NATURAL LOW POINT

1 08/02/22 | REVISION 1

0 11/10/21 | FIRST ISSUE

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CLIENT



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TEL: 011 545 346-344
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PROJECT: TSHWANE STORMWATER MASTER PLANNING

PART 2: NETWORK MODELLING

TOWNSHIP: TYGERPOORT AGRICULTURAL HOLDINGS

DRAINAGE BASIN: DPH189735

DRAWING NO: SWP/TPM/2001

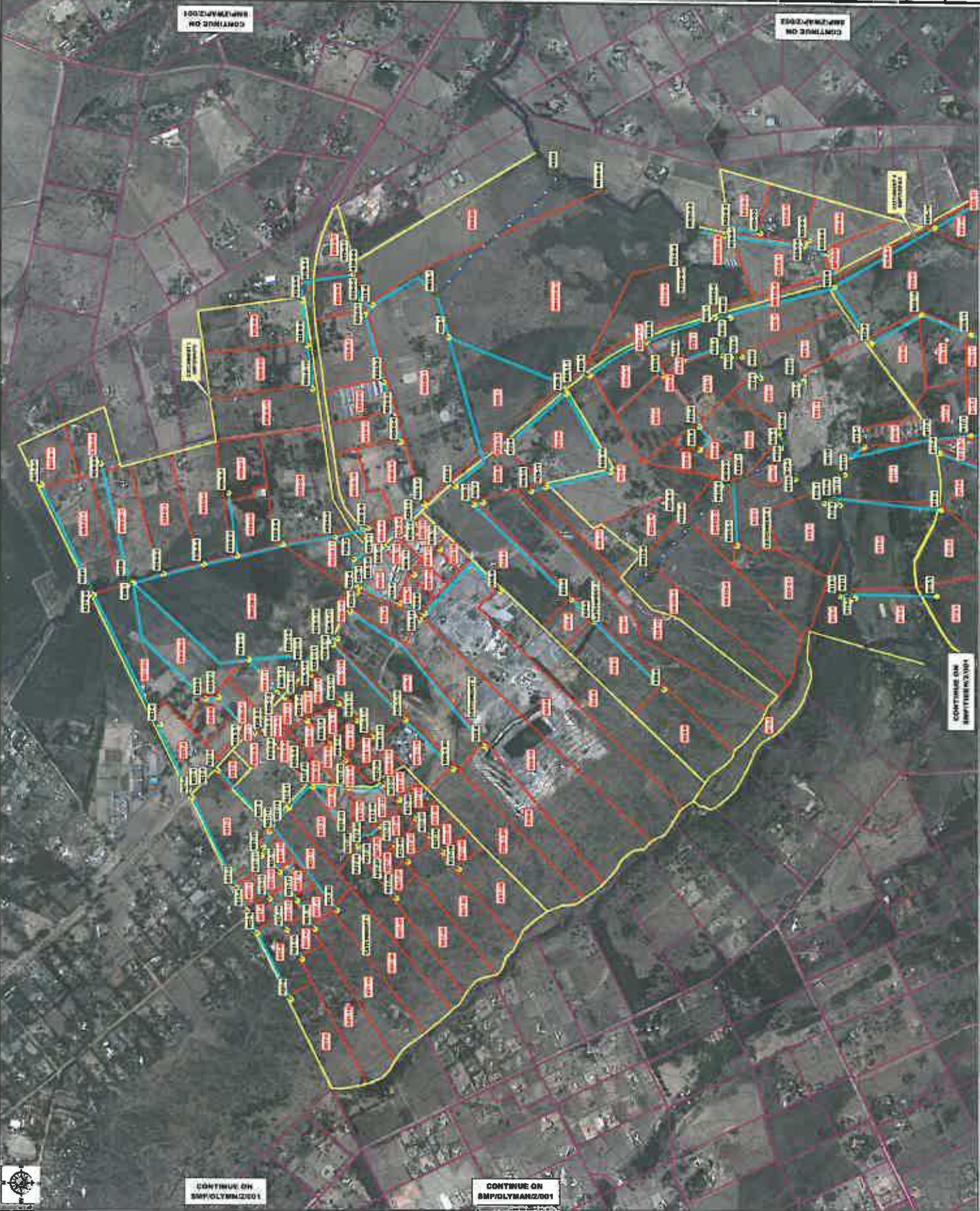
DESIGNED: W. STANDE

DRAWN: T. VAN NIEKERK

CHECKED: W. STANDE

SCALE: 1:10 000

DATE: 08/02/22



CONTINUE ON
SWP/POLYMAN/2/001

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SWP/POLYMAN/2/001

CONTINUE ON
SWP/POLYMAN/2/001

CONTINUE ON
SWP/POLYMAN/2/001

CONTINUE ON
SWP/POLYMAN/2/001



DETAILS OF STORMWATER NETWORKS

COMBINED 2 AND 20 YEAR

APPRAISAL ID No	PROPERTY MAP INDEX	SUBDIVISION	ZONING	APPROVAL DATE	APPROVAL TYPE	APPROVED CATEGORY	APPROVED BY	Area (sqm)	Area (sqft)	Volume (m³)	Volume (cu ft)	Floor Area (sqm)	Floor Area (sqft)	Structure	Description	Use	Yield (m³/sqm)	Yield (cu ft/sqft)	Value	Rate	Total Value		
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101R10-2																							
101R10-3																							
101R10-4																							
101R10-5																							
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101R10-48																							
101R10-49																							
101R10-50																							



SUB-CATCHMENT DETAILS

STORMWATER MASTER PLANNING - OLYMPUS AH

Total Area: 894.58

StormShape: Triangular

M.A.P:690

Catchment	Drain To	Area (Ha)	Length (M)	Slope (m/m)	% Imp	% FutImp	Depr Imp	Depr Per	Infilt i (mm/hr)	Infilt f (mm/hr)	n Per	n Imp
D1-1	R1-1	1.67	741.00	0.0610	80	80	1.0	3.0	45	6	0.150	0.016
D10-1-1	R10-1-1	8.65	414.00	0.0600	25	25	1.0	3.0	45	6	0.150	0.016
D10-1-2	R10-1-2	3.67	373.00	0.0400	25	25	1.0	3.0	45	6	0.150	0.016
D10-1-3	R10-1-3	4.45	310.00	0.0910	25	25	1.0	3.0	45	6	0.150	0.016
D10-2-1	R10-2-1	2.86	222.00	0.1310	25	25	1.0	3.0	45	6	0.150	0.016
D10-3-1	R10-3-1	8.81	420.00	0.0450	25	25	1.0	3.0	45	6	0.150	0.016
D10-3-2	R10-3-2	7.65	410.00	0.0420	25	25	1.0	3.0	45	6	0.150	0.016
D10-4-2	R10-4-2	2.42	248.00	0.0560	25	25	1.0	3.0	45	6	0.150	0.016
D10-5-1	R10-5-1	4.29	263.00	0.0470	25	25	1.0	3.0	45	6	0.150	0.016
D10-5-2	R10-5-2	3.58	242.00	0.0420	25	25	1.0	3.0	45	6	0.150	0.016
D10-5-3	R10-5-3	1.26	719.00	0.0560	80	80	1.0	3.0	45	6	0.150	0.016
D10-5-4	R10-5-4	9.69	406.00	0.0700	25	25	1.0	3.0	45	6	0.150	0.016
D10-5-6	R10-5-6	12.29	619.00	0.1090	25	25	1.0	3.0	45	6	0.150	0.016
D10-5-7	R10-5-7	4.45	274.00	0.0580	25	25	1.0	3.0	45	6	0.150	0.016
D10-5-8	R10-5-8	8.28	412.00	0.1300	25	25	1.0	3.0	45	6	0.150	0.016
D10-6-1	R10-6-1	8.69	506.00	0.0300	25	25	1.0	3.0	45	6	0.150	0.016
D10-6-10	R10-6-10	5.82	325.00	0.0390	25	25	1.0	3.0	45	6	0.150	0.016
D10-6-11	R10-6-11	2.46	202.00	0.0400	25	25	1.0	3.0	45	6	0.150	0.016
D10-6-12	R10-6-12	7.61	383.00	0.0640	25	25	1.0	3.0	45	6	0.150	0.016
D10-6-13	R10-6-13	8.21	415.00	0.0570	25	25	1.0	3.0	45	6	0.150	0.016
D10-6-14	R10-6-14	1.03	414.00	0.0100	80	80	1.0	3.0	45	6	0.150	0.016
D10-6-16	R10-6-16	0.65	302.00	0.0120	80	80	1.0	3.0	45	6	0.150	0.016
D10-6-17	R10-6-17	0.96	437.00	0.0070	80	80	1.0	3.0	45	6	0.150	0.016
D10-6-18	R10-6-5	8.09	409.00	0.0630	25	25	1.0	3.0	45	6	0.150	0.016
D10-6-2	R10-6-2	8.81	489.00	0.0370	25	25	1.0	3.0	45	6	0.150	0.016
D10-6-3	R10-6-3	8.58	449.00	0.0440	25	25	1.0	3.0	45	6	0.150	0.016
D10-6-4	R10-6-4	8.58	451.00	0.0510	25	25	1.0	3.0	45	6	0.150	0.016
D10-6-5	R10-6-5	8.07	417.00	0.0680	25	25	1.0	3.0	45	6	0.150	0.016
D10-6-6	R10-6-6	0.95	418.00	0.0210	80	80	1.0	3.0	45	6	0.150	0.016
D10-6-7	R10-6-7	4.38	241.00	0.0390	25	25	1.0	3.0	45	6	0.150	0.016
D10-6-8	R10-6-8	5.13	284.00	0.0230	25	25	1.0	3.0	45	6	0.150	0.016
D10-6-9	R10-6-9	8.31	432.00	0.0230	25	25	1.0	3.0	45	6	0.150	0.016
D10-7-1	R10-7-1	8.72	416.00	0.0400	25	25	1.0	3.0	45	6	0.150	0.016
D10-7-10	R10-7-10	8.56	430.00	0.0350	25	25	1.0	3.0	45	6	0.150	0.016
D10-7-11	R10-7-11	8.50	431.00	0.0250	25	25	1.0	3.0	45	6	0.150	0.016
D10-7-12	R10-7-12	7.66	418.00	0.0130	25	25	1.0	3.0	45	6	0.150	0.016
D10-7-13	R10-7-13	0.61	71.00	0.0880	25	25	1.0	3.0	45	6	0.150	0.016
D10-7-15	R10-7-15	8.53	393.00	0.1010	25	25	1.0	3.0	45	6	0.150	0.016
D10-7-16	R10-7-16	8.56	398.00	0.0430	25	25	1.0	3.0	45	6	0.150	0.016
D10-7-17	R10-7-17	8.54	433.00	0.0270	25	25	1.0	3.0	45	6	0.150	0.016
D10-7-18	R10-7-18	6.08	427.00	0.0250	25	25	1.0	3.0	45	6	0.150	0.016
D10-7-19	R10-7-19	8.56	429.00	0.0230	25	25	1.0	3.0	45	6	0.150	0.016
D10-7-2	R10-7-2	8.57	393.00	0.0390	25	25	1.0	3.0	45	6	0.150	0.016
D10-7-20	R10-7-20	8.59	428.00	0.0230	25	25	1.0	3.0	45	6	0.150	0.016
D10-7-21	R10-7-21	8.55	436.00	0.0430	25	25	1.0	3.0	45	6	0.150	0.016
D10-7-22	R10-7-22	8.59	434.00	0.0360	25	25	1.0	3.0	45	6	0.150	0.016
D10-7-3	R10-7-3	9.71	413.00	0.0400	25	25	1.0	3.0	45	6	0.150	0.016
D10-7-4	R10-7-4	4.62	328.00	0.0260	25	25	1.0	3.0	45	6	0.150	0.016
D10-7-5	R10-7-5	8.63	413.00	0.0310	25	25	1.0	3.0	45	6	0.150	0.016

Catchment	Drain To	Area (Ha)	Length (M)	Slope (m/m)	% Imp	% FutImp	Depr Imp	Depr Per	Infilt i (mm/hr)	Infilt f (mm/hr)	n Per	n Imp
D10-7-6	R10-7-6	8.57	438.00	0.0330	25	25	1.0	3.0	45	6	0.150	0.016
D10-7-7	R10-7-7	8.52	435.00	0.0300	25	25	1.0	3.0	45	6	0.150	0.016
D10-7-8	R10-7-8	7.69	454.00	0.0080	25	25	1.0	3.0	45	6	0.150	0.016
D10-7-9	R10-7-9	8.56	417.00	0.0630	25	25	1.0	3.0	45	6	0.150	0.016
D10-8-1	R10-8-1	7.90	419.00	0.0230	25	25	1.0	3.0	45	6	0.150	0.016
D10-9-1	R10-9-1	8.55	448.00	0.0520	25	25	1.0	3.0	45	6	0.150	0.016
D10-9-2	R10-9-2	13.08	556.00	0.0940	25	25	1.0	3.0	45	6	0.150	0.016
D10-9-3	R10-9-3	11.97	592.00	0.0940	25	25	1.0	3.0	45	6	0.150	0.016
D10-9-4	R10-9-4	11.46	459.00	0.0760	25	25	1.0	3.0	45	6	0.150	0.016
D10-9-5	R10-9-5	14.14	459.00	0.0560	25	25	1.0	3.0	45	6	0.150	0.016
D10-9-6	R10-9-6	13.07	502.00	0.0260	25	25	1.0	3.0	45	6	0.150	0.016
D10-9-7	R10-9-7	2.52	166.00	0.0230	25	25	1.0	3.0	45	6	0.150	0.016
D11-1	R11-1	20.77	638.00	0.0280	25	25	1.0	3.0	45	6	0.150	0.016
D11-2	R11-2	12.78	580.61	0.0970	25	25	1.0	3.0	45	6	0.150	0.016
D11-3	R11-3	6.16	362.51	0.0822	25	25	1.0	3.0	45	6	0.150	0.016
D11-4	R11-4	5.53	332.99	0.0777	25	25	1.0	3.0	45	6	0.150	0.016
D11-5	R11-5	10.24	435.88	0.0648	25	25	1.0	3.0	45	6	0.150	0.016
D11-6	R11-6	5.63	235.78	0.0903	25	25	1.0	3.0	45	6	0.150	0.016
D12-1	R12-1	9.20	415.00	0.0630	25	25	1.0	3.0	45	6	0.150	0.016
D12-2	R12-2	4.41	321.00	0.1130	25	25	1.0	3.0	45	6	0.150	0.016
D12-3	R12-3	8.87	436.00	0.0830	25	25	1.0	3.0	45	6	0.150	0.016
D12-4	R12-4	1.65	228.00	0.0500	25	25	1.0	3.0	45	6	0.150	0.016
D12-5	R12-5	1.76	143.00	0.0470	25	25	1.0	3.0	45	6	0.150	0.016
D12-6	R12-6	5.52	348.00	0.0950	25	25	1.0	3.0	45	6	0.150	0.016
D13-1	R13-1	10.46	394.00	0.0750	25	25	1.0	3.0	45	6	0.150	0.016
D13-10	R13-10	4.25	308.96	0.1221	25	25	1.0	3.0	45	6	0.150	0.016
D13-11	R13-11	4.77	323.22	0.2016	25	25	1.0	3.0	45	6	0.150	0.016
D13-12	R13-12	4.48	293.33	0.0834	25	25	1.0	3.0	45	6	0.150	0.016
D13-13	R13-13	4.02	287.00	0.0636	25	25	1.0	3.0	45	6	0.150	0.016
D13-14	R13-14	8.89	447.50	0.1183	25	25	1.0	3.0	45	6	0.150	0.016
D13-15	R13-15	4.82	256.50	0.0575	25	25	1.0	3.0	45	6	0.150	0.016
D13-3	R13-3	10.33	532.00	0.1760	25	25	1.0	3.0	45	6	0.150	0.016
D13-4	R13-4	10.97	527.00	0.1440	25	25	1.0	3.0	45	6	0.150	0.016
D13-5	R13-5	10.55	531.00	0.1440	25	25	1.0	3.0	45	6	0.150	0.016
D13-6	R13-6	12.22	606.00	0.1320	25	25	1.0	3.0	45	6	0.150	0.016
D13-7	R13-7	3.33	252.00	0.0540	25	25	1.0	3.0	45	6	0.150	0.016
D13-8	R13-8	10.23	432.00	0.0580	25	25	1.0	3.0	45	6	0.150	0.016
D13-9	R13-9	6.53	403.40	0.1806	25	25	1.0	3.0	45	6	0.150	0.016
D14-1	R14-1	8.44	384.00	0.0940	25	25	1.0	3.0	45	6	0.150	0.016
D14-2	R14-2	20.35	572.00	0.1940	25	25	1.0	3.0	45	6	0.150	0.016
D14-3	R14-3	12.69	654.00	0.0560	25	25	1.0	3.0	45	6	0.150	0.016
D2-1	R2-1	7.71	415.00	0.1370	25	25	1.0	3.0	45	6	0.150	0.016
D2-2	R2-2	9.47	458.01	0.0584	25	25	1.0	3.0	45	6	0.150	0.016
D2-3	R2-3	9.38	451.51	0.0643	25	25	1.0	3.0	45	6	0.150	0.016
D2-4	R2-4	9.43	458.22	0.0723	25	25	1.0	3.0	45	6	0.150	0.016
D29-1	R29-1	1.03	369.00	0.0070	80	80	1.0	3.0	45	6	0.150	0.016
D3-1	R3-1	9.82	483.00	0.0740	25	25	1.0	3.0	45	6	0.150	0.016
D4-1	R4-1	8.60	402.00	0.1420	25	25	1.0	3.0	45	6	0.150	0.016
D5-1	R5-1	9.52	469.00	0.0450	25	25	1.0	3.0	45	6	0.150	0.016
D6-1	R6-1	8.63	423.00	0.1030	25	25	1.0	3.0	45	6	0.150	0.016
D6-2	R6-2	8.73	415.00	0.0670	25	25	1.0	3.0	45	6	0.150	0.016

Catchment	Drain To	Area (Ha)	Length (M)	Slope (m/m)	% Imp	% FutImp	Depr Imp	Depr Per	Infilt i (mm/hr)	Infilt f (mm/hr)	n Per	n Imp
D6-3	R6-3	8.69	419.00	0.0880	25	25	1.0	3.0	45	6	0.150	0.016
D6-4	R6-4	8.30	409.00	0.0630	25	25	1.0	3.0	45	6	0.150	0.016
D6-5	R6-5	8.68	419.00	0.0520	25	25	1.0	3.0	45	6	0.150	0.016
D6-6	R6-6	8.74	418.00	0.0490	25	25	1.0	3.0	45	6	0.150	0.016
D6-7	R6-7	1.01	202.00	0.1060	25	25	1.0	3.0	45	6	0.150	0.016
D6-8	R6-1	5.08	369.00	0.0580	25	25	1.0	3.0	45	6	0.150	0.016
D6-9	R6-9	9.08	471.00	0.0550	25	25	1.0	3.0	45	6	0.150	0.016
D7-1	R7-1	8.63	412.00	0.0710	25	25	1.0	3.0	45	6	0.150	0.016
D7-2	R7-2	8.91	407.00	0.0630	25	25	1.0	3.0	45	6	0.150	0.016
D8-1	R8-1	9.26	377.00	0.1010	25	25	1.0	3.0	45	6	0.150	0.016
D9-1	R9-1	4.48	289.00	0.0790	25	25	1.0	3.0	45	6	0.150	0.016
DNS1	NS1	1.01	471.00	0.1200	25	25	1.0	3.0	45	6	0.150	0.016
DNS10	NS10	4.43	299.00	0.0760	25	25	1.0	3.0	45	6	0.150	0.016
DNS10-1	NS10-1	8.71	398.00	0.0670	25	25	1.0	3.0	45	6	0.150	0.016
DNS10-3	NS10-3	8.60	386.00	0.0590	25	25	1.0	3.0	45	6	0.150	0.016
DNS10-5	NS10-5	7.36	363.00	0.0430	25	25	1.0	3.0	45	6	0.150	0.016
DNS10-7	NS10-7	8.55	338.00	0.0710	25	25	1.0	3.0	45	6	0.150	0.016
DNS10-8	NS10-8	8.56	394.00	0.0710	25	25	1.0	3.0	45	6	0.150	0.016
DNS10-9	NS10-9	7.76	420.00	0.0560	25	25	1.0	3.0	45	6	0.150	0.016
DNS6	NS6	8.60	378.00	0.1090	25	25	1.0	3.0	45	6	0.150	0.016

