E-Moduli (MPa) and Layer Strength Diagram (Existing Pavement Structure)

Depth (mm)	Ave. E-Moduli (MPa)	E-Moduli Range (MPa) 10P - 90P MPa	CBR (%)	UCS (kPa)
0 - 150	108	48 - 247	26	260
151 - 300	196	86 - 446	51	481
301 - 450	111	49 - 254	26	267
451 - 600	61	27 - 139	13	142
601 - 800	46	20 - 105	9	106

TEST PIT 33

DCP Report - Single analysis

Region:	LIDWALA CONSULTING ENGINEERS	**Road number:**	RE/2 BOTHASFONTEIN FARM
Project date:	06 May, 2005	**Print date:**	06 May, 2005

Measurements included in analysis

Measurement Name	Date	Position	Distance (km)	Condition	Rutting	Pumping	Long. Crack	Croc. Crack	Deform	Other
TP 33	06 May 2005	5 - MID	33	Sound	No	No	No	No	No	No

Design Structure Number in blows (DSN_{800}):	83	**Selected Design Traffic:**	Heavy traffic
Balance Number (BN_{100}) of data:	12.8	**BN_{100} of SPBC:**	12.3
Standard Pavement Balance Curve (SPBC):	B=-1, A=844	**Road category**	B
Rut Limit:	20mm	**Base type:**	Granular
Structural capacity (MISA):	0.2	**Moisture condition of base:**	Optimum

(MISA = Million Standard Axles, 80 kN)

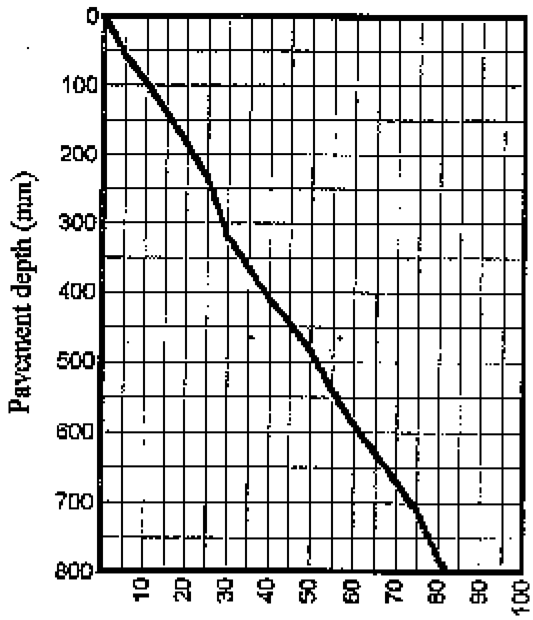
Category VII : Well-Balanced Inverted Structure (WBI)

Average equivalent strength (Existing Pavement Structure)

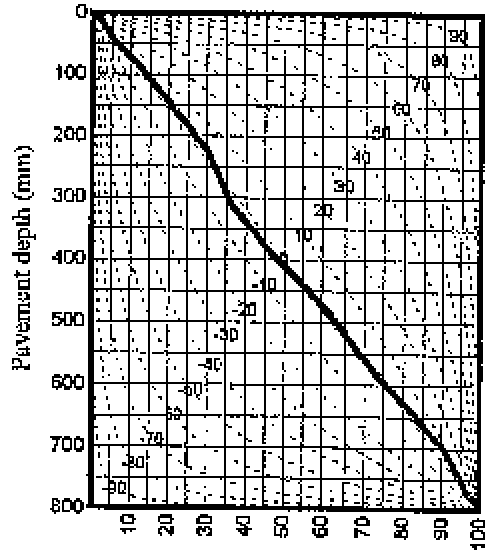
Depth (mm)	W. Ave. Pen. * (mm / blow)	Blows	SD (mm / blow)	90P (mm / blow)	CBR ** (%)	UCS *** (kPa)	Ave. E-Moduli (MPa)	E-Moduli Range 10P - 90P MPa
0 - 150	9.61	16	1.7	11.8	23	241	101	44 - 230
151 - 300	12.89	13	3.8	17.8	16	174	74	32 - 169
301 - 450	9.63	17	3.1	13.7	23	241	101	44 - 230
451 - 600	9.60	16	1.3	11.2	24	241	101	44 - 231
601 - 800	10.00	21	2.4	13.1	22	231	97	42 - 221

* *Weighted average penetration rate*
** *California Bearing Ratio*
*** *Unconfined Compressive Strength*
P = Percentile value in %

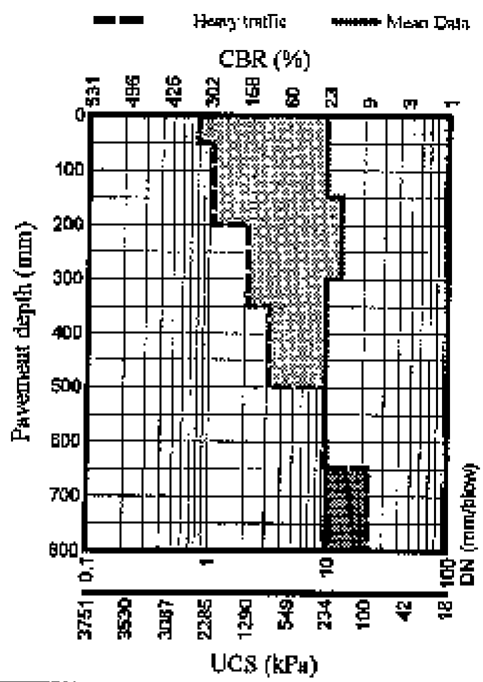
DCP Field Curve



DCP Balance Curve



Layer Strength Diagram (LSD)(Existing Structure)



E-Moduli (MPa) and Layer Strength Diagram (Existing Pavement Structure)

Depth (mm)	Ave. E-Moduli (MPa)	E-Moduli Range (MPa) 10P - 90P MPa	CBR (%)	UCS (kPa)
0 - 150	101	44 - 230	23	241
151 - 300	74	32 - 169	16	174
301 - 450	101	44 - 230	23	241
451 - 600	101	44 - 231	24	241
601 - 800	97	42 - 221	22	231

TEST PIT 34

DCP Report - Single analysis

Region:	LIDWALA CONSULTING ENGINEERS	**Road number:**	RE/2 BOTHASFONTEIN FARM
Project date:	06 May, 2005	**Print date:**	06 May, 2005

Measurements included in analysis

Measurement Name	Date	Position	Distance (km)	Condition	Rutting	Pumping	Long. Crack	Croc. Crack	Deform	Other
TP 34	06 May 2005	5 - MID	34	Sound	No	No	No	No	No	No

Design Structure Number in blows (DSN_{800}): 130
Balance Number (BN_{100}) of data: 21.5
Standard Pavement Balance Curve (SPBC): B=-8, A=3788
Rut Limit: 20mm
Structural capacity (MISA): 0.8
(MISA = Million Standard Axles, 80 kN)

Selected Design Traffic: Heavy traffic
BN_{100} of SPBC: 9.7
Road category B
Base type: Granular
Moisture condition of base: Optimum

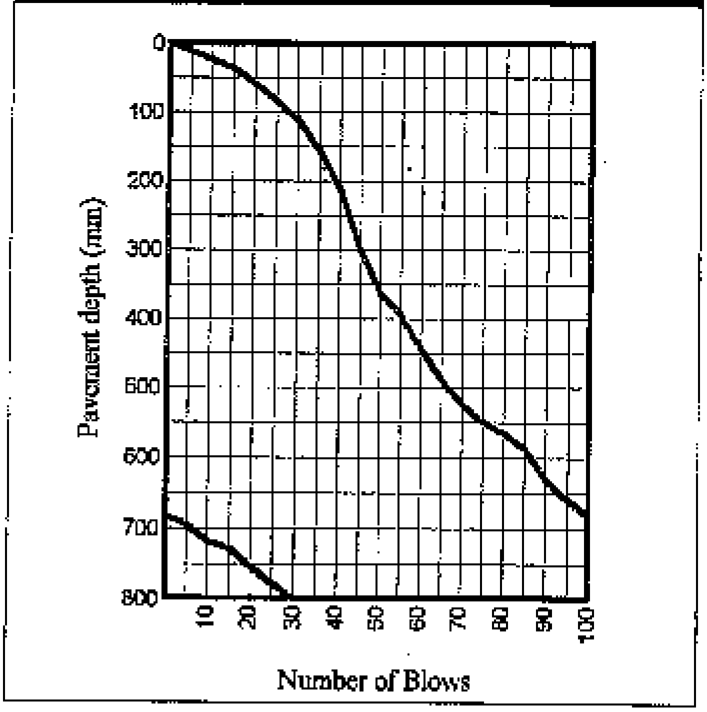
Category IX : Poorly Balanced Inverted Structure (PBI)

Average equivalent strength (Existing Pavement Structure)

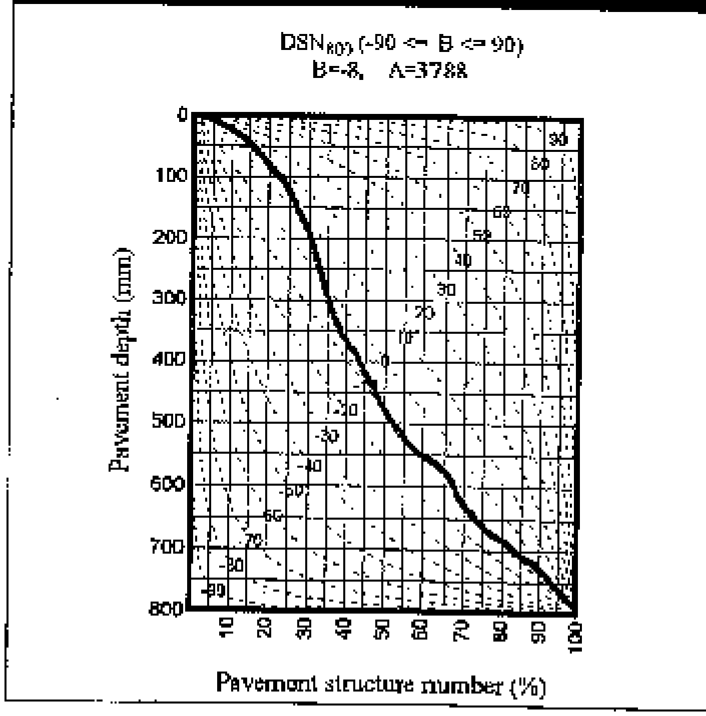
Depth (mm)	W. Ave. Pen. * (mm / blow)	Blows	SD (mm / blow)	90P (mm / blow)	CBR ** (%)	UCS *** (kPa)	Ave. E-Moduli (MPa)	E-Moduli Range 10P - 90P MPa
0 - 150	5.41	34	2.4	8.5	48	455	186	81 - 424
151 - 300	14.87	11	3.3	19.1	14	149	64	28 - 145
301 - 450	10.12	16	2.4	13.1	22	228	96	42 - 218
451 - 600	6.61	26	2.1	9.3	38	365	150	66 - 342
601 - 800	5.21	44	1.8	7.5	51	475	193	85 - 441

* *Weighted average penetration rate*
** *California Bearing Ratio*
*** *Unconfined Compressive Strength*
P = Percentile value in %