STORMWATER MASTER PLANNING - TYGERPOORT AH

Total Area: 1,259.27

StormShape: Triangular

M.A.P:690

Catchment	Drain To	Area (Ha)	Length (M)	Slope (m/m)	% Imp	% FutImp	Depr Imp	Depr Per	Infilt i (mm/hr)	Infilt f (mm/hr)	n Per	n Imp
D15-1	R15-1	4.65	192.00	0.4690	5	5	1.0	3.0	45	6	0.150	0.016
D15-2	R15-2	9.34	498.00	0.0300	50	50	1.0	3.0	45	6	0.150	0.016
D15-3	D15-1	7.23	894.00	0.0610	10	10	1.0	3.0	45	6	0.150	0.016
D15-4	R15-4	9.55	381.01	0.2218	5	5	1.0	3.0	45	6	0.150	0.016
D16-1	R16-1	8.12	276.00	0.2170	5	5	1.0	3.0	45	6	0.150	0.016
D16-2	R16-2	14.36	468.00	0.0530	40	40	1.0	3.0	45	6	0.150	0.016
D16-3	R16-3	7.46	385.08	0.1406	5	5	1.0	3.0	45	6	0.150	0.016
D17-1	R17-1	9.84	409.00	0.0610	50	50	1.0	3.0	45	6	0.150	0.016
D17-10	R17-10	7.48	675.10	0.1301	5	5	1.0	3.0	45	6	0.150	0.016
D17-11	R17-11	2.82	246.21	0.1005	5	5	1.0	3.0	45	6	0.150	0.016
D17-12	R17-12	4.23	281.50	0.1574	5	5	1.0	3.0	45	6	0.150	0.016
D17-13	R17-13	2.16	297.60	0.1361	5	5	1.0	3.0	45	6	0.150	0.016
D17-14	R17-14	2.18	283.49	0.1133	5	5	1.0	3.0	45	6	0.150	0.016
D17-15	R17-15	2.37	270.40	0.1976	5	5	1.0	3.0	45	6	0.150	0.016
D17-2	R17-2	4.55	304.94	0.0543	5	5	1.0	3.0	45	6	0.150	0.016
D17-2-1	R17-2	9.06	720.36	0.1335	5	5	1.0	3.0	45	6	0.150	0.016
D17-3	R17-3	4.14	291.20	0.0715	5	5	1.0	3.0	45	6	0.150	0.016
D17-4	R17-4	11.06	607.60	0.1305	5	5	1.0	3.0	45	6	0.150	0.016
D17-5	R17-5	8.38	468.78	0.1481	5	5	1.0	3.0	45	6	0.150	0.016
D17-6	R17-6	19.53	681.50	0.2298	5	5	1.0	3.0	45	6	0.150	0.016
D17-8	R17-8	9.38	605.57	0.1433	5	5	1.0	3.0	45	6	0.150	0.016
D17-9	R17-9	8.37	615.33	0.1630	5	5	1.0	3.0	45	6	0.150	0.016
D18-1	R18-1	2.68	263.00	0.0380	50	50	1.0	3.0	45	6	0.150	0.016
D19-1	R19-1	8.21	373.00	0.1210	5	5	1.0	3.0	45	6	0.150	0.016
D20-1	R20-1	2.25	144.00	0.1390	5	5	1.0	3.0	45	6	0.150	0.016
D20-2	R20-2	6.17	341.00	0.0440	50	50	1.0	3.0	45	6	0.150	0.016
D20-2-1	R20-2-1	8.18	456.00	0.1210	10	10	1.0	3.0	45	6	0.150	0.016
D20-4-1	R20-4-1	4.29	319.00	0.0310	60	60	1.0	3.0	45	6	0.150	0.016
D21-1	R21-1	18.81	503.00	0.0400	50	50	1.0	3.0	45	6	0.150	0.016
D22-1	R22-1	4.71	245.00	0.0200	60	60	1.0	3.0	45	6	0.150	0.016
D23-1	R23-1	7.14	522.00	0.0770	50	50	1.0	3.0	45	6	0.150	0.016
D24-1	R24-1	5.76	279.00	0.0540	60	60	1.0	3.0	45	6	0.150	0.016
D24-2	R24-2	0.51	91.00	0.0550	60	60	1.0	3.0	45	6	0.150	0.016
D25-0-0	R25-0-0	11.86	586.00	0.0377	65	65	1.0	3.0	45	6	0.150	0.016
D25-0-1	R25-0-1	7.39	431.00	0.0280	65	65	1.0	3.0	45	6	0.150	0.016
D25-0-2	R25-0-2	4.18	263.00	0.0100	65	65	1.0	3.0	45	6	0.150	0.016
D25-0-3	R25-0-3	4.39	272.00	0.0170	65	65	1.0	3.0	45	6	0.150	0.016
D25-0-5	R25-0-5	4.69	392.00	0.0160	65	65	1.0	3.0	45	6	0.150	0.016
D25-0-6	R25-0-6	3.53	401.00	0.0190	65	65	1.0	3.0	45	6	0.150	0.016
D25-0-7	R25-0-7	2.47	1 562.00	0.0220	80	80	1.0	3.0	45	6	0.150	0.016
D25-1	R25-1	4.77	291.00	0.0520	60	60	1.0	3.0	45	6	0.150	0.016
D25-10	R25-10	5.09	346.57	0.0592	50	50	1.0	3.0	45	6	0.150	0.016
D25-11	R25-11	4.55	328.10	0.0627	50	50	1.0	3.0	45	6	0.150	0.016
D25-12	R25-12	11.44	486.49	0.0785	50	50	1.0	3.0	45	6	0.150	0.016
D25-13	R25-13	9.48	594.10	0.1471	5	5	1.0	3.0	45	6	0.150	0.016
D25-15	R25-15	4.22	284.90	0.1805	50	50	1.0	3.0	45	6	0.150	0.016
D25-16	R25-16	7.95	532.73	0.0395	50	50	1.0	3.0	45	6	0.150	0.016
D25-17	R25-17	8.81	568.12	0.0322	50	50	1.0	3.0	45	6	0.150	0.016
D25-18	R25-18	4.90	421.30	0.0447	50	50	1.0	3.0	45	6	0.150	0.016
D25-19	R25-19	4.97	435.20	0.0397	50	50	1.0	3.0	45	6	0.150	0.016

Catchment	Drain To	Area (Ha)	Length (M)	Slope (m/m)	% Imp	% FutImp	Depr Imp	Depr Per	Infil i (mm/hr)	Infil f (mm/hr)	n Per	n Imp
D25-2	R25-2	0.81	419.00	0.0170	80	80	1.0	3.0	45	6	0.150	0.016
D25-2-1	R25-2	5.14	332.00	0.0410	60	60	1.0	3.0	45	6	0.150	0.016
D25-20	R25-20	8.36	438.20	0.0373	50	50	1.0	3.0	45	6	0.150	0.016
D25-21	R25-21	5.04	437.60	0.0440	50	50	1.0	3.0	45	6	0.150	0.016
D25-22	R25-22	4.95	452.40	0.0475	50	50	1.0	3.0	45	6	0.150	0.016
D25-23	R25-23	4.99	363.70	0.0427	50	50	1.0	3.0	45	6	0.150	0.016
D25-24	R25-24	5.03	344.30	0.0368	50	50	1.0	3.0	45	6	0.150	0.016
D25-25	R25-25	5.12	420.20	0.0462	50	50	1.0	3.0	45	6	0.150	0.016
D25-26	R25-26	9.54	595.40	0.1631	5	5	1.0	3.0	45	6	0.150	0.016
D25-27	R25-27	8.38	557.80	0.1218	5	5	1.0	3.0	45	6	0.150	0.016
D25-28	R25-28	4.66	414.03	0.0395	50	50	1.0	3.0	45	6	0.150	0.016
D25-29	R25-29	12.29	703.00	0.1452	5	5	1.0	3.0	45	6	0.150	0.016
D25-3	R25-3	16.28	738.00	0.0340	60	60	1.0	3.0	45	6	0.150	0.016
D25-30	R25-30	9.03	685.00	0.1426	5	5	1.0	3.0	45	6	0.150	0.016
D25-31	R25-31	4.94	525.82	0.1357	50	50	1.0	3.0	45	6	0.150	0.016
D25-32	R25-32	3.21	288.45	0.1549	5	5	1.0	3.0	45	6	0.150	0.016
D25-33	R25-33	9.31	522.45	0.1431	5	5	1.0	3.0	45	6	0.150	0.016
D25-34	R25-34	4.34	320.73	0.1151	5	5	1.0	3.0	45	6	0.150	0.016
D25-35	R25-35	4.24	308.00	0.1039	5	5	1.0	3.0	45	6	0.150	0.016
D25-36	R25-36	3.57	254.28	0.1042	5	5	1.0	3.0	45	6	0.150	0.016
D25-4	R25-4	6.67	359.00	0.0420	60	60	1.0	3.0	45	6	0.150	0.016
D25-5	R25-5	2.47	251.00	0.0200	60	60	1.0	3.0	45	6	0.150	0.016
D25-6	R25-6	2.74	157.00	0.0320	60	60	1.0	3.0	45	6	0.150	0.016
D25-7	R25-7	7.69	460.00	0.0330	50	50	1.0	3.0	45	6	0.150	0.016
D25-8	R25-8	59.64	1 882.31	0.0818	30	30	1.0	3.0	45	6	0.150	0.016
D25-9	R25-9	5.64	707.85	0.0443	50	50	1.0	3.0	45	6	0.150	0.016
D26-0	R26-0	2.14	181.00	0.0290	65	65	1.0	3.0	45	6	0.150	0.016
D26-0-1	R26-0-1	3.20	281.00	0.0290	65	65	1.0	3.0	45	6	0.150	0.016
D26-0-10	R26-0-10	4.45	317.00	0.0110	65	65	1.0	3.0	45	6	0.150	0.016
D26-0-11	R26-0-6	4.53	358.00	0.0260	65	65	1.0	3.0	45	6	0.150	0.016
D26-0-3	R26-0-3	8.56	499.00	0.0270	65	65	1.0	3.0	45	6	0.150	0.016
D26-0-4	R26-0-4	8.51	512.00	0.0180	65	65	1.0	3.0	45	6	0.150	0.016
D26-0-5	R26-0-5	4.63	308.00	0.0110	65	65	1.0	3.0	45	6	0.150	0.016
D26-0-6	R26-0-6	12.95	520.00	0.0140	65	65	1.0	3.0	45	6	0.150	0.016
D26-0-7	R26-0-4	4.60	286.00	0.0130	65	65	1.0	3.0	45	6	0.150	0.016
D26-0-8	R26-0-8	4.61	220.00	0.0380	65	65	1.0	3.0	45	6	0.150	0.016
D26-0-9	R26-0-9	0.98	152.00	0.0240	65	65	1.0	3.0	45	6	0.150	0.016
D26-1-1	R26-1-1	4.32	221.00	0.0310	65	65	1.0	3.0	45	6	0.150	0.016
D26-1-11	R26-1-11	1.38	164.00	0.0420	60	60	1.0	3.0	45	6	0.150	0.016
D26-1-12	R26-1-12	1.63	160.00	0.0210	60	60	1.0	3.0	45	6	0.150	0.016
D26-1-13	R26-1-13	1.46	159.00	0.0230	60	60	1.0	3.0	45	6	0.150	0.016
D26-1-14	R26-1-14	1.44	143.00	0.0120	60	60	1.0	3.0	45	6	0.150	0.016
D26-1-15	R26-1-15	1.36	136.00	0.0110	60	60	1.0	3.0	45	6	0.150	0.016
D26-1-18	R26-1-18	6.82	443.00	0.0370	60	60	1.0	3.0	45	6	0.150	0.016
D26-1-19	R26-1-19	4.58	304.00	0.0390	60	60	1.0	3.0	45	6	0.150	0.016
D26-1-20	R26-1-20	11.88	723.00	0.1510	5	5	1.0	3.0	45	6	0.150	0.016
D26-1-3	R26-1-3	1.21	142.00	0.0490	60	60	1.0	3.0	45	6	0.150	0.016
D26-1-4	R26-1-4	1.36	142.00	0.0270	60	60	1.0	3.0	45	6	0.150	0.016
D26-1-5	R26-1-5	1.12	143.00	0.0220	60	60	1.0	3.0	45	6	0.150	0.016
D26-1-6	R26-1-6	1.21	185.00	0.0180	60	60	1.0	3.0	45	6	0.150	0.016
D26-1-7	R26-1-7	1.20	167.00	0.0370	60	60	1.0	3.0	45	6	0.150	0.016
D26-1-9	R26-1-9	1.43	545.00	0.0120	65	65	1.0	3.0	45	6	0.150	0.016
D26-10	R26-10	27.03	1 359.00	0.0950	10	10	1.0	3.0	45	6	0.150	0.016

Catchment	Drain To	Area (Ha)	Length (M)	Slope (m/m)	% Imp	% Futimp	Depr Imp	Depr Per	Infilt i (mm/hr)	Infilt f (mm/hr)	n Per	n Imp
D26-12	R26-12	1.29	161.00	0.0570	60	60	1.0	3.0	45	6	0.150	0.016
D26-13	R26-13	2.28	282.00	0.0500	60	60	1.0	3.0	45	6	0.150	0.016
D26-14	R26-14	1.12	146.00	0.0530	60	60	1.0	3.0	45	6	0.150	0.016
D26-15	R26-15	1.16	139.00	0.0420	60	60	1.0	3.0	45	6	0.150	0.016
D26-16	R26-16	1.05	129.00	0.0380	60	60	1.0	3.0	45	6	0.150	0.016
D26-2-2	R26-2-2	7.03	385.00	0.0280	60	60	1.0	3.0	45	6	0.150	0.016
D26-2-3	R26-2-3	1.13	123.00	0.0480	60	60	1.0	3.0	45	6	0.150	0.016
D26-2-4	R26-2-4	1.28	148.00	0.0570	60	60	1.0	3.0	45	6	0.150	0.016
D26-2-5	R26-2-5	1.11	139.00	0.0360	60	60	1.0	3.0	45	6	0.150	0.016
D26-2-6	R26-2-6	0.70	282.00	0.0060	65	65	1.0	3.0	45	6	0.150	0.016
D26-2-7	R26-2-7	1.87	776.00	0.0140	65	65	1.0	3.0	45	6	0.150	0.016
D26-3	R26-3	3.21	213.00	0.0330	60	60	1.0	3.0	45	6	0.150	0.016
D26-4	R26-4	3.28	288.00	0.0310	15	15	1.0	3.0	45	6	0.150	0.016
D26-5	R26-5	14.76	804.00	0.0320	10	10	1.0	3.0	45	6	0.150	0.016
D26-6	R26-6	10.35	774.00	0.1590	10	10	1.0	3.0	45	6	0.150	0.016
D26-7	R26-7	1.50	139.00	0.0490	60	60	1.0	3.0	45	6	0.150	0.016
D26-8	R26-8	29.88	1 376.00	0.0910	10	10	1.0	3.0	45	6	0.150	0.016
D26-9	R26-9	16.58	1 200.00	0.9100	10	10	1.0	3.0	45	6	0.150	0.016
D27-0	R27-0	4.71	306.00	0.0380	65	65	1.0	3.0	45	6	0.150	0.016
D27-0-0	R27-0-0	10.05	619.00	0.0270	65	65	1.0	3.0	45	6	0.150	0.016
D27-0-1	R27-0-1	4.27	262.00	0.0180	65	65	1.0	3.0	45	6	0.150	0.016
D27-1	R27-1	1.89	721.00	0.0040	65	65	1.0	3.0	45	6	0.150	0.016
D27-10	R27-10	1.32	163.00	0.0400	60	60	1.0	3.0	45	6	0.150	0.016
D27-12	R27-12	1.36	173.00	0.0500	60	60	1.0	3.0	45	6	0.150	0.016
D27-13	R27-13	1.48	159.00	0.0870	15	15	1.0	3.0	45	6	0.150	0.016
D27-14	R27-14	1.56	164.00	0.1010	5	5	1.0	3.0	45	6	0.150	0.016
D27-15	R27-15	8.20	578.00	0.1450	5	5	1.0	3.0	45	6	0.150	0.016
D27-16	R27-16	1.37	149.00	0.0660	60	60	1.0	3.0	45	6	0.150	0.016
D27-17	R27-17	1.56	151.00	0.0870	10	10	1.0	3.0	45	6	0.150	0.016
D27-18	R27-18	9.40	639.00	0.1320	5	5	1.0	3.0	45	6	0.150	0.016
D27-19	R27-19	4.97	420.00	0.0770	15	15	1.0	3.0	45	6	0.150	0.016
D27-2	R27-2	8.50	338.00	0.0390	60	60	1.0	3.0	45	6	0.150	0.016
D27-20	R27-20	9.17	645.00	0.1230	5	5	1.0	3.0	45	6	0.150	0.016
D27-21	R27-21	4.57	324.00	0.0670	15	15	1.0	3.0	45	6	0.150	0.016
D27-22	R27-22	2.13	180.00	0.0270	60	60	1.0	3.0	45	6	0.150	0.016
D27-23	R27-23	1.41	110.00	0.0950	60	60	1.0	3.0	45	6	0.150	0.016
D27-25	R27-25	1.23	113.00	0.1670	10	10	1.0	3.0	45	6	0.150	0.016
D27-26	R27-26	1.01	123.00	0.1520	5	5	1.0	3.0	45	6	0.150	0.016
D27-27	R27-27	1.05	127.00	0.1010	5	5	1.0	3.0	45	6	0.150	0.016
D27-28	R27-28	7.78	526.00	0.1460	5	5	1.0	3.0	45	6	0.150	0.016
D27-29	R27-29	7.97	755.00	0.1130	15	15	1.0	3.0	45	6	0.150	0.016
D27-3	R27-3	1.10	119.00	0.0440	60	60	1.0	3.0	45	6	0.150	0.016
D27-30	R27-30	1.41	145.00	0.0690	60	60	1.0	3.0	45	6	0.150	0.016
D27-31	R27-31	1.30	147.00	0.0970	5	5	1.0	3.0	45	6	0.150	0.016
D27-32	R27-32	8.88	564.00	0.1520	5	5	1.0	3.0	45	6	0.150	0.016
D27-33	R27-33	2.29	227.00	0.0380	60	60	1.0	3.0	45	6	0.150	0.016
D27-34	R27-34	1.31	137.00	0.0270	60	60	1.0	3.0	45	6	0.150	0.016
D27-35	R27-35	1.45	154.00	0.0570	60	60	1.0	3.0	45	6	0.150	0.016
D27-36	R27-36	1.41	160.00	0.0890	5	5	1.0	3.0	45	6	0.150	0.016
D27-37	R27-37	1.41	160.00	0.0840	5	5	1.0	3.0	45	6	0.150	0.016
D27-38	R27-38	1.41	166.00	0.1300	5	5	1.0	3.0	45	6	0.150	0.016
D27-39	R27-39	6.51	403.00	0.1640	5	5	1.0	3.0	45	6	0.150	0.016
D27-4	R27-4	1.16	125.00	0.0480	60	60	1.0	3.0	45	6	0.150	0.016

Catchment	Drain To	Area (Ha)	Length (M)	Slope (m/m)	% Imp	% FutImp	Depr Imp	Depr Per	Infil i (mm/hr)	Infil f (mm/hr)	n Per	n Imp
D27-5	R27-5	3.76	310.00	0.0920	20	20	1.0	3.0	45	6	0.150	0.016
D27-6	R27-6	6.34	472.00	0.1540	5	5	1.0	3.0	45	6	0.150	0.016
D27-8	R27-8	1.30	138.00	0.0330	60	60	1.0	3.0	45	6	0.150	0.016
D28-0-1	R28-0-1	7.61	384.00	0.0150	65	65	1.0	3.0	45	6	0.150	0.016
D28-0-10	R28-0-10	8.62	463.00	0.0090	65	65	1.0	3.0	45	6	0.150	0.016
D28-0-2	R28-0-2	4.10	284.00	0.0130	65	65	1.0	3.0	45	6	0.150	0.016
D28-0-3	R28-0-3	3.71	298.00	0.0090	65	65	1.0	3.0	45	6	0.150	0.016
D28-0-4	R28-0-4	5.85	323.00	0.0170	65	65	1.0	3.0	45	6	0.150	0.016
D28-0-5	R28-0-5	3.61	223.00	0.0080	65	65	1.0	3.0	45	6	0.150	0.016
D28-0-7	R28-0-7	3.12	156.00	0.0080	65	65	1.0	3.0	45	6	0.150	0.016
D28-0-8	R28-0-8	8.59	474.00	0.0070	65	65	1.0	3.0	45	6	0.150	0.016
D28-0-9	R28-0-9	8.56	456.00	0.0040	65	65	1.0	3.0	45	6	0.150	0.016
D28-1	R28-1	10.69	491.00	0.0310	65	65	1.0	3.0	45	6	0.150	0.016
D28-1-1-1	R28-1-1	1.96	737.00	0.0290	65	65	1.0	3.0	45	6	0.150	0.016
D28-11	R28-11	4.16	486.00	0.0220	60	60	1.0	3.0	45	6	0.150	0.016
D28-12	R28-12	12.78	1 356.00	0.0770	35	35	1.0	3.0	45	6	0.150	0.016
D28-2	R28-2	13.16	695.00	0.0370	60	60	1.0	3.0	45	6	0.150	0.016
D28-4	R28-4	2.40	196.00	0.0330	60	60	1.0	3.0	45	6	0.150	0.016
D28-5	R28-5	7.59	428.00	0.0810	15	15	1.0	3.0	45	6	0.150	0.016
D28-6	R28-6	7.72	429.00	0.1580	5	5	1.0	3.0	45	6	0.150	0.016
D28-7	R28-7	21.37	1 503.00	0.0780	35	35	1.0	3.0	45	6	0.150	0.016
D28-8	R28-8	4.72	239.00	0.0370	60	60	1.0	3.0	45	6	0.150	0.016
D28-9	R28-9	10.10	378.00	0.0460	60	60	1.0	3.0	45	6	0.150	0.016
DNS20-3	NS20-3	4.59	335.00	0.1160	5	5	1.0	3.0	45	6	0.150	0.016
DNS20-4	NS20-4	16.86	786.00	0.1350	5	5	1.0	3.0	45	6	0.150	0.016
DNS20-5	NS20-5	8.61	760.00	0.1430	5	5	1.0	3.0	45	6	0.150	0.016
DNS25-0	NS25-0	1.38	452.00	0.0320	65	65	1.0	3.0	45	6	0.150	0.016
DNS25-0-2	NS25-0-2	4.27	353.00	0.0700	65	65	1.0	3.0	45	6	0.150	0.016
DNS25-0-3	NS25-0-3	51.98	914.00	0.0270	65	65	1.0	3.0	45	6	0.150	0.016
DNS26-1	NS26	8.55	475.00	0.0180	65	65	1.0	3.0	45	6	0.150	0.016
DNS26-2	R26-1	29.37	903.00	0.0280	65	65	1.0	3.0	45	6	0.150	0.016
DNS26-3	R26-1	7.47	562.00	0.0300	65	65	1.0	3.0	45	6	0.150	0.016
DNS27-1	NS27	8.64	469.00	0.0370	65	65	1.0	3.0	45	6	0.150	0.016
DNS28	NS28	21.61	994.00	0.0290	65	65	1.0	3.0	45	6	0.150	0.016
DNS28-1	NS28-1	25.60	889.00	0.0230	65	65	1.0	3.0	45	6	0.150	0.016

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ABBREVIATIONS

CLO	Community Liaison Officer
DEA	Department of Environmental Affairs
DWA	Department of Water Affairs
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
ELO	Environmental Liaison
EMPr	Environmental Management Programme
EO	Environmental Officer
ESO	Environmental Site Officer
I&AP	interested and Affected Party

1.0 PROJECT OVERVIEW

1.1 Background

Bokamoso Landscape Architects and Environmental Consultants, Independent Environmental Assessment Practitioners were appointed by **the City of Tshwane Metropolitan Municipality (CTMM)** to draft the Environmental Management Programme for the **construction of the Atterbury Road Extension and associated infrastructure as part of the Environmental Authorisation process**. The Basic Assessment Report has been prepared in accordance with the requirements of EIA Regulations, 2010 promulgated in terms of the National Environmental Management Act (NEMA), 1998 (Act 107 of 1998).