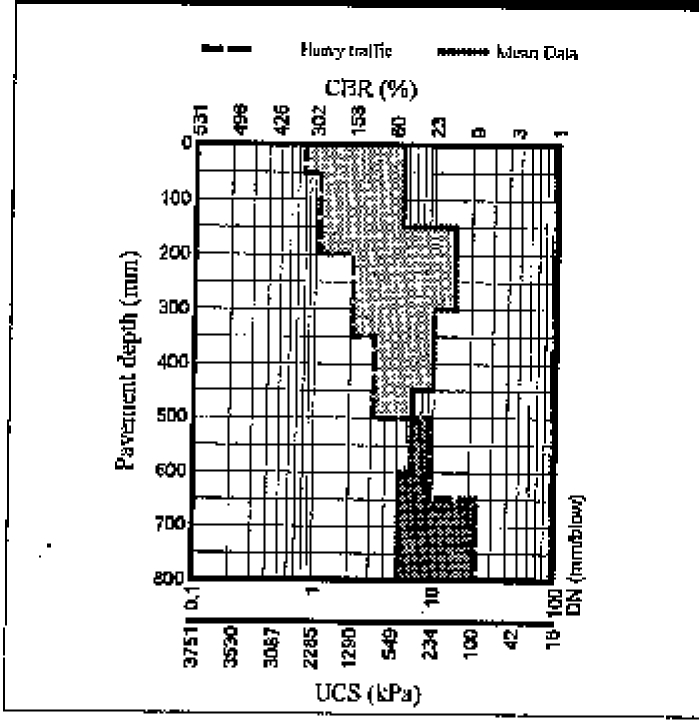
DCP Field Curve



DCP Balance Curve



Layer Strength Diagram (LSD)(Existing Structure)



E-Moduli (MPa) and Layer Strength Diagram (Existing Pavement Structure)

Depth (mm)	Ave. E-Moduli (MPa)	E-Moduli Range (MPa) 10P - 90P MPa	CBR (%)	UCS (kPa)
0 - 150	186	81 - 424	48	455
151 - 300	64	28 - 145	14	149
301 - 450	96	42 - 218	22	228
451 - 600	150	66 - 342	38	365
601 - 800	193	85 - 441	51	475

DCP Report - Single analysis

Region:	LIDWALA CONSULTING ENGINEERS	**Road number:**	RE/2 BOTHASFONTEIN FARM
Project date:	06 May, 2005	**Print date:**	06 May, 2005

Measurements included in analysis

Measurement Name	Date	Position	Distance (km)	Condition	Rutting	Pumping	Long. Crack	Croc. Crack	Deform	Other
TP 34	06 May 2005	5 - MID	34	Sound	No	No	No	No	No	No

Design Structure Number in blows (DSN_{800}): 130
Balance Number (BN_{100}) of data: 21.5
Standard Pavement Balance Curve (SPBC): B=8, A=3788
Rut Limit: 20mm
Structural capacity (MISA): 0.8
(MISA = Million Standard Axles, 80 kN)

Selected Design Traffic: Heavy traffic
BN_{100} of SPBC: 9.7
Road category B
Base type: Granular
Moisture condition of base: Optimum

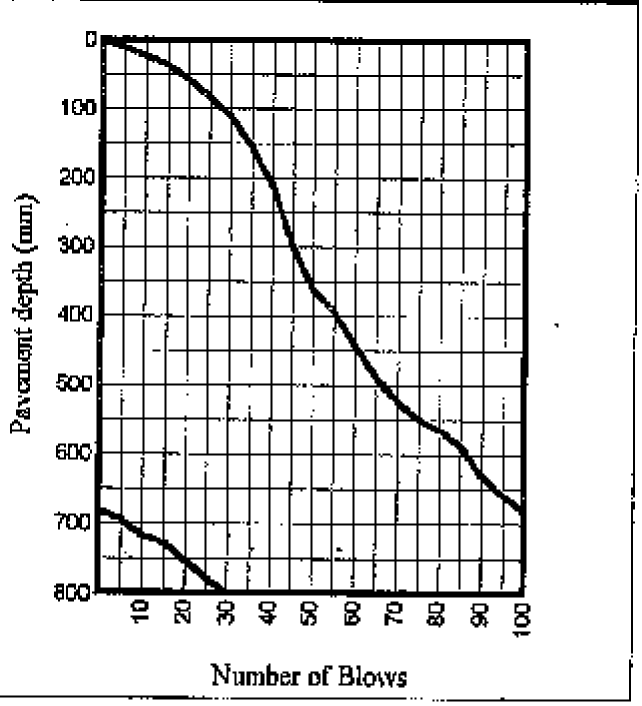
Category IX : Poorly Balanced Inverted Structure (PBI)

Average equivalent strength (Existing Pavement Structure)

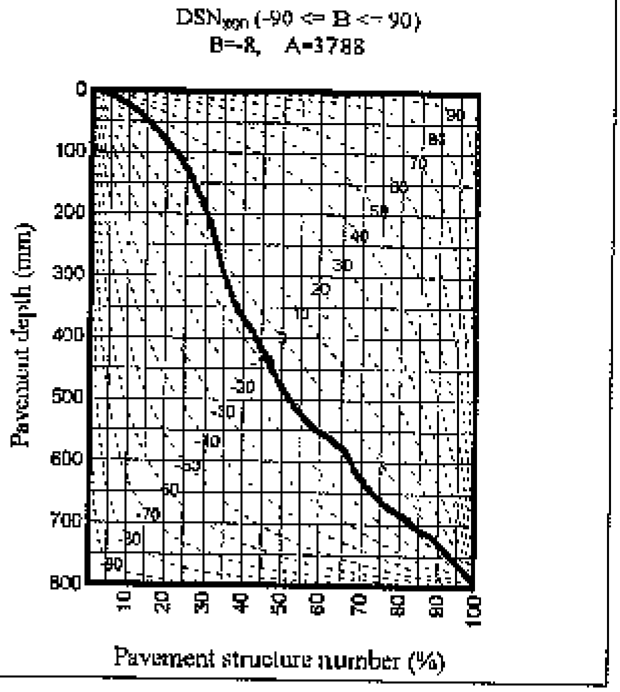
Depth (mm)	W. Ave. Pen. * (mm / blow)	Blows	SD (mm / blow)	90P (mm / blow)	CBR ** (%)	UCS *** (kPa)	Ave. E-Moduli (MPa)	E-Moduli Range 10P - 90P MPa
0 - 150	5.41	34	2.4	8.5	48	455	186	81 - 424
151 - 300	14.87	11	3.3	19.1	14	149	64	28 - 145
301 - 450	10.12	16	2.4	13.1	22	228	96	42 - 218
451 - 600	6.61	26	2.1	9.3	38	365	150	66 - 342
601 - 800	5.21	44	1.8	7.5	51	475	193	85 - 441