1.2 Principles of this EMPr

This EMPr is compiled using the following concepts and implementation requirements so that the higher principles of sustainable development are realised:

- *Continuous improvement.* The project proponent (or implementing organisation) must commit to review and to continually improve environmental management, with the objective of improving overall environmental performance.
- *Broad level of commitment.* A broad level of commitment is required from all levels of management as well as the workforce in order for the development and implementation of this EMPr to be successful and effective.
- *Flexible and responsive.* The implementation of the EMPr must respond to new and changing circumstances, i.e. rapid short-term responses to problems or incidents. The EMPr is a dynamic "living" document and thus regular planned review and revision of the EMPr must be carried out.
- *Integration across operations.* This EMPr must integrate across existing line functions and operational units such as health, safety and environmental departments in a company/project. This is done to change the redundant mindset of seeing environmental management as a single domain unit.
- *Compliance with legislation.* It is understood that any development project during its construction phase is a dynamic activity within a dynamic environment. The Developer, Engineer, Contractor and Sub-contractor must therefore be aware that certain activities conducted during construction may require further licensing or environmental approvals, e.g. river or stream diversions, bulk fuel storage, waste disposal, etc. The Contractor must consult the ER, EO and ECO on a regular basis in this regard.

1.3 Proposed Activity

The proposed activity is located on Portions 116 & 130 of the Farm Zwavelpoort No. 373 JR and the Remainder of Portion 1077 of the Farm Rieffontein No. 375 JR. The activity entails the construction of approximately 900m of a road with a 25m road reserve with associated infrastructure. The proposed road extension starts from the end of an existing dirt road (sharp bend to the east) up to the intersection with the proposed K147 Road. As part of the road extension, a bridge will be constructed over the Swavelpoort Spruit. The section of the existing dirt road from the Jollify Main Road intersection to the bend will be upgraded/surfaced, see Figs. 1 and 2.

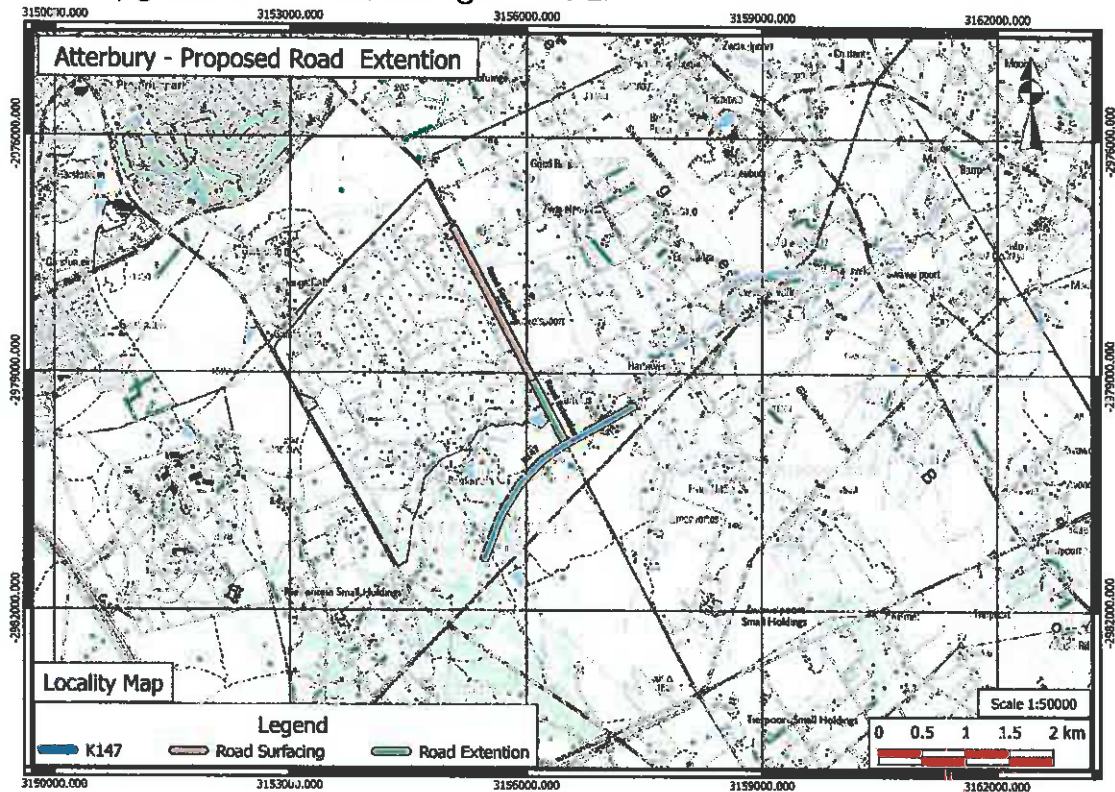
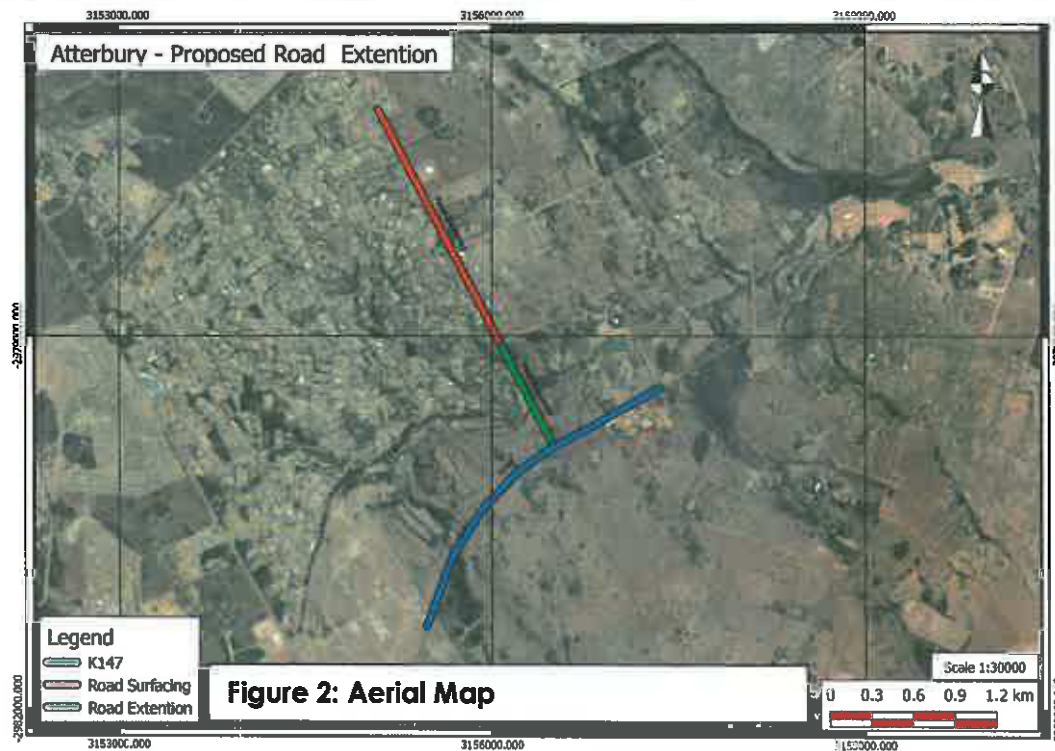


Figure 1: Locality Map



1.4 Summary of key impacts associated with the proposed activity

The negative impacts associated with the development during the construction phase include the following:

- **Surface and groundwater contamination (-):** Contamination can occur as a result of excavations and spills during the construction phase and pollution of the Swavelpoort Spruit as a result of stormwater runoff.
- **Soil erosion and pollution (-):** The clearing of vegetation and excavation of slopes causes soil instability and the natural slope of the site gives rise to potential gully erosion towards the Spruit.
- **Increased storm water run-off (-):** Increased amount of water will be transported to the Swavelpoort Spruit once vegetation has been cleared.
- **Ecological functioning of the site (-):** The clearing of vegetation during construction can have a significant impact on the ecological systems such as fauna and flora along or affected by the alignment of the road.
- **Impact on hydro-geomorphic units (-):** The alteration of land and river banks will have an influence on the functioning of the hydro-geomorphic units.
- **Alteration of the Swavelpoort Spruit hydrological regime (-):** The pollution and alteration of the natural water course during construction and operational phase due to soil erosion, other pollutants and increased water volumes originating from activities on site.

- **Increased noise levels (-):** Due to construction vehicles and labourers on site
- **Traffic Congestion and Densification (-):** The movement of construction vehicles to and from the site will cause traffic congestion.
- **Dust Nuisance (-):** Due to site clearance, heavy trucks and the use of other equipment on site.

1.5 Interpretations

The implementation of the EMPr is not an additional or "add on" requirement. The EMPr is legally binding through NEMA and the relevant EA. The proponent is to ensure that through the project tender process the EMPr forms part of the Project Construction Contract Document to be incorporated in line with:

- General project specifications; and
- SANS 1200 A or SANS 1200 AA, as applicable.

1.6 Role players and responsibility matrix

In order for the EMPr to be successfully implemented, all the role players involved in the project need to co-operate. For this to happen, role players must clearly understand their roles and responsibilities in the project, must be professional, form respectful and transparent relationships, and maintain open lines of communication.

Table 1: Functions and Responsibilities of the Project Team

KEY	FUNCTION	RESPONSIBILITY
D	Developer/ proponent	Proponent ultimately accountable for ensuring compliance to the EMPr and conditions contained in the Environmental Authorisation (EA). The ECO must be contracted by the developer (full time or part time depending on the size of the project) as an independent appointment to objectively monitor implementation of relevant environmental legislation, conditions of Environmental Authorisations (EA's), and the EMPr for the project. The developer is further responsible for providing and giving mandate to enable the ECO to perform responsibilities. The developer must ensure that the ECO is integrated as part of the project team.
CE	Consulting Engineer	Contracted by the developer to design and specify the project engineering aspects. Generally the engineer runs the works contract. The CE may also fulfil the role of Project Manager on the proponent's behalf
PM	Project Manger	The Project Manager has over-all responsibility for managing the project, contractors, and consultants and for ensuring that the environmental management requirements are met. The CE may also act as the PM. All decisions regarding environmental procedures must be approved by the PM. The PM has the authority to stop any construction activity in contravention of the EMPr in accordance with an agreed warning procedure.

ER	Engineers Representative	The consulting engineer's representative on site. Has the power/mandate to issue site instructions and in some instances, variation orders to the contractor, following request by the EO or ECO. The ER oversees site works, liaison with Contractor and ECO.
ECO	Environmental Control Officer	<p>An independent appointment to objectively monitor implementation of relevant environmental legislation, conditions of Environmental Authorisations (EA's), and the EMPR for the project. The ECO must be on site prior to any site establishment and must endeavour to form an integral part of the project team.</p> <p>The ECO must be proactive and have access to specialist expertise as and when required, these include botanists, ecologists, etc. Further, the ECO must also have access to expertise such as game capture, snake catching, etc.</p> <p>The ECO must conduct audits on compliance to relevant environmental legislation, conditions of EA, and the EMPR for the project. The size and sensitivity of the development, based on the EIA, will determine the frequency at which the ECO will be required to conduct audits. (A minimum of a monthly site inspection must be undertaken).</p> <p>The ECO must be the liaison between the relevant authorities and the project team. The ECO must communicate and inform the developer and consulting engineers of any changes to environmental conditions as required by relevant authoritative bodies. The ECO must ensure that the registration and updating of all relevant EMPR documentation is carried out.</p> <p>The ECO must be suitably experienced with the relevant environmental management qualifications and preferably competent in construction related methods and practices.</p> <p>The ECO must handle information received from whistle blowers as confidential and must address and report these incidences to the relevant Authority as soon as possible.</p> <p>On small projects, where no EO is appointed, the ECO must convey the contents of this EMPR to the Contractor site team and discuss the contents in detail with the Contractor as well as undertake to conduct an induction and an environmental awareness training session prior to site handover to all contractors and their workforce.</p>
C	Contractor	<p>The principle contractor, hereafter known as the 'Contractor', is responsible for implementation and compliance with the requirements of the EMPR and conditions of the EA's, contract and relevant environmental legislation. The Contractor must ensure that all sub- contractors have a copy of and are fully aware of the content and requirements of this EMPR.</p> <p>The contractor is required, where specified, to provide Method Statements setting out in detail how the management actions contained in the EMPR will be implemented.</p>

ESO	Environmental Site Officer	<p>The ESO is EMPLOYED by the Contractor as his/her environmental representative to monitor, review and verify compliance with the EMPr by the contractor. This is not an independent appointment; rather the ESO must be a respected member of the contractor's management team.</p> <p>Dependent on the size of the development the ESO must be on site one week prior to the commencement of construction. The ESO must ensure that he/she is involved at all phases of the construction (from site clearance to rehabilitation).</p>
A	Lead Authority	<p>The authorities are the relevant environmental department that has issued the Environmental Authorisation. The authorities are responsible for ensuring that the monitoring of the EMPr and other authorisation documentation is carried out, this will be achieved by reviewing audit reports submitted by the ECO and conducting regular site visits.</p>
OA	Other Authority	<p>Other authorities are those that may be involved in the approval process of an EMPr. Their involvement may include reviewing EMPr's to ensure the accuracy of the information relevant to their specific mandate.</p> <p>Other authorities may be involved in the development, review or implementation of an EMPr. For example if a specific development requires a water use licence for the relevant national authority then that authority should review and comment on the content of the particular section pertaining to that mandate.</p>
EAP	Environmental Assessment Practitioner	<p>The definition of an environmental assessment practitioner in Section 1 of NEMA is "the individual responsible for the planning, management and coordination of environmental impact assessments, strategic environmental assessments, environmental management plans or any other appropriate environmental instruments introduced through regulations".</p>

1.7 Enforcement, monitoring and auditing

The ECO must conduct, at a frequency as determined by the Department and stipulated in the relevant Environmental Authorisation (EA) for the project, independent environmental audits. The audits are to verify the projects compliance with the EMPr and conditions of the Environmental Authorisation (EA).

Before any construction activities commence, the ECO must be appointed, conduct site inspection and, together with the contractor determine the positioning of the construction camp and other equipment on site. The ECO must at the request of the Department forward audit reports to the Department at a frequency determined by the Department which must be stipulated in the Environmental Authorisation (EA). Evidence of the following as **key performance indicators**, must be included in the audit reports where required:

1. Complaints received from landowners and actions taken.
2. Environmental incidents, such as oil spills, concrete spills, etc. and actions taken (litigation excluded).
3. Incidents leading to litigation and legal contraventions.
4. Environmental damage that needs rehabilitation measures to be taken.

Copies of all monitoring reports, contractor method statements and pro forma documentation must be kept on site and be made available to the Department or officials upon request.

1.8 Non-Compliance

The Contractor is deemed NOT to have complied with the EMPr if:

- a. within the boundaries of the site, site extensions and haul/ access roads there is evidence of contravention of the EMPr confirmed and verified by the ECO;
- b. environmental damage ensues due to non-compliance to EMPr requirements;
- c. the Contractor fails to comply with corrective or other instructions issued by the ECO within a specific time, and
- d. the Contractor fails to respond adequately to complaints from the public in line with requirements of this EMPr.

1.9 General guidelines

The following measures provide guideline solutions to frequently anticipated issues on most development activities.

- The prevention of any site degradation due to non-compliance, administrative or financial problems, and inactivity during the construction

phase, illegal activities, delays caused by archaeological finds, etc. is ultimately the responsibility of the applicant/developer. Section 28, National Environmental Management Act [NEMA] (Act No. 107 of 1998)

- The study area must be clearly defined, surveyed and fenced according to the project authorisation. All workforce members and other construction personnel are not to go beyond the fenced footprint. Landowners are not comfortable when strangers come on to their properties. They will look for reasons to interfere with the construction process and may therefore cause delays in the process that can be very costly to the Contractor.
- The Contractors must adhere to agreed and approved access points and hauls roads which will for the most be off Allandale Road.
- No camping is allowed on any private property.
- Damage to private or public property such as fences, gates and other infrastructure may occur at any time. All damage to be repaired immediately and to the satisfaction of the owner.
- Relevant landowners and businesses must be informed of the starting date of construction as well as the phases in which the construction shall take place.
- The Contractor must adhere to all conditions of contract including this EMPR.
- Proper planning of the construction process must be undertaken to allow for disruptions due to rain and very wet conditions.
- All private and public manmade structures near the project site must be protected against damage at all times and any damage must be rectified immediately.
- Proper site management and regular monitoring of site works.
- Proper documentation and record keeping of all complaints and actions taken.
- Regular site inspections and good control over the construction process throughout the construction period.
- A positive attitude towards Environmental Management by all site personnel must be motivated through regular and effective awareness and training sessions (see below).
- An ESO, on behalf of the Contractor, is to be appointed to implement this EMPR. The EO and not the Contractor or his/her ESO is to deal with any landowner related matters (see figure 1)
- Environmental Audits to be carried out during and upon completion of construction.

1.10 Awareness training

The ECO is responsible for ensuring that the contractor and other professions on site are given an environmental awareness induction session which not only clearly defines what the environment is and gives specifics detailing the local environment but outlines the requirements of the EMPr as a management tool to protect the environment. The EO or ESO must ensure daily toolbox talks include alerting the workforce to particular environmental concerns associated with the tasks for that day or the area/habitat in which they are working. Awareness posters and a hand out must be produced to create awareness throughout the site.

1.11 Contractor Environmental Method Statements

Method Statements are written submissions by the Contractor in collaboration with his/her ESO, in response to a request by the EO, ECO and/or Engineer. The Method Statements set out the plant, materials, labour and method that the contractor proposes using to carry out an activity, identified by the EO, ECO and/or Engineer. The Method Statements contain the appropriate detail that allows an assessment to be made on whether the Contractor's proposal is in accordance with the requirements of the EMPr.

All Method Statements including those which may be required as *ad hoc* or emergency construction method statements must be submitted to the Engineer for approval prior to the commencement of the activity.

Any changes to the method of works must be reflected by amendments to the original approved Method Statement. Any changes in this regard must be approved by the EO and Engineer on the understanding that such changes are environmentally acceptable and in line with the requirements of this EMPr.

The *pro forma* Method Statements attached must be used and method statements for the following activities must be submitted to the EO, ECO and Engineer for approval before construction commences. These include *inter alia*:

- Solid waste management;
- Ecological sound stormwater management plan;
- Crew camps and construction lay down areas;
- Workshop and maintenance/cleaning of plant;
- Cement and concrete batching;
- Dust control;
- Hydrocarbon and emergency spills procedures;
- Diesel tanks and refuelling procedures;
- Sourcing, excavating, transporting and dumping of fill and spoil material;

- Topsoil management;
- Protection of the Riparian Zone and the associated buffer
- Protection of the Plant of Conservation Concern within the isolated patch of Egoli Granite Grassland;
- Noise;
- Fire; and
- Rehabilitation of disturbed areas

1.12 Site documentation

The following is list of documentation that must be held on site and must be made available to the ECO and/or Approving Authority on request.

- Site daily diary /instruction book/ Incident reports;
- Records of all remediation / rehabilitation activities;
- Copies of ECO reports (management and monitoring);
- Environmental Management Plan (EMPR);
- Complaints register; and
- Method statements.

1.13 Legislative framework and guidelines

The common list of legislative references contained herein is by no means exhaustive but is applicable to the general principals of this document.

Advertising on Roads and Ribbon Development Act No. 24 of 1940: Regulates the display of adverts at places visible from public roads. Also controls the depositing of machinery or refuse, and the construction or laying of structures, near public roads.
Provincial Authorities

Animals Protection Act No. 71 of 1962: Provides for the protection of animals.

Conservation of Agricultural Resources Act No. 43 of 1983: Control of the utilisation and protection of wetlands, soil conservation, control and prevention of veldt fires, control of weeds and invader plants.

Department of Agriculture, Forestry and Fisheries

National Environmental Management Act No. 107 of 1998: Control/prevention of pollution; combating of noise; activities which may have a detrimental effect on the environment, preparation and contents of environmental impact reports.

Department of Environmental Affairs, Department of Water Affairs, Directorate: Environmental Management of the Provincial Department of Agriculture and Rural Development, Local Authorities

Fencing Act No. 31 of 1963: Clearing of bushes for border fencing, Access to property for

fencing.

Department of Agriculture, Forestry and Fisheries

Hazardous Substances Act No. 15 of 1973: Provides for the control of substances, which may cause injury or ill health to, or the death of human beings.

National Department of Health. Local Authorities may be authorized

Health Act No. 63 of 1977: Control of solid, liquid and gaseous wastes that may pose a health hazard.

Department of Health and Local Authorities

Minerals and Petroleum Resources Development Act No. 28 of 2002

National Building Regulations and Standards Act 103 of 1977 (SABS 0400)

National Heritage Resources Act No. 25 of 1999

National Roads Traffic Act No. 93 of 1996: Provides for road traffic matters which apply uniformly throughout South Africa.

Department of Transport.

National Veldt and Forest Fires Act No.101 of 1998: Fire Protection Associations. Building of fire breaks.

Department of Water Affairs

National Water Act No. 36 of 1998 and Water Services Act No. 108 of 1997: Diversion or impoundment of rivers. Conservation and use of water. Treatment and disposal of waste, wastewater and effluent. Pollution and pollution emergencies. Water Users & Associations. Dam safety. Registration of boreholes.

Department of Water Affairs

Nature Conservation Ordinance No. 74 of 1979: Private Nature Reserves, Conservancies, Certificate of adequate enclosure, translocation and re-establishment of animals. Certification of hunting regulations and protection of flora & fauna.

Gauteng Department of Agriculture and Rural Development

Occupational Health and Safety Act No. 85 of 1993: Controls the exposure of employees and the public to dangerous and toxic substances or activities.

Department of Labour

Road Transportation Act No. 74 of 1977

Department of Transport

2.0 PROJECT ACTIVITIES

2.1 Pre-Construction Phase

Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
2.1.1. General					
Project contract	To make the EMPr enforceable under the general conditions of the contract	The EMPr document must be included as part of the tender documentation for all contractor appointments.	The EMPr is included as part of the tender documentation	Applicant Contractor	
2.1.2 Design and planning					
Preparing Site Access to ensure					
Environmental integrity	To avoid erosion and disturbance to indigenous vegetation	<ul style="list-style-type: none"> - Designated routes and storage areas shall be determined for the construction vehicles and equipment. - Clearly mark the site access point and routes to be used by construction vehicles and pedestrians. - Access map to be provided to all contractors whom in turn must provide copies to the construction workers. Instruct all drivers to use access point and pre-determined routes. 	<p>Access to site is erosion free</p> <p>Minimum disturbance to surrounding vegetation</p> <p>Vehicles make use of established access routes</p>	Contractor	Continuous
Site camp and storage areas					
Environmental integrity	To avoid disturbance to	- The site camp and storage areas shall be established in a disturbed area as indicated by the	Sensitive areas and indigenous flora	ECO Site supervisor	Before construction

Environmental risk or Issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
	indigenous vegetation	ECO prior to construction. These areas should preferably be as close to the road as possible.	protected		activities commence
Waste storage	To control the temporary storage of waste	<ul style="list-style-type: none"> - Temporary waste storage points on site shall be determined. - These storage points shall be accessible by waste removal trucks and should not be located in sensitive areas, areas highly visible to surrounding areas or in areas where the wind direction will carry bad odours across the properties of adjacent tenants or landowners. 	Waste points marked out and suitable bins are provided for waste at these points.	Contractor ESO	Before construction activities commence
	Ensure waste storage does not generate pollution	<ul style="list-style-type: none"> - Build a bund around waste storage area to stop overflow into stormwater. - Ensure adequate protection from elements 	Bund around waste area installed.	Contractor	Before construction activities commence
Road design	To ensure stability of structures	- The detail design of the road should be approved by relevant authority	Written approval of provided	Engineer	Before construction activities commence
	Reduce the noise impact of the road	- Road design and choice of material to reduce the noise levels on facades within 20m of the road	Acoustical performance of the road	Engineer	Pre-planning
Fauna and Flora					
Damage to indigenous	To give smaller birds, mammals and	- Work should be planned to be restricted to one area at a time.	-	Contractor Site manager	Before construction

Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
vegetation and disturbance to fauna	reptiles a chance to move into other undisturbed areas close to their natural territories				activities commence
	To prevent and reduce the negative impact on fauna species residing on the site	- No fauna species should be disturbed, trapped, hunted or killed during the construction phase. Conservation orientated clauses should be built into contracts for construction personnel, complete with penalty clauses for non-compliance.	Conservation orientated clause occurs in contracts of construction personnel.	Contractor Site manager	Before construction activities commence and as and when required
	To prevent the invasion of the area by alien invaders	- Alien invaders must be eradicated before, during and after construction.	Alien invaders controlled	ECO Project manager	Before commencement of construction activities and as and when required
	To prevent the destruction of indigenous vegetation	- Construction workers should be made aware of procedures to follow if any Red Data species are discovered during any phase of the construction. Procedures as stipulated at the end of the EMPr should be followed. - If any areas are fenced off with assistance of the ECO, fauna and flora specialist and the contractor	Indigenous vegetation protected Sensitive areas and indigenous flora protected	ECO • Contractors • Sub-contractors • ECO • Fauna and Flora specialist	Before construction activities commence and as and when required

Environmental risk or Issue	Objective or requirement	Mitigation measure	Performance Indicator	Responsibility	Frequency of Action
		shall serve as a no-go area for vehicles, pedestrians or workers.			
Geology and Soils					
Erosion and Siltation	To prevent the unnecessary loss of soil through bad management	<ul style="list-style-type: none"> - Suitable locations should be selected on site to place the stockpiles and to avoid release of materials into the stormwater channels. - A storm water management plan must be compiled for the construction and operational phases of the proposed road. The storm water design for the proposed road must: <ul style="list-style-type: none"> o Reduce and/ or prevent siltation, erosion and water pollution; o Avoid concentration of storm water runoff and allow for sheet flow; - The vegetation must be retained as far as possible, and rehabilitated if disturbed by construction activities to ensure that erosion and siltation do not take place; and - Extended interruptions in water flow must be avoided. 	<p>Areas for stockpiles are marked out on suitable locations.</p> <p>Storm water management plan approved by the Local Authority</p>	<p>Contractor ECO</p>	<p>Before construction activities commence</p>
Instability of structures	To prevent the collapse of /or damage of structures and	<ul style="list-style-type: none"> - Although the site has no geotech constraints, founding designs must be done by a suitably qualified engineer. - The foundation design to include precautionary 		<p>Developer Engineer</p>	<p>Before construction activities commence</p>

Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
	embankments due to underlying geological conditions	measures if there are potentially collapsible and expansive soils. - Detailed foundation investigations should be conducted for structures such as culverts.			
Hydrology					
Pollution of ground and surface water	Prevent the pollution of the ground- and surface water	- Chemical toilets shall not be in close proximity of any water bodies.	Toilets are located at least 100m away from drainage lines and wetlands.	Contractor ECO	Before construction activities commence
	Prevention of siltation of stormwater infrastructure	- Drainage channels should be provided on site to convey stormwater to sand/silt traps for removal of soil particles.	Drainage channels provided and sand/silt traps are installed.	Contractor	Before or as soon as construction activities commence
		- Berms or other acceptable measures to prevent siltation into the stormwater system during the construction phase must be used/installed. Stormwater outlets must be protected or sealed during the construction phase to prevent sediment from entering the system	- No visible signs of erosion and siltation. - Berms are installed and storm water outlets are appropriately protected.	Contractor	Before or as soon as construction activities commence
		- Provision of earth bunds or sand bags in areas where a large amount of exposed soils exist is required.	Earth bunds and/ or sand bags are readily available to protect	Contractor	Before or as soon as construction

Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
			exposed soils during construction.		activities commence
		- The construction works shall be properly programmed to minimise soil excavation in rainy seasons to prevent soil erosion from exposed soil surfaces.	No visible signs of erosion and sedimentation	Contractor	Before or as soon as construction activities commence
		- Suitable locations should be selected on site to place the stockpiles as to avoid release of materials into the drainage channels.	No visible signs of erosion and sedimentation	Contractor	Before or as soon as construction activities commence
		- Explain how the sediment controls work and the importance of the controls to all site workers and subcontractors when they start to work.		ECO Site supervisor	Before or as soon as construction activities commence
Flood line and wetland crossings	To mitigate impact on wetlands and drainage lines by the road at crossings.	<ul style="list-style-type: none"> - The culverts/bridge over the stream/areas within the floodline need to be constructed in such a way so as to minimise the change in flow patterns. - Should stream diversion be required, this should be designed in such a way to minimize changes to natural flow. 	Culvert/bridge design must be approved by the Department of Water and Environmental Affairs (DWEA) as part of Section 21 Water Use	Engineer	Before construction

Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
			Licenses approval		
Social					
Visual impact and air pollution	To minimise the visual impact of the proposed activity	- Waste storage and stockpile areas should not be in areas highly visible from the properties of the surrounding land-owners/tenants or in areas where the wind direction will carry bad odours across the properties of adjacent tenants or landowners.	Visual impact and bad odours minimised	ECO	Before or as soon as construction activities commence
"Sense of Place"	To enhance the "Sense of Place" of the area	- Landscaping guidelines should be provided for the linear strips of land adjacent to the proposed road.	Landscape Development Plan form part of the road design	Landscape Architect	Before construction commence
Noise	To minimise the noise impact associated with the proposed activity	- Site workers and construction equipment must comply with the Provincial noise requirements as outlined in Provincial Notice No. 5479 of 1999: Gauteng Noise Control Regulations and the Environmental Conservation Act: Noise Regulations, 1989 (Act No: 73 of 1989)	Minimum noise generated by the proposed activity and contractors keep to working hours stipulated below.	Contractor	Continuous
		- Construction activities should be planned to only take place between 7:00 and 17:00 on weekdays and between 8h00 and 15h00 on Saturdays, no construction activities will be allowed to take place on Sundays and Public Holidays.	Contractors keep to working hours stipulated below.	Contractor	Continuous

2.2 Construction Phase

Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
Contractor's Camp					
Loss of Vegetation, and topsoil	To minimise damage to/loss of vegetation, and retain quality of topsoil	- Site to be established under supervision of ECO/ESO.	Minimal vegetation removed/damaged during site activities	Contractor	Before any construction activity commences
Surface and groundwater pollution	To minimise pollution of surface and Groundwater resources	<ul style="list-style-type: none"> - Sufficient facilities including ablation facilities must be provided for construction workers operating on site. - A minimum of one chemical toilet shall be provided per 10 construction workers. - The contractor shall keep the toilets in a clean, neat and hygienic condition. - Toilets must be easily accessible and a maximum of 50 m from the working area to ensure they are utilised. The contractor (who must use reputable toilet-servicing company) shall be responsible for the cleaning, maintenance and servicing of the toilets. The contractor shall ensure that all toilets are cleaned and emptied before the builders' or other public holidays. - No person will be allowed to use any other area than chemical toilets. - No French drain systems may be installed. 	<ul style="list-style-type: none"> - Effluents managed effectively - No pollution of water resources from site - Workforce use toilets provided - Chemical toilets are clean and maintained. 	Contractor ESO	As and when required

Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
		<ul style="list-style-type: none"> - No chemical or waste water must be allowed to contaminate the run-off on site. - The chemical toilets may not be placed on the boundary in close proximity of adjacent developments. - Avoid the cleaning of the site camp or paved surfaces with soap. - The building rubble, excavated material and hazardous material and substances must be disposed of in an appropriate, permitted waste disposal facility. - Culverts or other infrastructure to cross the stream and drainage line should be constructed first to allow the remainder of the work to be undertaken on grade and should preferably be constructed during the dry season. - Containment of run-off from construction areas should be implemented and the streams closed off from access by construction workers. - Cut-off drains should be trenched between the streams and the construction activities and hay bales (or similar) should be stacked along the trenches where possible to contain siltation. 			
	To minimise pollution of surface and	- Drip trays and/or lined earth bunds must be provided under vehicles and equipment, to contain spills of	No pollution of the environment.	Contractor ESO	Daily

Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
	Groundwater resources due to spilling of materials.	<p>hazardous materials such as fuel, oil and cement.</p> <ul style="list-style-type: none"> - Repair and storage of vehicles only within the demarcated site area. - Spill kits must be available on site. - Oils and chemicals must be confined to specific secured areas within the site camp. These areas must be bunded with adequate containment (at least 1.5 times the volume of the fuel) for potential spills or leaks. - All spilled hazardous substances must be contained in impermeable containers for removal to a licensed hazardous waste site. - No leaking vehicle shall be allowed on site. The mechanic/the mechanic of the appointed contractor must supply the environmental officer with a letter of confirmation that the vehicles and equipment are leak proof. - No bins containing organic solvents such as paint and thinners shall be cleaned on site, unless containers for liquid waste disposal are placed for this purpose on site. - All spillages must be cleaned up and contaminated soil removed as hazardous waste. - Affected soil must be treated with DRIZIT or similar product. 			

Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
	To minimise pollution of surface and groundwater resources by cement	<ul style="list-style-type: none"> - The mixing of concrete shall only be done at specifically selected sites, as close as possible to the entrance, on mortar boards or similar structures to prevent run-off into surrounding drainage lines, streams and natural vegetation. - All cement spills shall be cleaned immediately and the resultant material disposed of properly 	No evidence of contaminated soil on the construction site	Contractor ESO	Daily
	To minimise pollution of surface and groundwater resources due to effluent	<ul style="list-style-type: none"> - No effluent (including effluent from any storage areas) may be discharged into any water surface or groundwater resource. 	No evidence of contaminated water resources	Contractor ESO	Daily
Pollution of the environment	To prevent unhygienic usage on the site and pollution of the natural assets	<ul style="list-style-type: none"> - Weather proof waste bins must be provided and emptied regularly. - The contractor shall provide laborers to clean up the contractor's camp and construction site on a daily basis. - Temporary waste storage points shall be pre-determined and be located in already disturbed areas. These storage points should be accessible by waste removal trucks and shall not be highly visible from the properties of the surrounding land-owners/in areas where the wind direction will not carry bad odours across the properties of adjacent landowners. This site should comply with the following: 	<p>No waste bins overflowing</p> <p>No litter or building waste lying in or around the site</p>	Contractor ESO	Daily/ Weekly

Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
		<ul style="list-style-type: none"> o Skips for the containment and disposal of waste that could cause soil and water pollution, i.e. paint, lubricants, etc.; o Small lightweight waste items should be contained in bins with lids to prevent littering; and o Bunded areas for containment and holding of dry building waste. - No solid waste may be disposed of on site. - No waste materials shall at any stage be disposed of in the open veld, adjacent properties or in sensitive areas. - The temporary storage of solid waste on the site, must be in a manner acceptable to the local authority. - Cover/contain any waste that is likely to wash away or contaminate stormwater. 			
	<p>Recycle material where possible and correctly dispose of unusable wastes</p>	<ul style="list-style-type: none"> - Waste shall be separated into recyclable and non-recyclable waste, and shall be separated as follows: <ul style="list-style-type: none"> o General waste: including (but not limited to) construction rubble; and o Reusable construction material. - Recyclable waste shall preferably be deposited in separate bins. - All solid waste including excess spoil (soil, rock, rubble etc) must be removed to a permitted waste disposal site on a weekly basis. 	<p>Sufficient containers available on site</p> <p>No visible signs of pollution</p>	<p>Contractor ESO</p>	<p>Daily Weekly</p>

Environmental risk or issue	Objective or requirement	Mitigation measure	Performance Indicator	Responsibility	Frequency of Action
		<ul style="list-style-type: none"> - No bins containing organic solvents such as paints and thinners shall be cleaned on site, unless containers for liquid waste disposal are placed for this purpose on site. - Records of waste reuse, recycling and disposal must be kept on site and information provided to ESO. 			
Increased fire risk to site and surrounding areas	To decrease fire risk	<ul style="list-style-type: none"> - Fires shall only be permitted in specifically designated areas and under controlled circumstances. - Food vendors shall be allowed within specified areas. - Fire extinguishers to be provided in all vehicles and fire beaters must be available on site. - Emergency numbers/contact details must be available on site, where applicable. 	<ul style="list-style-type: none"> - No unattended open fires - Fire beaters present on site - Emergency numbers/contact details displayed at site camp - No signs of burnt void 	Contractor	Monitor daily
Geology and soils					
Stability of structures	To ensure the stability of structures and embankments	<ul style="list-style-type: none"> - The precautionary measures and foundation design from the engineers must be implemented. - Embankments will only be required where structures such as culverts are constructed 	No signs of collapse of structures or embankments.	Contractor, engineer	Monitor weekly
	To prevent seepage of groundwater into excavations, due to	<ul style="list-style-type: none"> - Special drainage designs will be required in areas with shallow ground water, especially for areas underlain by granite. 	No ground water seepage visible in excavations	Contractor, engineer	Monitor weekly

Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
	perched water.	- Precautionary measures to prevent seepage of groundwater into excavations should be implemented.			
Un authorized pits and quarries	To prevent unauthorized borrow pits on site	<ul style="list-style-type: none"> - No borrow pits will be dug on or off site if not approved by the relevant authorities. - Daily movement of construction material must be done effectively and must be kept to a minimum required for the construction. - Fill material, where required, will be obtained from nearby and existing licensed borrows pit operators. 	No unauthorized burrow pits/quarries on site	Contractor ESO ECO	Monitored monthly
Possible blasting required	To prevent hazards associated with blasting	<ul style="list-style-type: none"> - Surrounding residents must be informed of blasting exercises at least one week in advance. - Blasting permit must be obtained - Blasting operations should be carefully controlled and the necessary safety precautions must be implemented. - Dust suppression techniques e.g. erection of dust nets must be implemented, to mitigate low visibility on nearby roads and to protect surrounding residents from dust pollution 	No incidents reported and complaints from I & A Ps Blasting permit available		
Loss of topsoil	To prevent the loss of topsoil	<ul style="list-style-type: none"> - Stockpiling to be done in designated areas so as not to interfere with the natural drainage channels and must not be higher than 2m. - In order to minimise erosion of topsoil and siltation and disturbance to existing vegetation, it is 	<ul style="list-style-type: none"> - No loss of topsoil - Excavated materials correctly stockpiled 	Contractor of Contractor ECO	Monitor daily

Environmental risk or Issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
	To prevent soil and materials being tracked onto the road.	<p>recommended that stockpiling be done in already disturbed/exposed areas.</p> <ul style="list-style-type: none"> - Vegetation to be remove only in areas designated during the planning stage and for the purpose of construction. - Rehabilitation to be done immediately after the involved works are completed. - Establish an all-weather site access and wheel wash or shake down. - Silt to be removed from road surface (entrance to the construction area) 	<ul style="list-style-type: none"> - Stockpiles not higher than 2m. - No visible signs of erosion of topsoil/ sedimentation. - Vegetation only removed in designated areas - Minimal invasive weed growth - No silt on road surface 		
Erosion and siltation	To prevent erosion , siltation & water pollution	<ul style="list-style-type: none"> - Mark out the areas to be excavated - Unnecessary clearing of flora resulting in exposed soil prone to erosive conditions should be avoided. - The eradication of alien vegetation should be followed up as soon as possible by replacement with indigenous vegetation to ensure quick and sufficient coverage of exposed areas. - Provision of earth bunds or sand bags in areas where large amounts of exposed soils exist is required. - Drainage channels should be provided on site to convey stormwater to sand/silt traps for removal of 	<ul style="list-style-type: none"> - No erosion scars - All damaged areas successfully rehabilitated - Earth bunds present - Drainage channels established - Cut-off drains 	Contractor ESO	Monitor daily