* *Weighted average penetration rate*
** *California Bearing Ratio*
*** *Unconfined Compressive Strength*
P = Percentile value in %

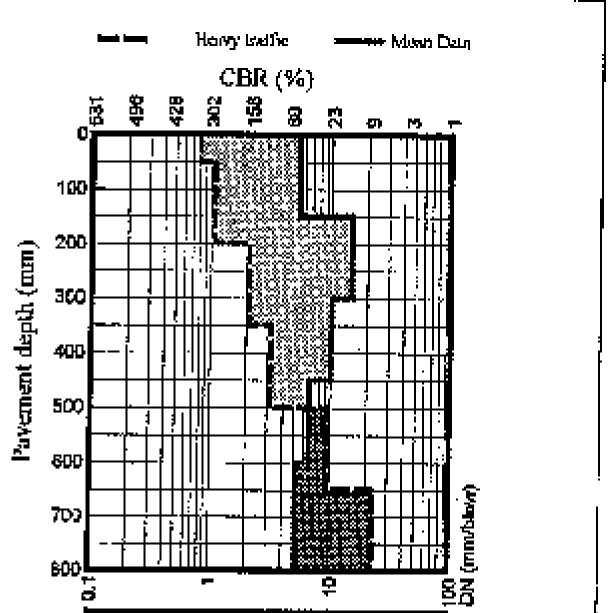
DCP Field Curve



DCP Balance Curve



Layer Strength Diagram (LSD)(Existing Structure)



E-Moduli (MPa) and Layer Strength Diagram (Existing Pavement Structure)

Depth (mm)	Ave. E-Moduli (MPa)	E-Moduli Range (MPa) 10P - 90P MPa	CBR (%)	UCS (kPa)
0 - 150	186	81 - 424	48	455
151 - 300	64	28 - 145	14	149
301 - 450	96	42 - 218	22	228
451 - 600	150	66 - 342	38	365
601 - 800	193	85 - 441	51	475

TEST PIT 35

DCP Report - Single analysis

Region: LIDWALA CONSULTING ENGINEERS
Road number: RE/2 BOTHASFONTEIN FARM
Project date: 06 May, 2005
Print date: 06 May, 2005

Measurements included in analysis

Measurement Name	Date	Position	Distance (km)	Condition	Rutting	Pumping	Long. Crack	Croc. Crack	Deform	Other
TP 35	06 May 2005	5 - MID	35	Sound	No	No	No	No	No	No

Design Structure Number in blows (DSN_{800}): 423
Balance Number (BN_{100}) of data: 2.5
Standard Pavement Balance Curve (SPBC): B=-22, A=4148
Rut Limit: 20mm
Structural capacity (MISA): 46.8
(MISA = Million Standard Axles, 80 kN)

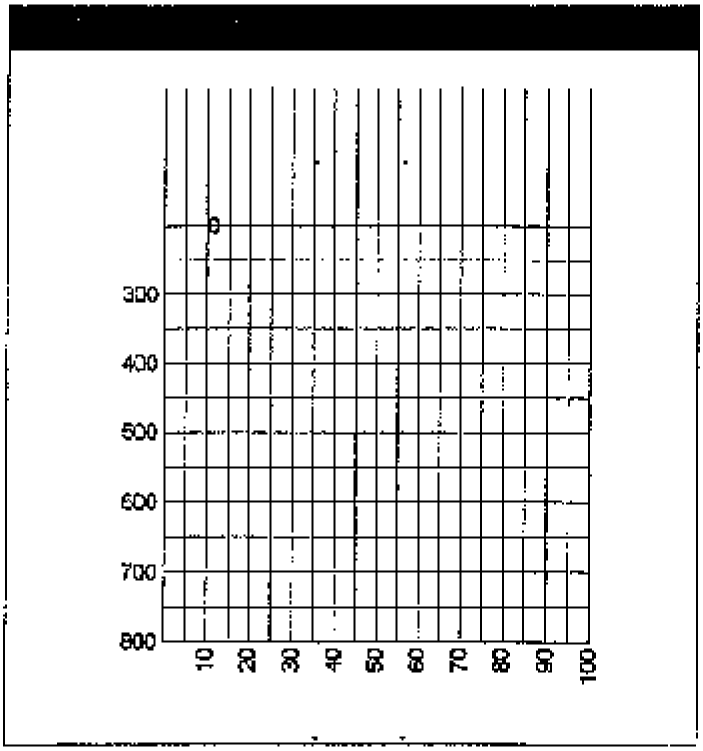
Selected Design Traffic: Heavy traffic
BN_{100} of SPBC: 5.3
Road category B
Base type: Granular
Moisture condition of base: Optimum

Category IX : Poorly Balanced Inverted Structure (PBI)

Average equivalent strength (Existing Pavement Structure)

Depth (mm)	W. Ave. Pen. * (mm / blow)	Blows	SD (mm / blow)	90P (mm / blow)	CBR ** (%)	UCS *** (kPa)	Ave. E-Moduli (MPa)	E-Moduli Range 10P - 90P MPa
0 - 150	8.80	18	2.1	11.5	26	266	111	49 - 253
151 - 300	7.31	22	1.8	9.6	33	326	135	59 - 308
301 - 450	2.31	92	1.5	4.5	127	1068	421	184 - 959
451 - 600	1.20	125	0.0	1.2	263	2024	919	403 - 2097
601 - 800	1.20	167	0.0	1.2	263	2024	919	403 - 2097

** Weighted average penetration rate*
*** California Bearing Ratio*
**** Unconfined Compressive Strength*
P = Percentile value in %


300
400
500
600
700
800
10
20
30
40
50
60
70
80
90
100

TEST PIT 36

DCP Report - Single analysis

Region:	LIDWALA CONSULTING ENGINEERS	**Road number:**	RE/2 BOTHASFONTEIN FARM
Project date:	06 May, 2005	**Print date:**	06 May, 2005

Measurements included in analysis

Measurement Name	Date	Position	Distance (km)	Condition	Rutting	Pumping	Long. Crack	Croc. Crack	Deform	Other
TP 36	06 May 2005	3 - MID	36	Sound	No	No	No	No	No	No

Design Structure Number in blows (DSN_{800}):	95	**Selected Design Traffic:**	Heavy traffic
Balance Number (BN_{100}) of data:	6.7	**BN_{100} of SPBC:**	15.4
Standard Pavement Balance Curve (SPBC):	B=7, A=2938	**Road category**	B
Rut Limit:	20mm	**Base type:**	Granular
Structural capacity (MISA):	0.3	**Moisture condition of base:**	Optimum

(MISA = Million Standard Axles, 80 kN)

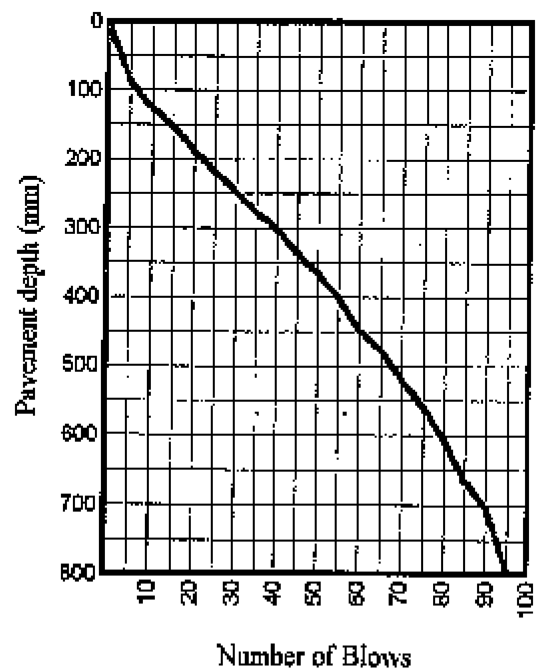
Category V : Averagely Balanced Deep Structure (ABD)

Average equivalent strength (Existing Pavement Structure)

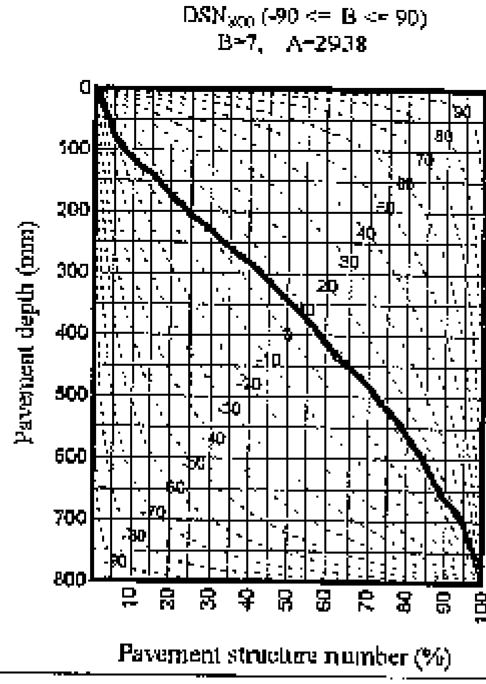
Depth (mm)	W. Ave. Pen. * (mm / blow)	Blows	SD (mm / blow)	90P (mm / blow)	CBR ** (%)	UCS *** (kPa)	Ave. E-Moduli (MPa)	E-Moduli Range 10P - 90P MPa
0 - 150	13.42	14	3.7	20.7	15	166	71	31 - 162
151 - 300	6.05	25	0.8	7.0	42	402	165	72 - 376
301 - 450	7.52	21	1.3	9.2	32	316	131	57 - 299
451 - 600	8.09	19	1.3	9.7	29	292	121	53 - 277
601 - 800	14.26	16	4.5	20.1	14	156	66	29 - 151

** Weighted average penetration rate*
*** California Bearing Ratio*
**** Unconfined Compressive Strength*
P = Percentile value in %

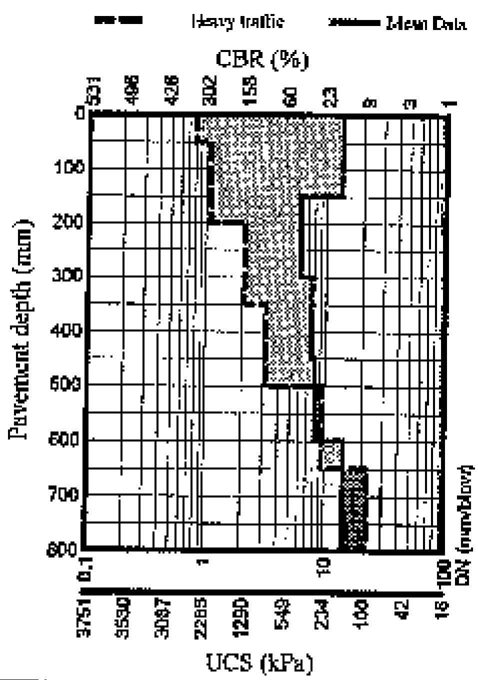
DCP Field Curve



DCP Balance Curve



Layer Strength Diagram (LSD)(Existing Structure)