Environmental risk or Issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
		<p>soil particles.</p> <ul style="list-style-type: none"> - Construction work must be properly programmed to minimise soil excavation in the rainy season. Exposed stockpiles must be covered with impervious sheets before a rainstorm. - It is recommended to pave haul roads with concrete and protect temporary access roads using crushed stone or gravel. - The top layer of soil of all areas to be excavated for the construction of the road shall be stripped and stockpiled in areas where this material will not be damaged, removed or compacted. - All surfaces that are susceptible to erosion, shall be protected either by cladding with biodegradable material or with the top layer of soil being seeded with grass seed/planted with a suitable groundcover. - Cut-off drains should be excavated up- and down-hill of denuded areas to reduce run-off across these areas. - Large exposed areas during the construction phases should be limited. Where possible areas earmarked for construction during later phases should remain covered with vegetation coverage until the actual construction phase. This will prevent unnecessary erosion and siltation in these areas. 	<p>excavated</p> <ul style="list-style-type: none"> - Stockpiles covered and sediment fence erected around stockpiles 		

Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
		<ul style="list-style-type: none"> - All embankments must be adequately compacted and planted with grass to stop any excessive soils erosion and scouring of the landscape. - Storm water diversion measures are recommended to control peak flows during thunder storms. - Cover stockpiles and surround downhill sides with a sediment fence to stop materials washing away. 	<ul style="list-style-type: none"> - Stockpiles suitably covered and sediment fence erected 		
	To prevent the compaction of valuable soils due to traffic and equipment	<ul style="list-style-type: none"> - All compacted areas should be ripped prior to them being rehabilitated by the contractor. - Construction vehicles should only use the designated routes as determined in the pre-construction phase. - The top layer of all areas to be excavated must be stripped and stockpiled in areas where this material will not be damaged, removed or compacted. This stockpiled material should be used for the rehabilitation of the site. - Topsoil to be striped at start of works and store in stockpiles no more than 2m high in designated materials storage area. 	Minimal compaction of soils	Contractor ESO	Monitor daily
	Contamination of soils	<ul style="list-style-type: none"> - Vehicle maintenance may only take place in designated and specially prepared areas. - Should the soil be contaminated by the leaking of fuel the following should apply: 	No signs of leakage Leakage	Contractor ESO	Monitor daily

Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
		<ul style="list-style-type: none"> - The contaminated soil should be removed to a depth of 200 mm and disposed of. Thereafter the area should be treated with an organic solvent 	adequately rehabilitated		
Hydrology					
Pollution of ground- and surface water	To minimise surface- and groundwater pollution	<ul style="list-style-type: none"> - Increased run-off during construction must be managed using berms and other suitable structures as required to ensure flow velocities are reduced. - The contractor shall ensure that excessive quantities of sand, silt and silted water do not enter the stormwater system. - Regular monitoring of discharge points in respect of erosion control and of energy dissipaters should be implemented. 	No visible signs of erosion No visible signs of pollution	Contractor	Monitor daily
Wetlands and drainage line crossings	To prevent the negative impact on wetlands and drainage lines	<ul style="list-style-type: none"> - Adequate stormwater management must be implemented for the proposed road in order to prevent bank and riparian zone erosion. - Throughout the construction phase compacted earth berms should be constructed at suitable intervals to reduce the volume and speed of runoff from construction areas into the stormwater and wetland systems for the duration of the construction phase of the road. The following guidelines should be used: <ul style="list-style-type: none"> o Where the area has a slope of less than 2%, berms every 50m should be installed. o Where the area slopes between 2% and 10%, 	Storm water management plan implemented. Earth berms installed No ponding visible	Contractor, Storm water engineer, Wetland specialist	

Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
		<p>berms every 25m should be installed.</p> <ul style="list-style-type: none"> o Where the area slopes between 10%-15%, berms every 20m should be installed. o Where the area has a slope greater than-15%, berms every 10m should be installed. <p>- It must be ensured that connectivity of the wetland feature to the wetland features upstream and downstream of the proposed crossings is maintained. In this regard, special mention is made of ensuring that no drying out of the seasonal and temporary zones occurs. Further no upstream ponding and downstream incision should occur .</p> <p>- All areas affected by construction should be rehabilitated upon completion of the construction phase of the road. Areas should be reseeded with indigenous grasses as required.</p> <p>- No vehicles should be allowed to indiscriminately drive through the wetland areas;</p> <p>- Ongoing removal of alien vegetation should take place throughout the construction and operational phase of the road.</p> <p>- No dumping of waste and no stockpiling of materials within the wetland areas and associated 32m buffer should take place.</p> <p>- Entry into the wetland areas by construction vehicles</p>	<p>No tracks of vehicles and pedestrians in wetland areas except where necessary to install culverts.</p> <p>No visible signs of alien vegetation.</p> <p>No signs of fires i.e. ashes</p>		

Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
		<ul style="list-style-type: none"> - and storing or dumping of topsoil, construction material and other waste in the wetland/drainage line must be avoided. - The bridge structure must be constructed in such a way so as to minimise the change in flow patterns so that the areas of the wetland which are influenced by the presence of a fluctuating water levels are minimally affected. - Care must be taken to ensure that construction activities remain within the boundary of the planned road reserve. - Site offices, parking areas for construction vehicles, etc. should be confined to non-sensitive areas. - No plants not indigenous to the area or exotic plant species especially lawn grasses and other ground-covering plants, should be used as soil-binding agents along new road verges as they will drastically interfere with the nature of the area. - All Category 1 Declared Weeds and other alien species must be removed from the vicinity of the proposed route. - All spillages must be cleaned up and contaminated soil removed as hazardous waste. - Affected soil must be treated with DRIZIT or similar product. 	<p>Fence erected</p> <p>Culvert/bridge design approved by Department of Water Affairs and the Local Authority</p>		

Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
Fauna and Flora					
Damage to indigenous flora and animals	To protect the existing fauna and flora	<ul style="list-style-type: none"> - All exotic invaders and weeds must be eradicated. - No invasive or exotic plant species should be planted in the road reserves. - Snaring and hunting of fauna by construction workers on or adjacent to the study area are strictly prohibited and offenders shall be prosecuted. - Conservation-orientated clauses should be built into contracts for construction personnel, complete with penalty clauses for non-compliance. Caught animals should be relocated to the conservation areas in the vicinity. - Wood harvesting of any trees or shrubs on the study area or adjacent areas shall not be allowed. - Where possible, work should be restricted to one area at a time. - Noise should be kept to a minimum during construction activities. - Entrance by vehicles in no-go areas should be prohibited. - No uncovered equipment or materials may be left at the construction site overnight. All such articles must be stored at a suitable area determined by the Environmental Control Officer. Alternatively, such articles should be left under weighted covering. 	<p>No exotic plants used for landscaping</p> <p>No measurable signs of habitat destruction</p> <p>Minimal damage to the possible indigenous vegetation that exists on site.</p>	<p>Contractor</p> <p>ESO</p> <p>Construction workers</p> <p>Project manager</p>	As and when required

Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
		<ul style="list-style-type: none"> - If any red data species are discovered during construction, procedures as stipulated at the end of the EMPr should be followed. - The areas in the road reserved must be rehabilitated by hydro-seeding with natural occurring grass seeds immediately after every section of the road has been completed and all new alien vegetation species should be removed on a regular basis until natural grasses has established up to 80 %. - Any areas that have been fenced off in assistance with the ECO will be No-Go areas during and after construction. - Upon completion of construction and rehabilitation the ECO should assess and approve the adequacy of the rehabilitation and ensure that sufficient levels of rehabilitation have been undertaken to allow re-establishment of the necessary vegetation. - Rehabilitation works should be monitored until 80 % of vegetation has been established. 			
Social					
Noise impact	To maintain noise levels below "disturbing" as defined in the national and provincial Noise	<ul style="list-style-type: none"> - Site workers must comply with the Provincial noise requirements as outlined. - Noise activities shall only take place during working hours - A noise barrier as determined by specialist must put 	No complaints from surrounding residents and I & A Ps	Contractor	Monitored daily Once off

Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
	Regulations	<p>to protect the Mooikloof Residential area.</p> <ul style="list-style-type: none"> - The layout designs of proposed new developments in the area must take the noise impact of the road into consideration and a form of noise screening must be implemented where buildings are to be located closer than 200m from the road i.e. building façade - the placement of windows away from the sources of noise or a noise barrier. 			
Dust impact	Minimise dust from the site	<ul style="list-style-type: none"> - Dust pollution could occur during the construction works, especially during the dry months. Regular and effective damping down of working areas (especially during the dry and windy periods) must be carried out to avoid dust pollution, impacting on adjacent residential areas and creating dangerous driving conditions on nearby roads. - When necessary, these working areas should be damped down in the mornings and afternoons, by sprinkling bare areas with water. - Dust nets must be used where the construction site borders the Residential Area. 	<p>No visible signs of dust pollution</p> <p>No complaints from surrounding residents and I & A Ps</p>	Contractor	Monitored daily
Atmospheric pollution	To prevent high pollution levels due to vehicle emissions on roads	<ul style="list-style-type: none"> - It is recommended that the areas where emissions in the area will lead to accumulation of pollutants during wind still nights, as experienced with high frequency during winter nights be smoke free zones if possible. 	Pollution levels are acceptable	Contractor Traffic Engineer Atmospheric pollution	Monitored every 6 months

Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
		<ul style="list-style-type: none"> - Traffic flow must be as smooth as possible at intersections, to minimize any cumulative impacts. 		engineer	
Safety and security	Ensure the safety and security of the public	<ul style="list-style-type: none"> - Although regarded as normal practice, it is important to erect proper signs indicating the operations of heavy vehicles in the vicinity of dangerous crossings and access roads or even on the application site if necessary. - With the exception of the appointed security personnel, no other workers, friend or relatives will be allowed to sleep on the construction site (weekends included). - Construction vehicles and activities to avoid peak hour traffic times. - The following actions would assist in management of safety along the road: <ul style="list-style-type: none"> o Adequate road marking; o Allowance for pedestrians and cyclists where necessary; o Erect proper signs indicating the danger of the excavation in and around the site; and - All areas that are excavated to a depth of 1.5 m and more must be marked with barrier tape to reduce the risk of injuries. - Fires shall only be permitted in specially designated areas and under controlled circumstances. 	<p>Signs are visible</p> <p>No incidences reported</p> <p>No signs of sleeping quarters on site</p> <p>Barrier tape erected around excavations</p> <p>No detrimental fire hazards</p>	Contractor ECO Site supervisor	Monitored daily

Environmental risk or issue	Objective or requirement	Mitigation measure	Performance Indicator	Responsibility	Frequency of Action
Influx of people from other areas	In order to limit the influx of people from other areas	<ul style="list-style-type: none"> - It is recommended that (where possible) only people from the local communities in and around the area are employed. 	People from local community employed	Contractor	When required
Infrastructure and services	Impact on existing infrastructure and services during the construction of the proposed road	<ul style="list-style-type: none"> - Possible disruptions to be communicated well in advance of dates to affected parties to minimize inconvenience. - Servitudes must be indicated on engineering drawings. Areas where services will be upgraded and relocated to be determined well in advance. - Proper signs indicating the operations of heavy vehicles in the vicinity of dangerous crossings and access roads to be erected. - Construction vehicles must avoid peak hour traffic, i.e. between 7am and 9am and again between 4pm and 6pm on weekdays. Routes should be planned to avoid construction vehicles traveling through residential areas where possible. - Traffic on existing roads should be controlled during construction activities impacting on these roads (i.e. construction works at intersections, construction of culverts). 	No complaints from I & A Ps	Contractor ESO	When required
Cultural Resources		<ul style="list-style-type: none"> - If any features are discovered during construction activities and clearing of the application site, the correct "procedures for an Environmental incident" (at the end of this EMPr) must be followed. 	No destruction of or damage to graves or discovered cultural resources	Contractor ECO	Monitor daily

Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
Visual impact	<p>In order to minimise the visual impact of construction works</p> <p>Visual impact of the road and vehicles on the road during the operational phase.</p>	<ul style="list-style-type: none"> - The disturbed areas shall be rehabilitated immediately after every section of the road is constructed. - Shade cloth must be used to conceal and minimise the visual impact of the site camps and storage areas. - Possible mitigation measures that could be considered are the establishment of dense vegetation at strategic points to screen-off the most visible sections of the roads / construction of berms adjacent to the road/ a combination of berms with vegetation. 	Visual impacts minimised	Contractor ESO	Monitor daily
"Sense of Place"	To enhance the "Sense of Place" of the area	<ul style="list-style-type: none"> - Landscaping guidelines provided for the linear strips of land adjacent to the proposed road, should be implemented. 	Guidelines developed	Landscaping contractor	Once off for installation and regular maintenance
Vegetation	Prevention of possible spread of weeds	<ul style="list-style-type: none"> - Ensure that materials used for mulching and topsoil/fertilisers are certified weed free. Collect certifications where available. - Control weeds growth that appears during construction. 	Weed growth controlled	Contractor	When required
	To ensure rehabilitation of the site	<ul style="list-style-type: none"> - Compacted soils shall be ripped at least 200 mm deep. - All clumps and rocks larger than 30 mm diameter shall be removed from the soil to be rehabilitated. 	Rehabilitation undertaken	Contractor	Once a day Then every 4 days

Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
		<ul style="list-style-type: none"> - The soil shall be leveled before seeding - Hydro-seed the soil with Patch mixture or plants with suitable indigenous ground covering as specified. - Watering shall take place at least once per day for the first 14 days until seeds have germinated. Thereafter watering should take place at least for 20 minutes every 4 days until grass have hardened off. 			

2.3 Operational Phase

Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
Site clean up					
Stormwater pollution	No materials to wash into the stormwater system	- Remove erosion and sediment controls only if all bare soil is sealed, covered or re-vegetated.	No pollution of the stormwater system	Contractor	Monitor
	Minimise waste	- Decontaminate and collect waste in storage area for off-site recycling or disposal Arrange for final collection and removal of excess and waste materials.	No waste on site once construction is completed	Contractor	When required
Geology	Prevent topsoil erosion	- The soil must be covered by means of re-seeding and vegetation with suitable ground covering.	Site successfully rehabilitated	Engineer Contractor	Once off
Erosion and compaction of soils	To rehabilitate the disturbed areas (site camp, storage area and access routes)	- The soil in these areas should be ripped 200mm deep and then hydro-seeded with an indigenous grass-seed mix. These areas should be monitored until 80% coverage has been achieved and are established.	Site successfully rehabilitated	Contractor ECO	To be agreed
Fauna and Flora	The establishment of	- Agreed schedule for regular follow-up watering,	Site successfully	ECO	To be agreed

Environmental risk or Issue	Objective or requirement	Mitigation measure	Performance Indicator	Responsibility	Frequency of Action
	vegetation after rehabilitation	<p>weed control, mulch supplements and amenity pruning, if needed.</p> <ul style="list-style-type: none"> - Replace all plant failures within a three month period after planting. - Upon completion of construction and rehabilitation the ECO should assess and approve the adequacy of the rehabilitation and ensure that sufficient levels of rehabilitation have been undertaken to allow re-establishment of the necessary vegetation. - Rehabilitation works should be monitored until 80 % of vegetation has established 	<p>rehabilitated</p> <p>Re-vegetation stabilize the soil</p>	Specialist Contractor	
Environmental Control Officer		- ECO to undertake last inspection of site and sign off that the EMPr has been complied with or identify breaches. Submit to GDARD for approval.	Last inspection report	ECO	
Establishment Stage					
Materials failure	Stability of road achieved	- The road must be inspected regularly to detect any cracking or structural problems. Problems to be rectified with matching materials, or other agreed solution.	No material failures	Project manager	To be agreed
Site audit					
Eventual project failure	Successful project establishment	- Routinely audit the works and adjust maintenance schedule accordingly.	No project failure	Maintenance team	Continuous
General					
Fire risks	To prevent any fire	- Open fires and smoking during maintenance works	No fire hazards	Maintenance	-

Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
	hazards	are strictly prohibited.	during maintenance work	workers	
Waste disposal	To prevent pollution	- No waste material shall at any stage be disposed of in Public Open Space or on adjacent properties during maintenance work.	No pollution	Contractor Maintenance workers	

3.0 PROCEDURES FOR ENVIRONMENTAL INCIDENTS

3.1 Leakages and Spills

- Identify source of problem;
- Stop the leak, if safe to do so;
- Contain spilt material, using spills kit or sand;
- Notify Environmental Control Officer;
- Remove spilt material and place in sealed container for disposal (if possible); and
- Site Manager in liaison with ECO, to follow Incident Management Plan.

3.2 Failure of Erosion/Sediment Control Devices

- Prevent further escape of sediments;
- Contain escaped material using silt fence, hay bales, pipes, etc.;
- Notify ECO;
- Repair or replace failed device as appropriate;
- Dig/scrape up escaped material; take care not to damage vegetation;
- Remove escaped material from site;
- Site Manager in liaison with ECO to follow Incident Management plan; and
- Monitor for effectiveness until re-establishment.

3.3 Bank/Slope Failure

- Stabilise toe of slope to prevent sediment escape using aggregate bags, silt fence, logs, hay bales, pipes, etc.;
- Notify ECO;
- Site Manager, in liaison with ECO to follow Incident Management plan;
- Divert water upslope from failed fence;
- Protect area from further collapse as appropriate;
- Restore as advised by ECO; and
- Monitor for effectiveness until stabilised.

3.4 Discovery of Rare or Endangered Species

- Stop work;
- Notify ECO;
- If a plant is found, mark location of plants;
- If an animal, mark location where sighted;

-
- ECO to identify or arrange for identification of species and or the relocation of the species if possible;
 - If confirmed significant, ECO to liaise with Endangered Wildlife Trust; and
 - Recommence work when cleared by ECO.

3.5 Discovery of Archeological or Heritage Items

- Stop work;
- Do not further disturb the area;
- Notify ECO;
- ECO to arrange appraisal of specimen;
- If confirmed significant, the Site Manager in consultation with the ECO to liaise with National, Cultural and History Museum
P.O. Box 28088
SUNNYSIDE
0132
- Recommence work when cleared by ECO.

4.0 EMPR REVIEW

1. The Site Supervisor is responsible for ensuring the work crew is complying with procedures, and for informing the work crew of any changes that may have been implemented by GDARD before starting any works.
2. If the contractor cannot comply with any of the activities as described above, they should inform the ECO with reasons within 7 working days.

5.0 ANNEXURES

ANNEXURE 1 (SAMPLE)

METHOD STATEMENT: Solid Waste Management

CONTRACT:..... **DATE:**.....

WHAT WORK IS TO BE UNDERTAKEN? [give a brief description of the works to be undertaken on site that will generate waste (hazardous and non-hazardous wastes)]; * Note: please attach extra pages if more space is required.

*Insert additional pages as required

WHERE ARE THE WORKS TO BE UNDERTAKEN? (where possible, provide an annotated plan and a full description of the extent of the works); * Note: please attach extra pages if more space is required

*Insert additional pages as required

METHOD STATEMENT: Solid Waste Management (contd.)

START AND END DATE OF THE WORKS FOR WHICH THE METHOD STATEMENT IS REQUIRED:

Start Date:.....

End Date:.....

HOW IS WASTE TO BE MANAGED ON SITE? (provide as much detail as possible, including annotated sketches and plans where possible): * Note: please attach extra pages if more space is required.