E-Moduli (MPa) and Layer Strength Diagram (Existing Pavement Structure)

Depth (mm)	Ave. E-Moduli (MPa)	E-Moduli Range (MPa) 10P - 90P MPa	CBR (%)	UCS (kPa)
0 - 150	71	31 - 152	15	166
151 - 300	165	72 - 376	42	402
301 - 450	131	57 - 299	32	316
451 - 600	121	53 - 277	29	292
601 - 800	66	29 - 151	14	156

TEST PIT 37

DCP Report - Single analysis

Region:	LIDWALA CONSULTING ENGINEERS	**Road number:**	RE/2 BOTHASFONTEIN FARM
Project date:	06 May, 2005	**Print date:**	06 May, 2005

Measurements included in analysis

Measurement Name	Date	Position	Distance (km)	Condition	Rutting	Pumping	Long. Crack	Cros. Crack	Deform	Other
TP 37	06 May 2005	5 - MID	37	Sound	No	No	No	No	No	No

Design Structure Number in blows (DSN_{800}):	111	**Selected Design Traffic:**	Heavy traffic
Balance Number (BN_{100}) of data:	3.8	**BN_{100} of SPBC:**	3.7
Standard Pavement Balance Curve (SPBC):	B=-20, A=2014	**Road category**	B
Rut Limit:	20mm	**Base type:**	Granular
Structural capacity (MISA):	0.4	**Moisture condition of base:**	Optimum

(MISA = Million Standard Axles, 80 kN)

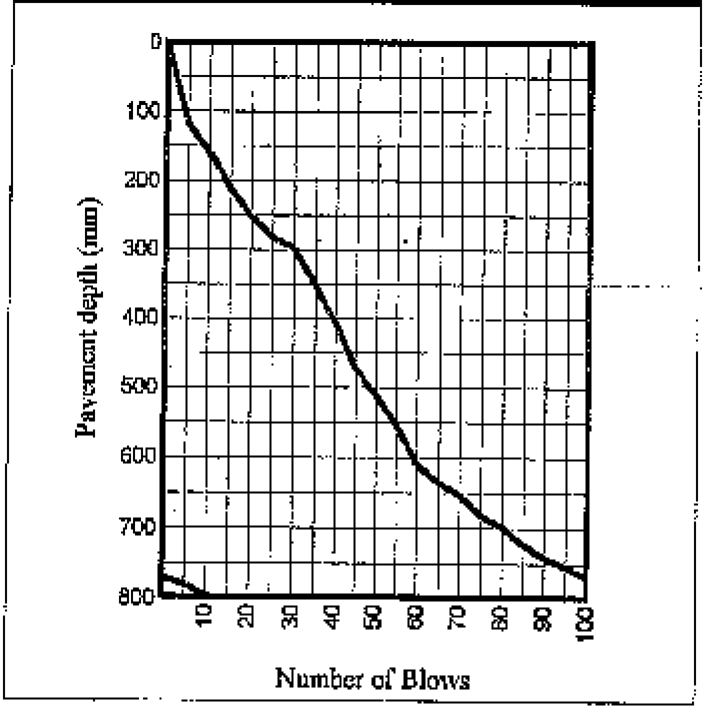
Category VIII : Averagely Balanced Inverted Structure (ABI)

Average equivalent strength (Existing Pavement Structure)

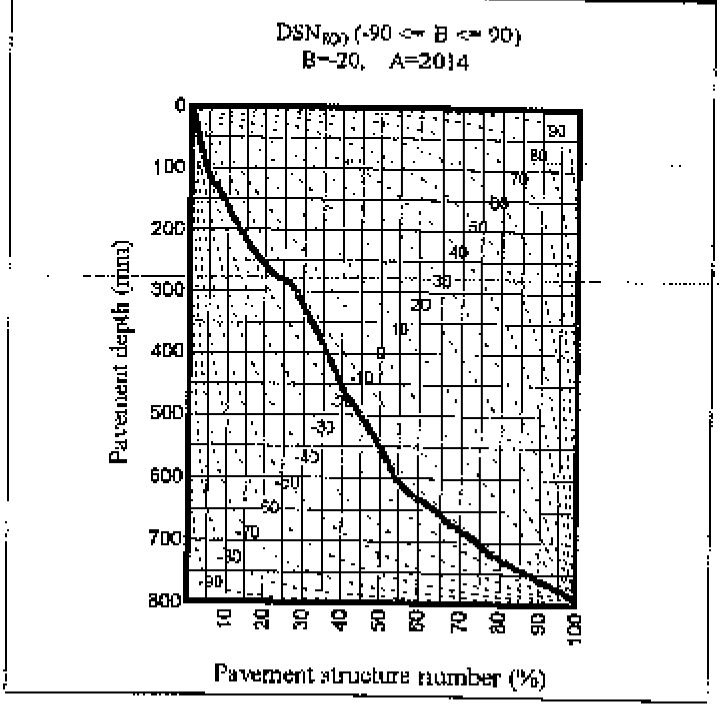
Depth (mm)	W. Ave. Pen. * (mm / blow)	Blows	SD (mm / blow)	90P (mm / blow)	CBR ** (%)	UCS *** (kPa)	Ave. E-Moduli (MPa)	E-Moduli Range 10P - 90P MPa
0 - 150	20.36	9	6.2	28.4	9	105	46	20 - 104
151 - 300	7.99	21	2.3	10.9	30	296	123	54 - 280
301 - 450	11.49	13	1.1	12.9	19	198	84	37 - 190
451 - 600	9.82	16	1.9	12.3	23	235	99	43 - 225
601 - 800	4.41	52	1.9	6.8	63	571	231	101 - 526

** Weighted average penetration rate*
*** California Bearing Ratio*
**** Unconfined Compressive Strength*
P = Percentile value in %

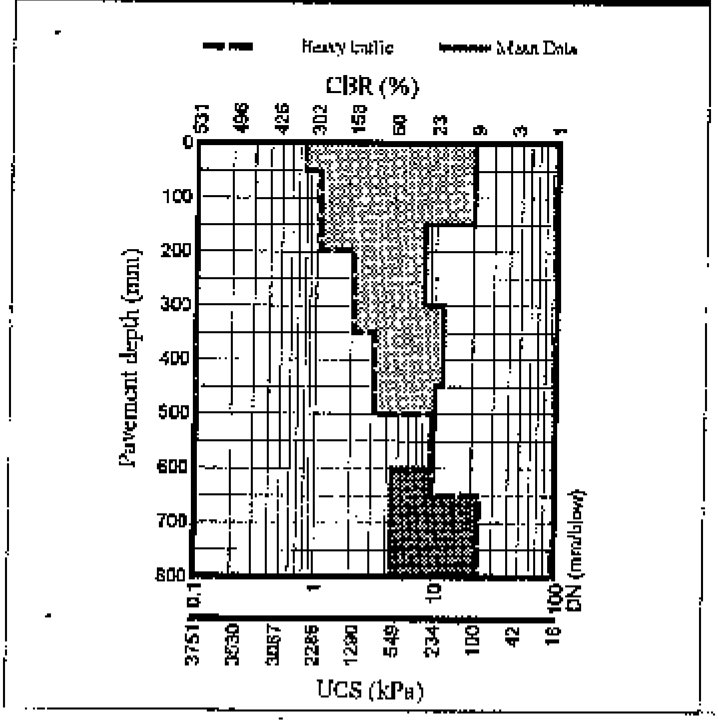
DCP Field Curve



DCP Balance Curve



Layer Strength Diagram (LSD)(Existing Structure)



E-Moduli (MPa) and Layer Strength Diagram (Existing Pavement Structure)

Depth (mm)	Ave. E-Moduli (MPa)	E-Moduli Range (MPa) 10P - 90P MPa	CBR (%)	UCS (kPa)
0 - 150	46	20 - 104	9	105
151 - 300	123	54 - 280	30	296
301 - 450	84	37 - 190	19	198
451 - 600	99	43 - 225	23	235
601 - 800	231	101 - 526	63	571

TEST PIT 39

DCP Report - Single analysis

Region: LIDWALA CONSULTING ENGINEERS
Project date: 06 May, 2005
Road number: RE/2 BOTHASFONTEIN FARM
Print date: 06 May, 2005

Measurements included in analysis

Measurement Name	Date	Position	Distance (km)	Condition	Rutting	Pumping	Long. Crack	Croc. Crack	Deform	Other
TP 39	06 May 2005	5 - MID	39	Sound	No	No	No	No	No	No

Design Structure Number in blows (DSN_{800}): 1275
Balance Number (BN_{100}) of data: 0.4
Standard Pavement Balance Curve (SPBC): B=-52, A=5724
Rut Limit: 20mm
Structural capacity (MISA): 2220.3
(MISA = Million Standard Axles, 80 kN)

Selected Design Traffic: Heavy traffic
BN_{100} of SPBC: 1.3
Road category B
Base type: Granular
Moisture condition of base: Optimum

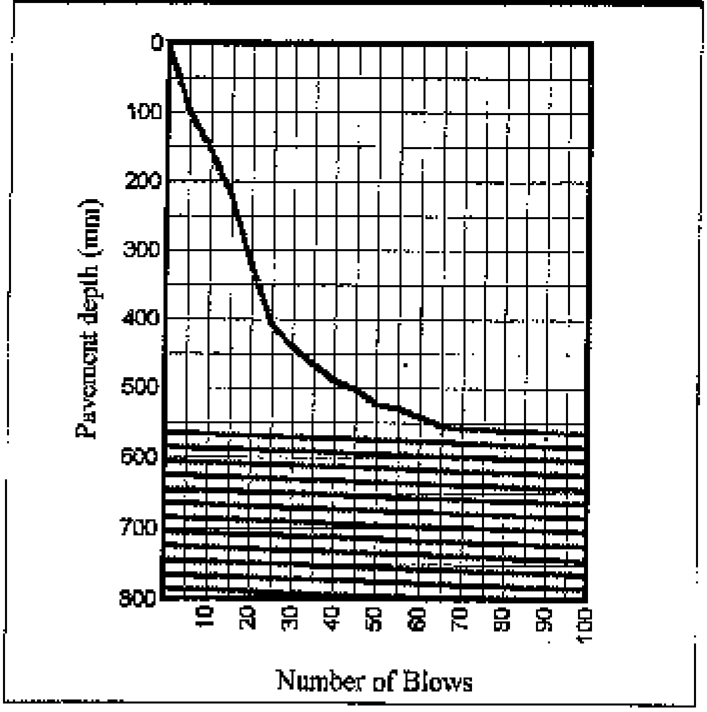
Category IX : Poorly Balanced Inverted Structure (PBI)

Average equivalent strength (Existing Pavement Structure)