*Insert additional pages as required

Appendix I: Other information

**Appendix I₁: Coordinates of the
Alternative Route along the k40**

COORDINATES ALONG THE K40 ALTERNATIVE

Position (metres for start)	Latitude (S):	Longitude (E):
Start	25.816172°	28.338640°
250	25.816754°	28.340905°
500	25.817449°	28.343298°
750	25.818637°	28.345481°
1000	25.819828°	28.347738°
1250	25.821453°	28.349715°
1500	25.822988°	28.351894°
1750	25.824442°	28.353830°
2000	25.826113°	28.355325°
2250	25.827714°	28.356141°
2500	25.829975°	28.357341°
2750	25.832148°	28.358235°
3000	25.834075°	28.359389°
3250	25.836049°	28.360312°
3500	25.837951°	28.361235°
3750	25.840050°	28.362536°
4000	25.841738°	28.362449°
4250	25.843036°	28.359859°
4500	25.843746°	28.358043°
End	25.845108°	28.355459°

Appendix I₂: Company Profile and CV



Bokamoso

Landscape Architects &
Environmental consultants

P.O.BOX 11375
Maroelana
0161

Tel: (012) 346 3810
Fax: (086) 570 5559

E-mail: lizelle@mvweb.co.za
Website: www.bokamoso.net

- 01 Executive Summary**
- 02 Vision, Mission & Values**
- 03 Human Resources**
- 04 Services**
- 05 Landscape Projects**
- 06 Corporate Highlights**
- 07 Environmental Projects**
- 08 Indicative Clients**
- 09 Tools**

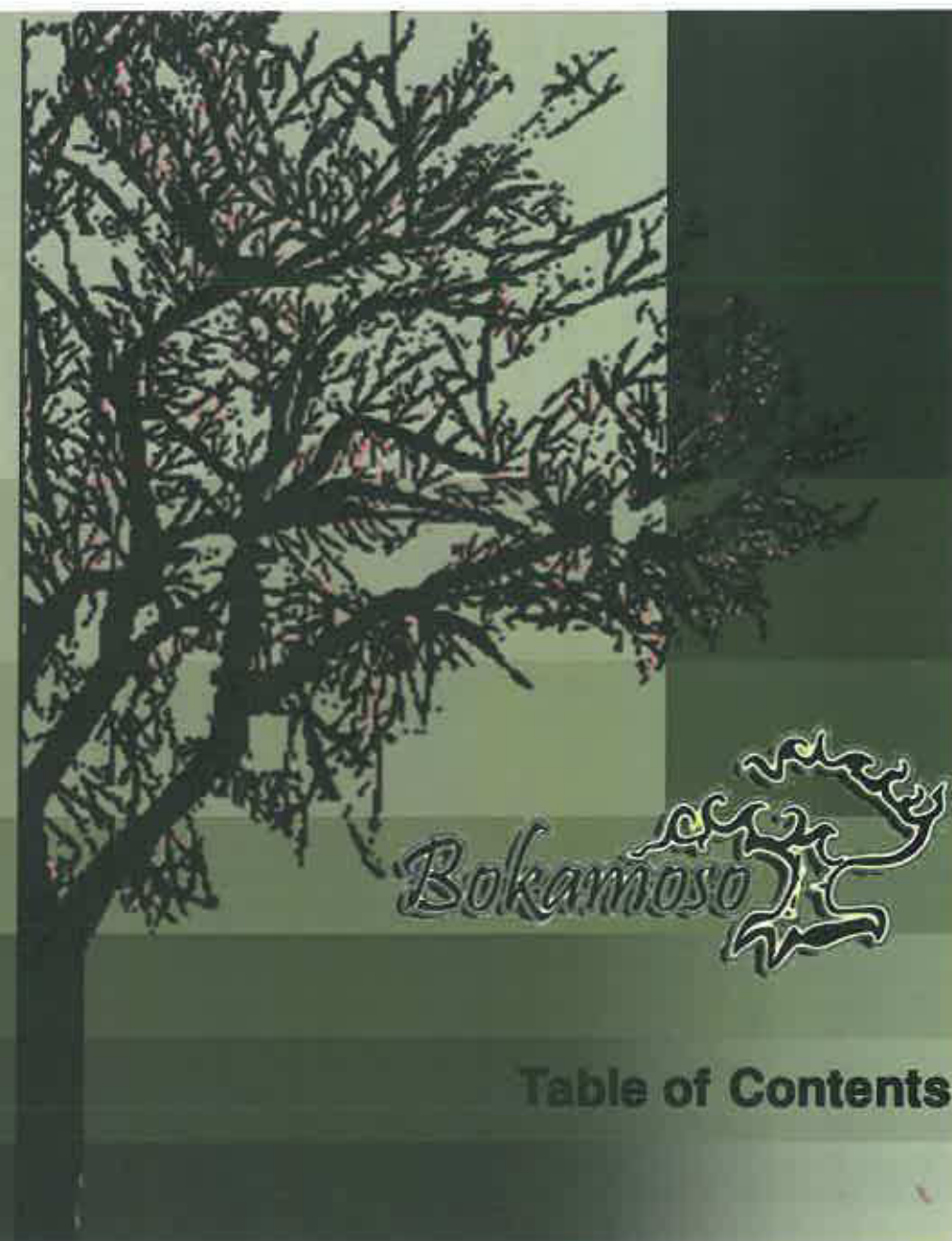


Table of Contents

Bokamoso specialises in the fields of Landscape Architecture and all aspects of Environmental Management and Planning. Bokamoso was founded in 1992 and has shown growth by continually meeting the needs of our clients. Our area of expertise stretches throughout the whole of South Africa. Our projects reflect the competence of our well compiled team. The diversity of our members enables us to tend to a variety of needs. Our integrated approach establishes a basis for outstanding quality. We are well known to clients in the private, commercial as well as governmental sector.

At Bokamoso we stand on a firm basis of environmental investigation in order to find unique solutions to the requirements of our clients and add value to their operations.



01 Executive Summary

Company Overview



Vision:

At Bokamoso we strive to find the best planning solutions by taking into account the functions of a healthy ecosystem. Man and nature should be in balance with each other.

Mission:

We design according to our ethical responsibility, take responsibility for successful completion of projects and constitute a landscape that contributes to a sustainable environment. We add value to the operations of our clients and build long term relationships that are mutually beneficial.

Values:

Integrity

Respect



Bokamoso stands on the basis of fairness. This include respect within our multicultural team and equal opportunities in terms of gender, nationality and race.

We have a wide variety of projects to tend to, from complicated reports to landscape installation. This wide range of projects enables us to combine a variety of professionals and skilled employees in our team.

Bokamoso further aids in the development of proficiency within the working environment. Each project, whether in need of skilled or unskilled tasks has its own variety of facets to bring to the table.

We are currently in the process of receiving our BEE scorecard. We support transformation in all areas of our company dynamics.



03 Human Resources

Employment Equity

Lizelle Gregory (100% interest)

Lizelle Gregory obtained a degree in Landscape Architecture from the University of Pretoria in 1992 and passed her board exam in 1995.

Her professional practice number is PrLArch 97078.

Ms. Gregory has been a member of both the Institute for Landscape Architecture in South Africa (ILASA) and South African Council for the Landscape Architecture Profession (SACLAP), since 1995.

Although the existing Environmental Legislation doesn't yet stipulate the academic requirements of an Environmental Assessment Practitioner (EAP), it is recommended that the Environmental Consultant be registered at the International Association of Impact Assessments (IAIA). Ms. Gregory has been registered as a member of IAIA in 2007.

Ms. Gregory attended and passed an International Environmental Auditing course in 2008. She is a registered member of the International Environmental Management and Assessment Council (IEMA).

She has lectured at the Tshwane University of Technology (TUT) and the University of Pretoria (UP). The lecturing included fields of Landscape Architecture and Environmental Management.

Ms. Gregory has more than 20 years experience in the compilation of Environmental Evaluation Reports:

Environmental Management Plans (EMP);

Strategic Environmental Assessments;

All stages of Environmental input ;

EIA under ECA and the new and amended NEMA regulations and various other Environmental reports and documents.

Ms. Gregory has compiled and submitted more than 600 Impact Assessments within the last 5-6 years. Furthermore, Ms. L. Gregory is also familiar with all the GDARD Provincial Environmental policies and guidelines. She assisted and supported QAI/TRANS former BIV-Committee with Environmental Impact and reports compilation and delivery plans. She



93 Human Resources

032 Members

Collaborative Arrangements

Bokamoso has entered into Collaborative Arrangements with Nali Sustainability Solutions (NSS); an emerging 100% black wholly owned consultancy service with the aim of leveraging resources, expertise and improved competitiveness in delivering value to clients.

NSS, established in 2012 has efficiently managed and delivered on EIA projects for both the private sector and government clients, provided advisory services on environmental and land use matters and undertaken or supported strategic environmental planning and policy development.

The EIA projects managed or involved in include residential/housing, mixed use, industrial, commercial, business/retail townships and infrastructure projects including roads and engineering services.

Pirate Ncube, (owner/director) has vast experience in land use, spatial planning and environmental management. Over a period of 20 years, he has served in various capacities in the sector including as a consulting town planner, reviewer and manager of EIAs, head of environment and conservation in Gauteng and a member of the Gauteng DFA Tribunal.



Consulting

Anè Agenbacht

Introduction to Sustainable Environmental Management—An overview of Principles, Tools, & Issues (Potch 2006)
Leadership Training School (Lewende Woord 2010)
BA Environmental Management (UNISA 2011)
PGCE Education (Unisa 2013) - CUM LAUDE
Project Manager
More than 10 years experience in the compilation of various environmental reports

Mary-Lee Van Zyl

Msc. Plant Science (UP)
BSc (Hons) Plant Science (UP)
BSc Ecology (UP)
1 year 5 months working experience in the Environmental field
Specialises in ECO works, Basic Assessments, EIA's, and Flora Reports

Dashentha Naidoo

BA Honours Degree in Environmental Management (UNISA)
Bachelor Social Science in Geography & Environmental Management (UKZN)
More than 4 years experience in WUL Application & Integrated Environmental Management within water resource management.
Senior Environmental Practitioner & Water Use Licences Consultant

Ben Bhukwana

BSc Landscape Architecture (UP)
More than 5 years experience in the field of Landscape Architecture (Design, Construction, and Implementation)
Specialises in Landscape Design, ECO & Environmentalist training (Assisting with DEAT)



03 Human Resources

033 Personnel

Anton Nel

B-Tech Landscape Technology (TUT)
N Dip Landscape Technology (TUT)
1 year experience in ECO.
Specialises in Basic Assessment Reports.

Juanita de Beer

Events Management and Marketing (Damelin)
Specializes in Public relations and public participation processes

Alfred Thomas

CIW Foundation & Internet Marketing (IT Academy)
12 years experience in GIS and IT in general.
GIS Operator and Multimedia Specialist.

Bianca Reyneke

Applying SHE Principles and Procedures (NOSA)
Intro to SAMTRAC Course (NOSA)
SHEQ Coordinator and compilation of environmental reports



03 Human Resources

034 Personnel

Elsa Viviers

Interior Decorating (Centurion College)
(Accounting/ Receptionist) and Secretary to Lizelle Gregory

Loura du Toit

N. Dip. Professional Teacher (Heidelberg Teachers Training College)
Librarian and PA to Project Manager

Merriam Mogalaki

Administration Assistant with in-house training in bookkeeping

Landscape Contracting

Elias Maloka

Site manager overseeing landscape installations.
Irrigation design and implementation.
Landscape maintenance
18 years experience in landscape contracting works.

The contracting section comprises of six permanently employed black male workers. In many cases the team consists of up to 12 workers, depending on the quantity of work.



03 Human Resources

035 Personnel



01 Environmental Management Services

- Basic Assessment Reports
- EIA & Scoping Reports
- Environmental Management Plans
- Environmental Scans
- Strategic Environmental Assessments
- EMP for Mines
- Environmental Input and Evaluation of Spatial Development Frameworks
- State of Environmental Reports
- Compilation of Environmental Legislation and Policy Documents
- Environmental Auditing and Monitoring
- Environmental Control Officer (ECO)
- Visual Impact assessments
- Specialist Assistance with Environmental Legislation Issues and Appeals
- Development Process Management
- Water Use License applications to DWA
- Waste Transfer Applications



04 Services

Consulting Services

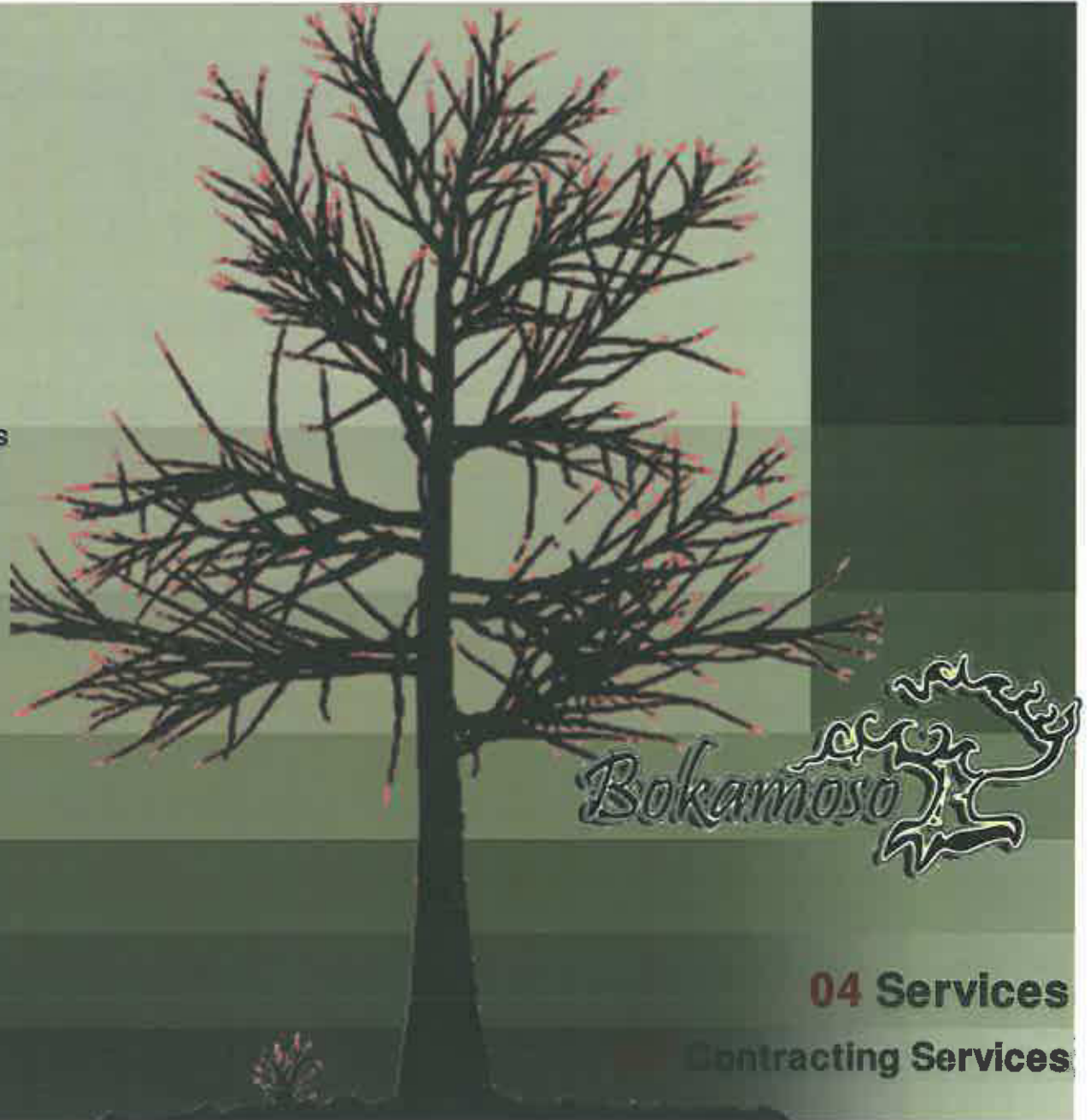
02 Landscape Architecture

- Master Planning
- Sketch Plans
- Planting Plans
- Working Drawings
- Furniture Design
- Detail Design
- Landscape Development Frameworks
- Landscape Development Plans (LDP)
- Contract and Tender Documentation
- Landscape Rehabilitation Works

03 Landscape Contracting

Implementation of Plans for:

- Office Parks
- Commercial/ Retail / Recreational
Development
- Residential Complexes
- Private Residential Gardens



04 Services

Contracting Services

▲ Team Composition

● Environmental

■ Landscape



04 Services

043 Orientation

01 Valpre Bottling Plant, Heidelberg



project

shelter-site plan

Bokamoso

03 Landscape Projects- Current
051 Commercial



01 Valpre Bottling Plant, Heidelberg



Landscaping Projects - Current

051 Commercial

01 Valpre Bottling Plant, Heidelberg

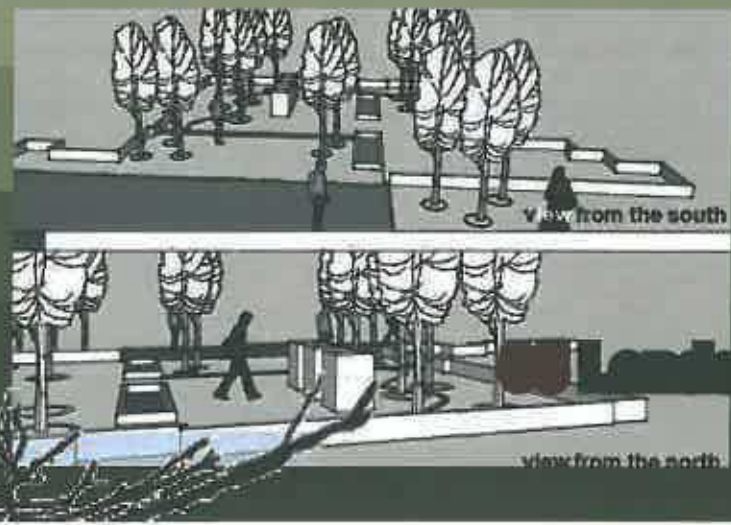
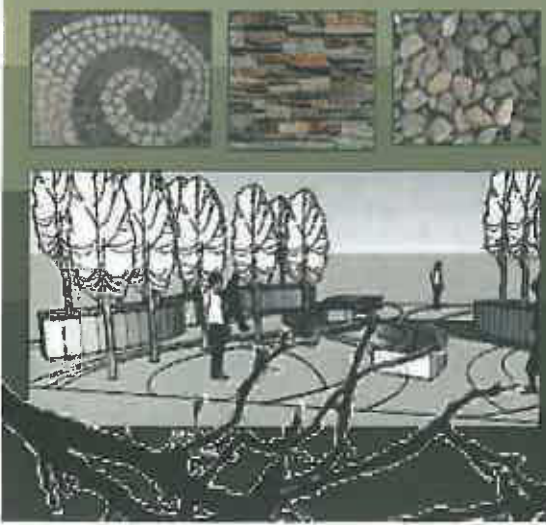
concept plan



Landscape Projects - Current

051 Commercial

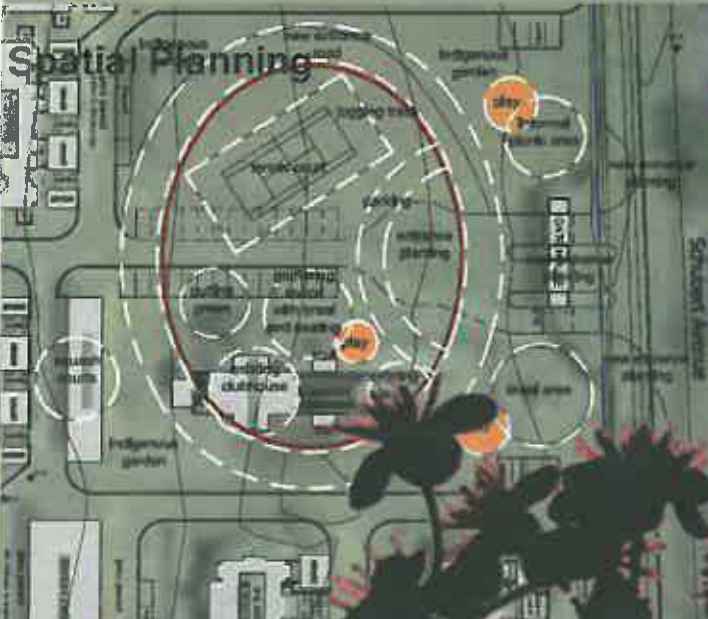
01 Valpre Bottling Plant, Heidelberg



Landscape Projects - Current

051 Commercial

02 Melodie Waters, Hartebeespoortdam



Indigenous Planting

Streetscape



Project - Current
[Red square icon] [Red square icon]

02 Melodie waters, Hartebeestpoortdam

Development Framework

jetty/paddle boat launch
bar and swimming pool
entrance to park landscape
jogging track
levels court
tropical garden
bar and seating
arrival entrance area

Rehabilitation Area Layout

habitat island
jetty/paddle boat launch
gathering/picnic area
bird hide
bar and seating
arrival entrance area

Bokamoso

05 Landscape Projects - Current

022 Conceptual Landscape

03 Grain Building, Pretoria



Bokamoso

Landscaping Projects - Completed

053 Offices

04 Ismail Dawson offices, Pretoria

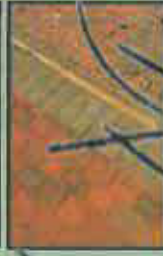


Bokamoso

Landscape Projects - Conceptual

053 Offices

05 Celtic Manor, Pretoria

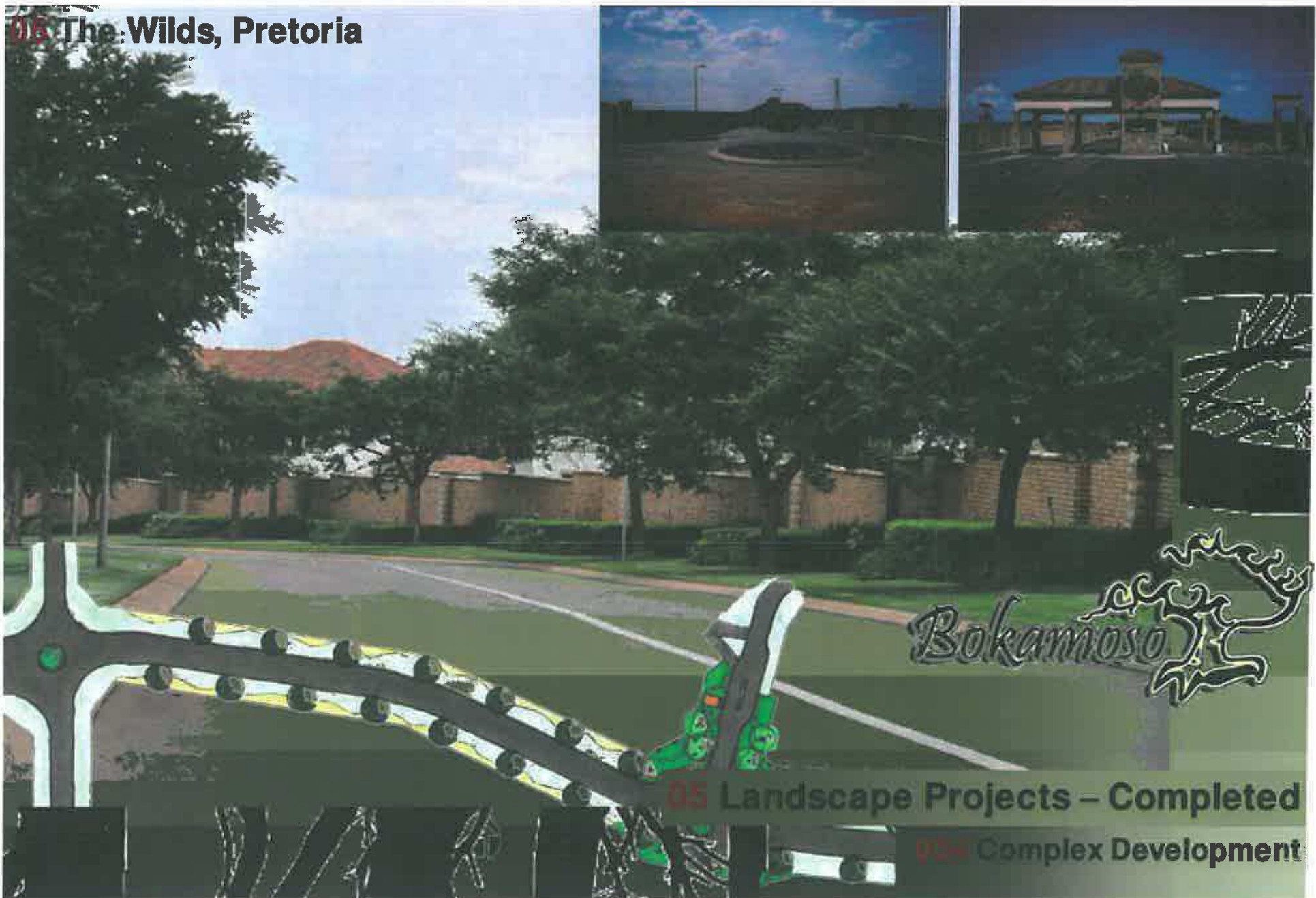


Bokamoso

95 Landscape Projects - Completed

100 Complex Development

05 The Wilds, Pretoria



05 Landscape Projects – Completed

05 Complex Development

07 The Wilds, Pretoria



Bokamoso

05 Landscape Projects – Completed

055 Residential

05 The Villa, Pretoria



Bokamoso

Landscape Projects - Completed

055 Residential

09 The Wilds, Pretoria



Bokamoso

Landscaping Projects - Completed

055 Residential

010 The Wilds, Pretoria



Bokamoso

■ Landscape Projects—Completed

055 Residential

011 Governor of Reserve Bank's Residence, Pretoria



Plant Palette



Option 1



Option 2



012 House Ismail, Pretoria



Front Garden



Back Garden



013 Forest Garden, Pretoria



Bokamoso

Landscape Projects - Completed

055 Residential

015 Forest Garden, Pretoria



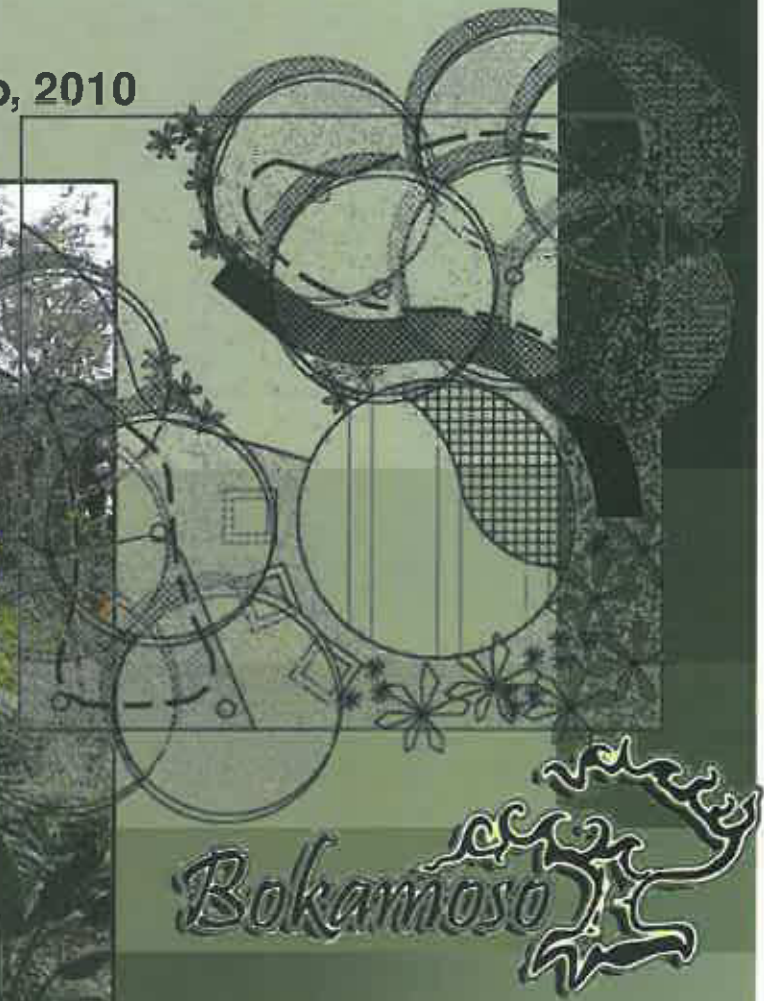
Bokamoso

Landscape Projects - Completed

055 Residential

01 Safari Garden Expo

Received a Silver Certificate at the Safari Garden Expo, 2010



06 Corporate Highlights

061 Awards

02 UNISA Sunnyside Campus, Pretoria

Best Commercial Paving Plan in Gauteng, 1997



06 Corporate Highlights

061 Awards

Project Name	Status	Project
Environmental Impact Assessment(EIA) and Scoping Report		
Junction 21	ROD	EIA
5 O'clock site access	In Progress	EIA
Bokamoso X 1	In Progress	Scoping & EIA
Doornvallei Phase 6 & 7	In Progress	EIA
Engen Interchange	In Progress	Scoping & EIA
Erasmia X15	In Progress	EIA
Franschkloof	In Progress	EIA
K113	Amendment of ROD	EIA
K220 East	ROD	EIA
K220 West	ROD	EIA
K54 ROD conditions	In Progress	EIA
Knopieslaagte 95/Peachtree	ROD	EIA
Knopieslaagte portion 20 & 21	ROD	EIA
Lillieslief/Nooitgedacht	In Progress	EIA
Mooiplaats 70 (Sutherland)	In Progress	EIA
Naauwpoort 1 - 12/Valley View	In Progress	EIA
PeachTree X5	In Progress	EIA
Strydfontein 60	In Progress	EIA
Thabe Motswere	In Progress	Scoping & EIA
Vlakplaats	In Progress	EIA
Waterval Valley	In Progress	EIA
Environmental Opinion		
Doornkloof 60 (Ross)	In Progress	Opinion
Maravani X 53	In Progress	BA & Opinion
Meyburg (UST)	In Progress	Opinion
Norwood Mill Farmstead	In Progress	Opinion
Rivierfontein X 1	In Progress	Opinion



The adjacent list host the status of our current projects. Only a selected amount of projects are displayed.



07 Current Environmental Projects
01 EIA, Scoping & Opinion

Project Name	Status	Project
Basic Assessment(BA)		
Annlin X 138	In Progress	BA
Clubview X 29	ROD	BA
Darrenwood Dam	In Progress	BA
Durley Holding 90 & 91	In Progress	BA
Elim	In Progress	BA
Fochville X 3	In Progress	BA
Hartebeeshoek 251	In Progress	BA
Klerksdorp (Matlosana Mall)	In Progress	BA
Monavoni External Services	ROD	BA
Monavoni X 45	Amendment of ROD	BA
Montana X 146	In Progress	BA
Rooihuiskraal X29	In Progress	BA
Thorntree Mall	In Progress	BA

Environmental control officer (ECO)		
Grace Point Church	In Progress	ECO
R 81	In Progress	ECO
Highveld X 61	In Progress	ECO
Mall of the North	In Progress	ECO
Olievenhoutbosch Road	In Progress	ECO
Orchards 39	In Progress	ECO
Pierre van Rynveld Reserve	In Progress	ECO
Project Shelter	In Progress	ECO

	S24 G	
Workshop	In Progress	S24 G



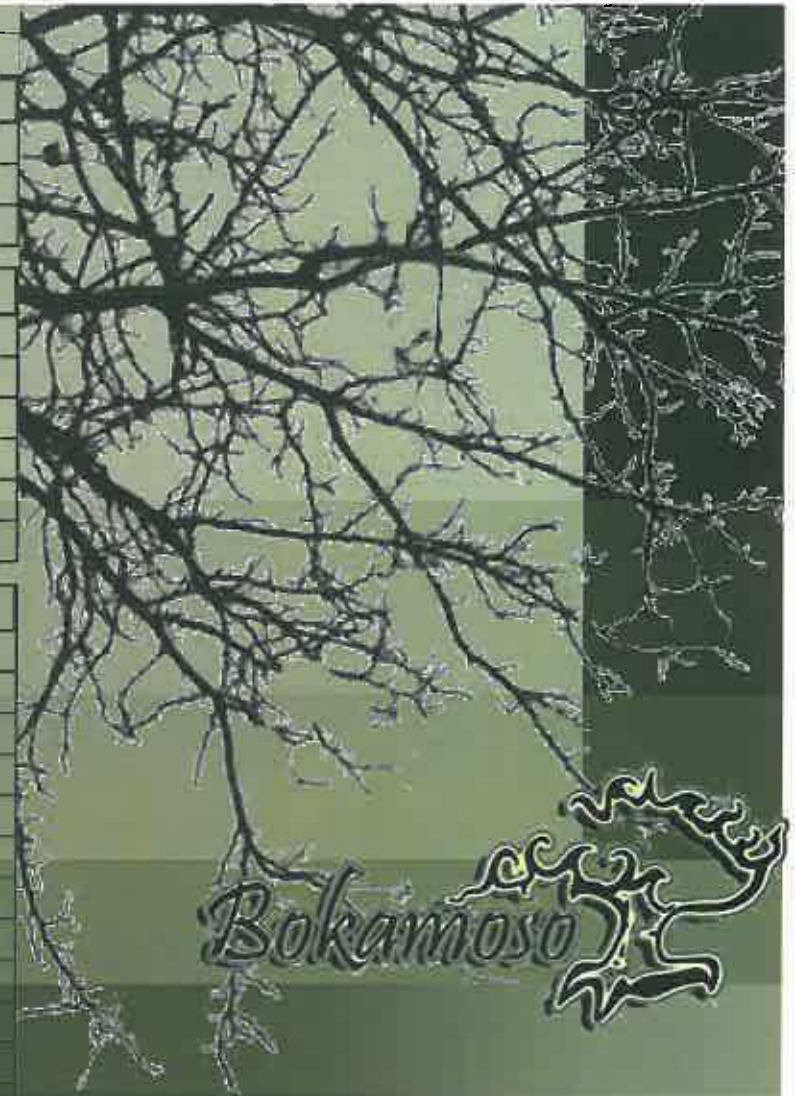
07 Current Environmental Projects

072 BA, ECO & S24 G

Project Name	Status	Project
Objection		
Colesberg WWTW	In Progress	Objection
Nigel Steelmill	Completed	Objection
Chantilly Waters	Completed	Objection

Development facilitation Act- Input (DFA)		
Burgersfort	In Progress	DFA & BA
Doornpoort Filling Station	In Progress	DFA & EIA & Scoping
Eastwood Junction	In Progress	DFA
Ingersol Road (Erf 78, 81 - 83)	In Progress	DFA
Roos Senekal	In Progress	DFA & EIA & Scoping
Thaba Meetse 1	In Progress	DFA & EIA & Scoping

Water Use License Act (WULA)		
Britstown Bulk Water Supply	In Progress	WULA
Celery Road / Green Channel	In Progress	WULA
Clayville X 46	In Progress	WULA
Dindingwe Lodge	In Progress	WULA
Doornpoort Filling Station	In Progress	WULA+DFA+EIA+SC
Eco Park Dam	In Progress	WULA
Groote Drift Poth	In Progress	WULA
Jozini Shopping Centre	In Progress	WULA+BA
K60	Completed	WULA
Maloto Roads	In Progress	WULA
Kwazele Sewage Works	In Progress	WULA
Mankwani External Supplies	In Progress	WULA+BA
Nyalu End Estate	In Progress	WULA
Project Ogata 2/3	In Progress	WULA



07 Current Environmental Projects

Objection, DFA & WULA

Project Name	Status	Project
Environmental Management Plan(EMP)		
Heidelberg X 12	ROD	EMP
Monavoni Shopping Centre	Completed	EMP
Forest Hill Development	Completed	EMP
Weltevreden Farm 105KQ	Completed	EMP+EIA
Raslow Holding 93	Completed	EMP+BA
Durley Development	Completed	EMP+BA
Rooihuiskraal North X 28	Completed	EMP

Rehabilitation Plan		
Norwood Mall/Sandspruit	In Progress	Rehabilitation
Project Shelter Heidelberg	In Progress	Rehabilitation
Sagewood Attenuation Pond	ROD	Rehabilitation
Velmore Hotel	Completed	Rehabilitation
Grace Point Church	Completed	Rehabilitation
Mmamelodi Pipeline	Completed	Rehabilitation

Visual Impact Assessment		
Swatzkop Industrial Developme	Completed	Assessment +DFA
Erasmia	Completed	Assessment

Signage Application		
Mantyn Advertising	Completed	Signage
The Villa Mall	Completed	Signage+EMP +BA



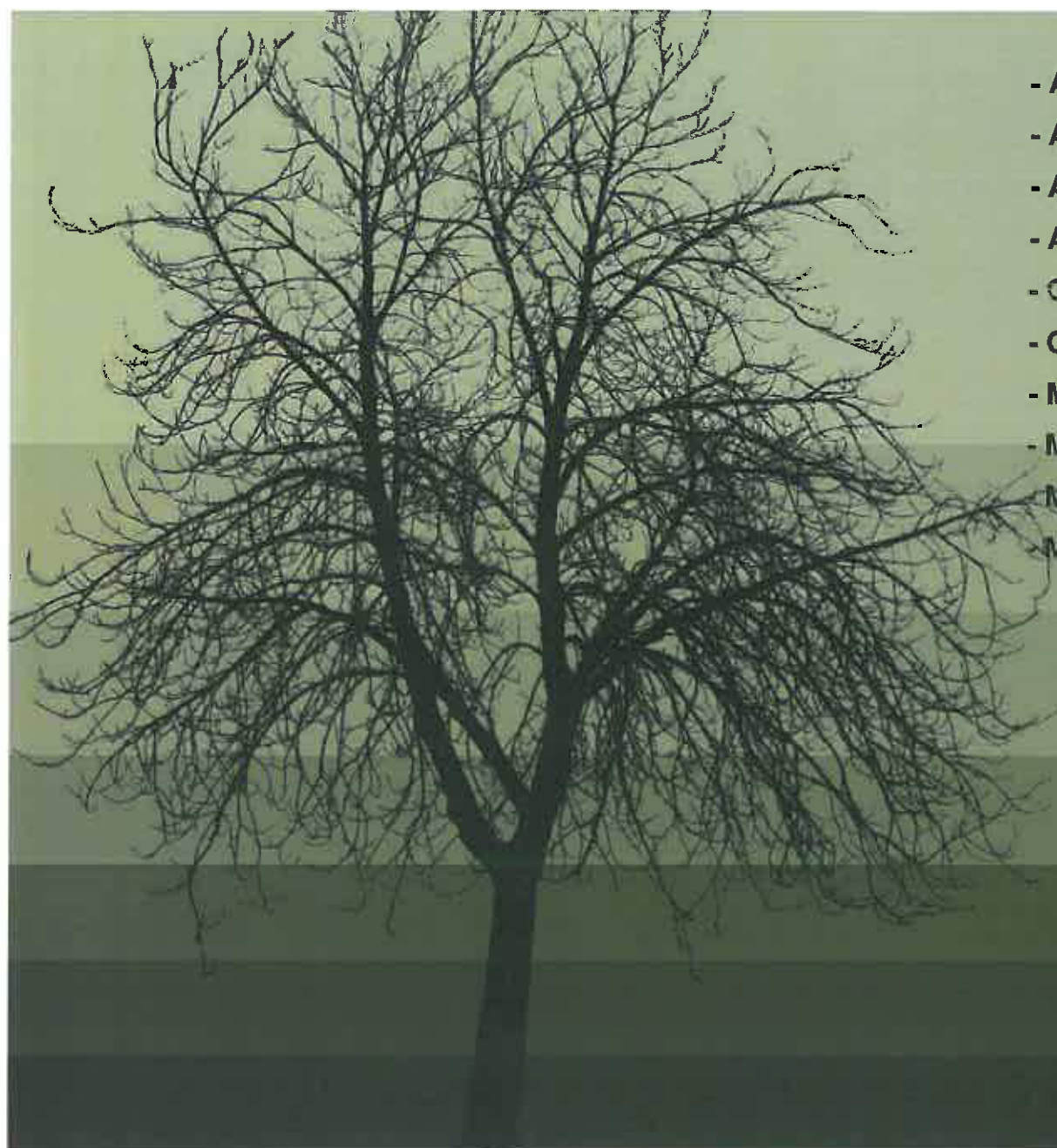
07 Current Environmental Projects

EMP, Rehabilitation, Visual Impact Assessment & Signage Application

- Billion Property Group
- Cavaleros Developments
- Centro Developers
- Chaimberlains
- Chieftain
- Century Property Group
- Coca Cola
- Elmado Property Development
- Flanagan & Gerard
- Gautrans
- Hartland Property Group
- Moolman Group
- MTN
- M&T Development
- Old Mutual
- Property Investment Company
- Petroland Developments
- RSD Construction
- SAND
- Stephan Parsons
- Twin City Developments
- Urban Construction
- USN



08 Indicative Clients

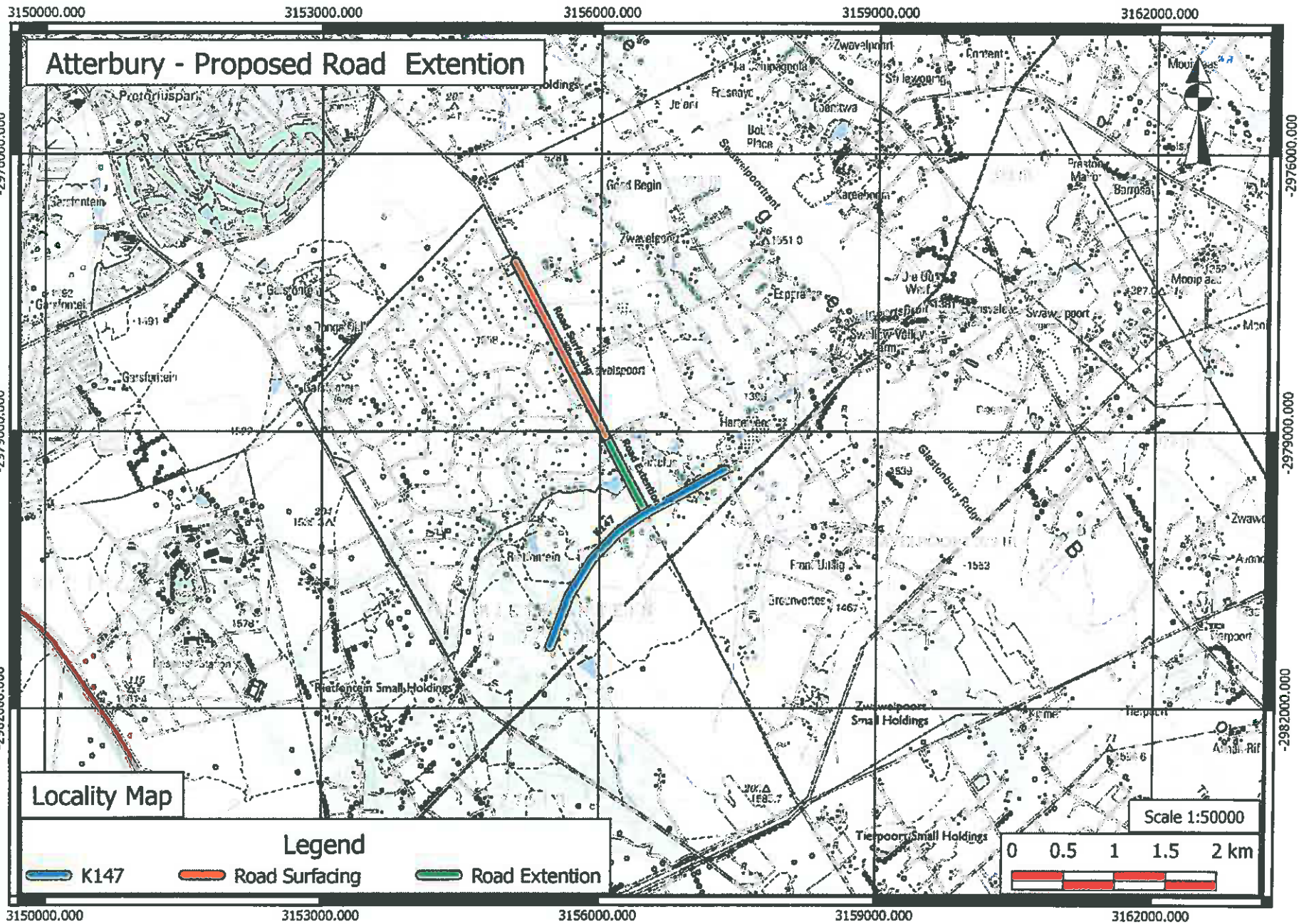


- Adobe Illustrator CS3
- Adobe Photoshop CS3
- Adobe InDesign CS3
- AutoCAD
- Google SketchUP
- GIS
- Microsoft Office Word
- Microsoft Office Excel
- Microsoft Office Publisher
- Microsoft Office Power Point



Appendix J: Enlarged Figures

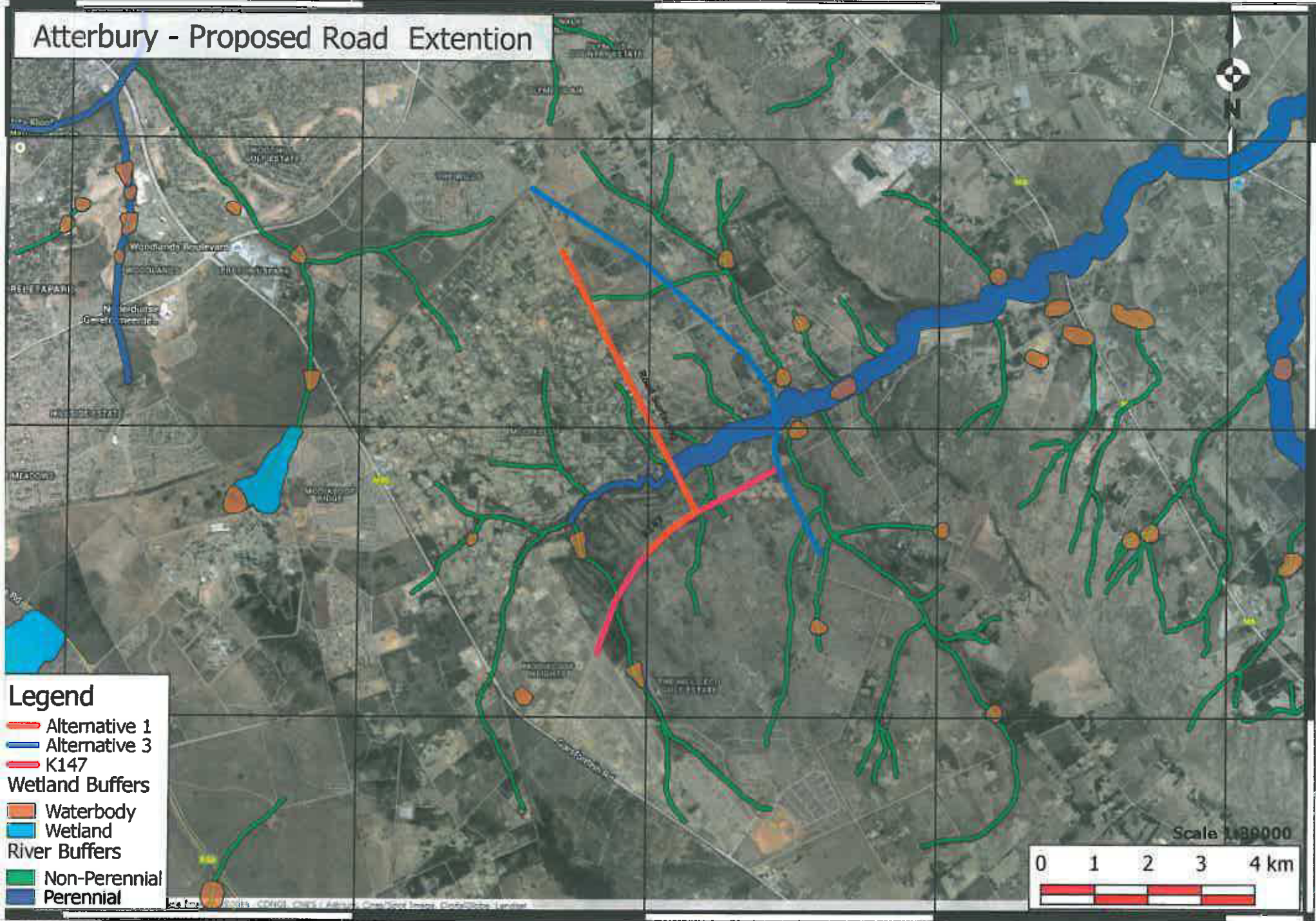
Appendix J₁ Locality Map



Appendix J₂: Perennial and non-perennial rivers

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Atterbury - Proposed Road Extention



Legend

- Alternative 1
- Alternative 3
- K147
- Wetland Buffers**
- Waterbody
- Wetland
- River Buffers**
- Non-Perennial
- Perennial



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Appendix J₃: Irreplaceable sites

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3156000.000

3159000.000

Atterbury - Proposed Road Extension



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000'0006'667-

-2982000.000

000'0007'867-

Irreplaceable-CPlan

- | | | |
|-----------------------|---|---|
| K147 | RL mammal hab, Prim veg | RL plant conf, RL plant hab, OL plant hab, RL mammal hab, RL bird hab, Prim veg |
| Road Surfacing | RL mammal hab, RL bird hab | RL plant conf, RL plant hab, RL mammal hab, RL bird hab, Prim veg |
| Road Extension | RL mammal hab, RL bird hab, Prim veg | RL plant hab, OL plant hab, Prim veg |
| Irreplaceable | RL plant conf | RL plant hab, OL plant hab, RL bird hab, Prim veg |
| Prim veg | RL plant conf, Prim veg | RL plant hab, OL plant hab, RL mammal hab, Prim veg |
| RL bird hab, Prim veg | RL plant conf, RL mammal hab, Prim veg | RL plant hab, OL plant hab, RL mammal hab, RL bird hab, Prim veg |
| RL mammal hab | RL plant conf, RL mammal hab, RL bird hab | RL plant hab, RL mammal hab, Prim veg |
| | RL plant conf, RL mammal hab, RL bird hab, Prim veg | |

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Appendix J₄: Biodiversity sensitivities

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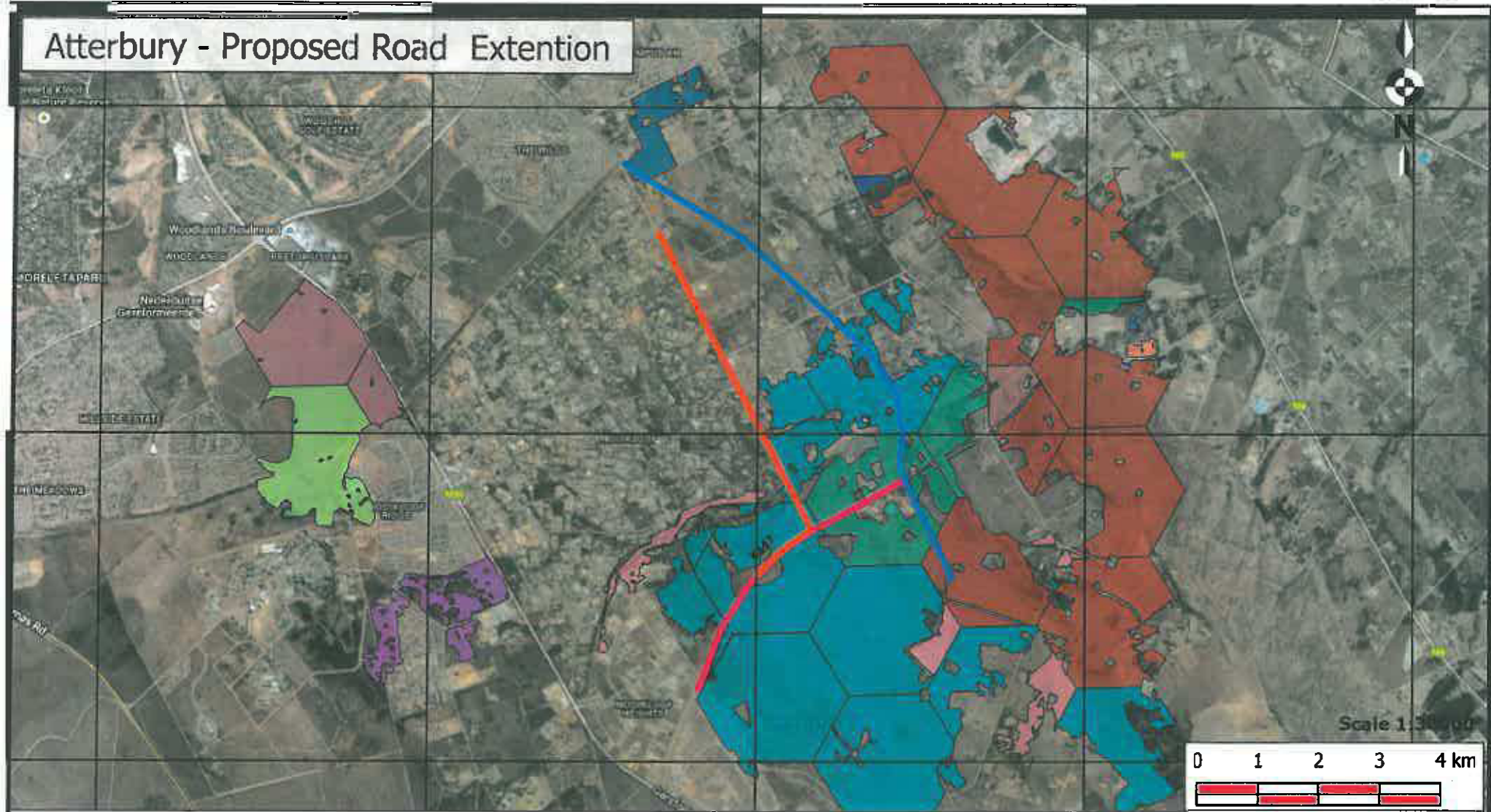
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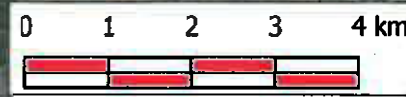
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Atterbury - Proposed Road Extention



Scale 1:30,000



Legend

- | | | |
|-----------------------|---|---|
| Alternative 1 | RL mammal hab, Prim veg | RL plant conf, RL plant hab, OL plant hab, RL mammal hab, RL bird hab, Prim veg |
| Alternative 3 | RL mammal hab, RL bird hab | RL plant conf, RL plant hab, RL mammal hab, RL bird hab, Prim veg |
| K147 | RL mammal hab, RL bird hab, Prim veg | RL plant hab, OL plant hab, Prim veg |
| Irreplaceable | RL plant conf | RL plant hab, OL plant hab, RL bird hab, Prim veg |
| Prim veg | RL plant conf, Prim veg | RL plant hab, OL plant hab, RL mammal hab, Prim veg |
| RL bird hab, Prim veg | RL plant conf, RL mammal hab, Prim veg | RL plant hab, OL plant hab, RL mammal hab, RL bird hab, Prim veg |
| RL mammal hab | RL plant conf, RL mammal hab, RL bird hab | RL plant hab, RL mammal hab, Prim veg |
| | RL plant conf, RL mammal hab, RL bird hab, Prim veg | |

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Appendix J₅:
Gauteng Urban Edge

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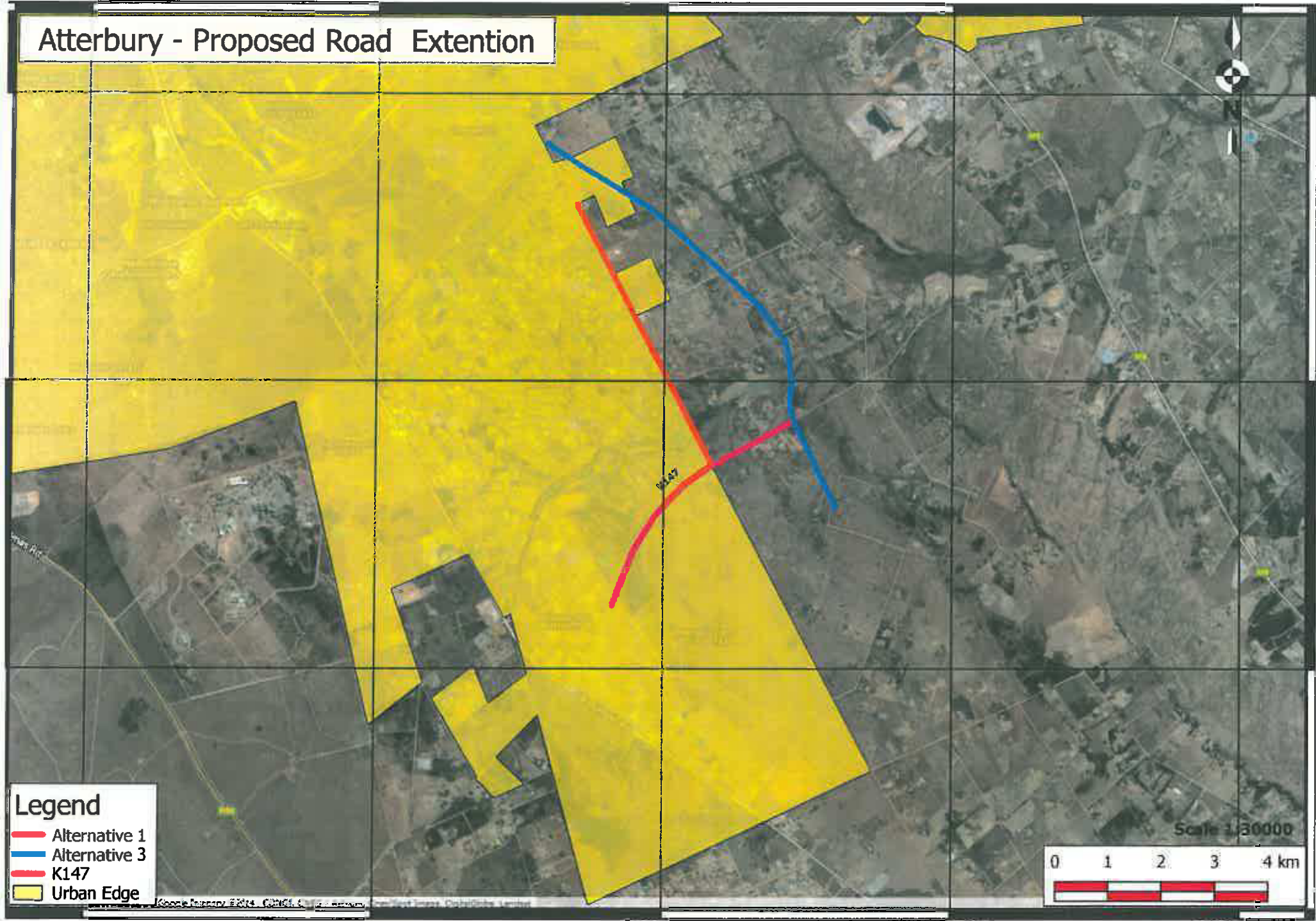
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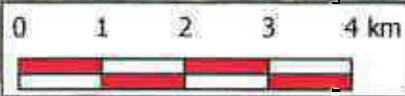
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Atterbury - Proposed Road Extension



Scale 1:30000



- Legend**
- Alternative 1
 - Alternative 3
 - K147
 - Urban Edge

3150000.000

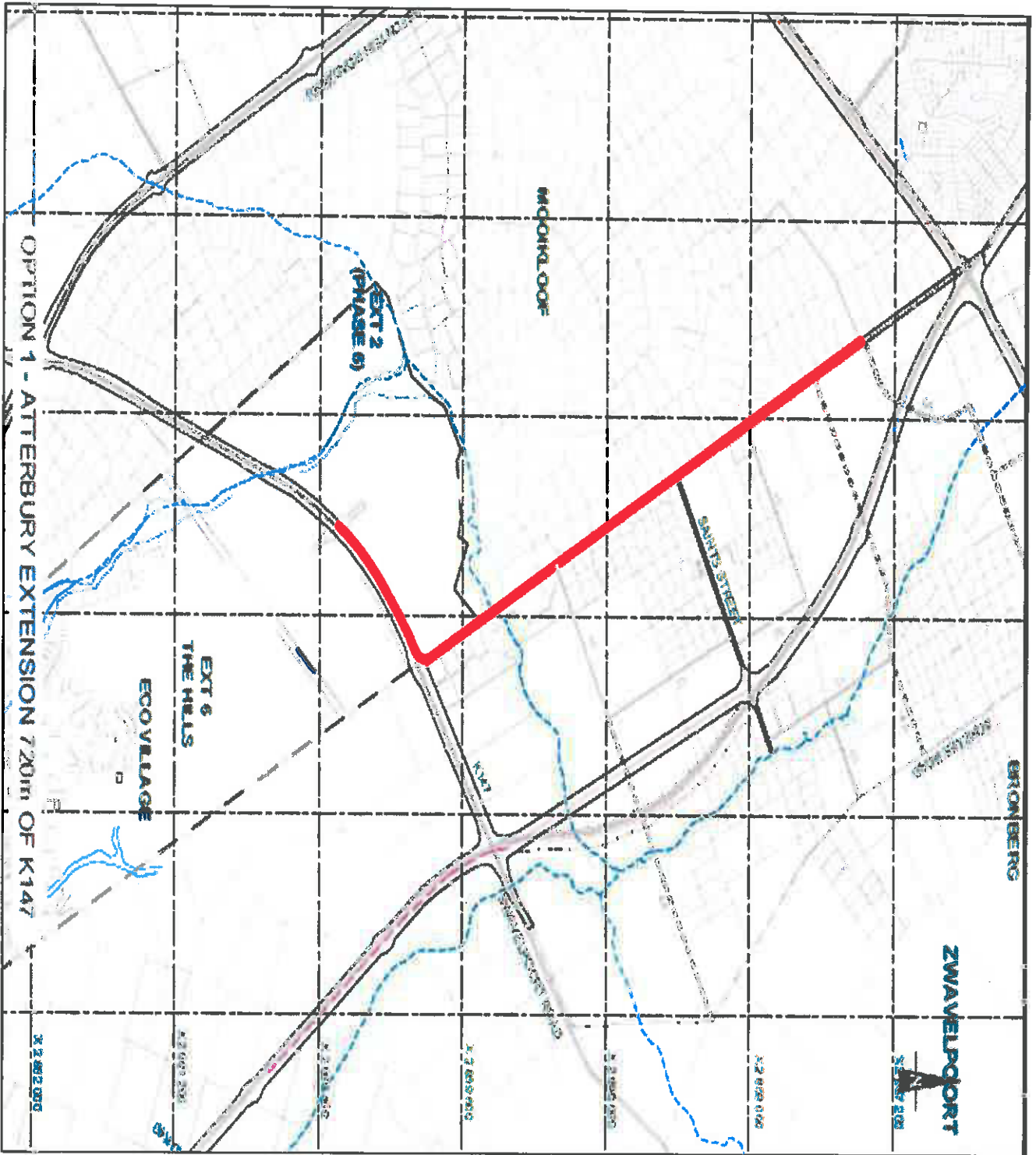
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Appendix J₆: Routes Illustration



Appendix J7: Agricultural Hubs

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3162000.000

Atterbury - Proposed Road Extention

-2976000.000

-2979000.000

-2982000.000

-2976000.000

-2979000.000

-2982000.000

Legend

-  K147
-  Road Surfacing
-  Road Extention
- Agricultural Hubs**
-  Ekurhuleni Kungwini

Scale 1:30000



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3159000.000

3162000.000