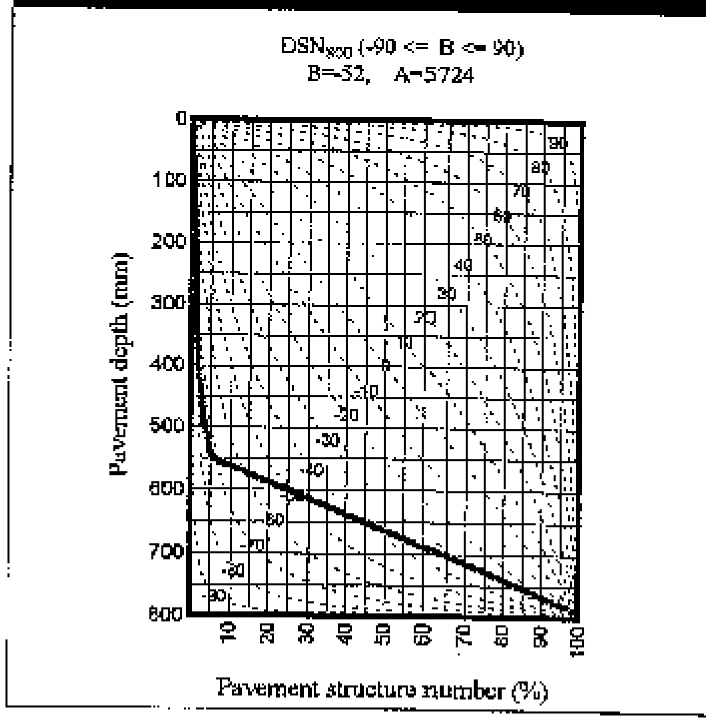
Depth (mm)	W. Avg. Pen. * (mm / blow)	Blows	SD (mm / blow)	90P (mm / blow)	CBR ** (%)	UCS *** (kPa)	Ave. E-Moduli (MPa)	E-Moduli Range 10P - 90P MPa
0 - 150	16.93	10	4.4	22.5	12	129	55	24 - 126
151 - 300	16.80	9	3.1	20.8	12	130	56	24 - 127
301 - 450	14.86	13	5.4	21.7	14	149	64	28 - 145
451 - 600	2.62	243	1.8	5.0	120	1017	401	176 - 915
601 - 800	0.20	1000	0.0	0.2	500	3558	6161	2702 - 14049

* *Weighted average penetration rate*
** *California Bearing Ratio*
*** *Unconfined Compressive Strength*
P = Percentile value in %

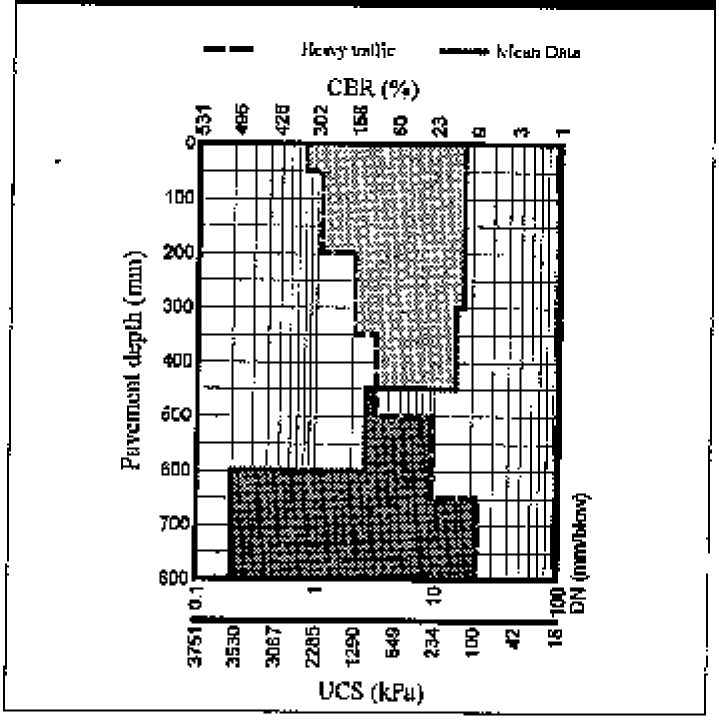
DCP Field Curve



DCP Balance Curve



Layer Strength Diagram (LSD)(Existing Structure)



E-Moduli (MPa) and Layer Strength Diagram (Existing Pavement Structure)

Depth (mm)	Ave. E-Moduli (MPa)	E-Moduli Range (MPa) 10P - 90P MPa	CBR (%)	UCS (kPa)
0 - 150	55	24 - 126	12	129
151 - 300	56	24 - 127	12	130
301 - 450	64	28 - 145	14	149
451 - 600	401	176 - 915	120	1017
601 - 800	6161	2702 - 14049	500	3558

TEST PIT 40

DCP Report - Single analysis

Region:	LIDWALA CONSULTING ENGINEERS	**Road number:**	RE/2 BOTHASFONTEIN FARM
Project date:	06 May, 2005	**Print date:**	06 May, 2005

Measurements included in analysis

Measurement Name	Date	Position	Distance (km)	Condition	Rutting	Pumping	Long. Crack	Croc. Crack	Deform	Other
TP 40	06 May 2005	5 - MID	40	Sound	No	No	No	No	No	No

Design Structure Number in blows (DSN_{800}):	71	**Selected Design Traffic:**	Heavy traffic
Balance Number (BN_{100}) of data:	7.1	**BN_{100} of SPBC:**	9.4
Standard Pavement Balance Curve (SPBC):	B=-7, A=2706	**Road category**	B
Rut Limit:	20mm	**Base type:**	Granular
Structural capacity (MISA):	0.1	**Moisture condition of base:**	Optimum
(MISA = Million Standard Axles, 80 kN)			

Category VIII : Averagely Balanced Inverted Structure (ABI)

Average equivalent strength (Existing Pavement Structure)

Depth (mm)	W. Ave. Pen. * (mm / blow)	Blows	SD (mm / blow)	90P (mm / blow)	CBR ** (%)	UCS *** (kPa)	Ave. E-Moduli (MPa)	E-Moduli Range 10P - 90P MPa
0 - 150	18.13	8	2.6	21.5	11	119	51	23 - 117
151 - 300	14.34	11	1.6	16.4	14	155	66	29 - 151
301 - 450	9.20	17	2.5	12.4	25	253	106	46 - 241
451 - 600	9.49	18	3.4	13.8	24	245	102	45 - 233
601 - 800	13.29	16	3.1	17.3	16	168	72	31 - 163

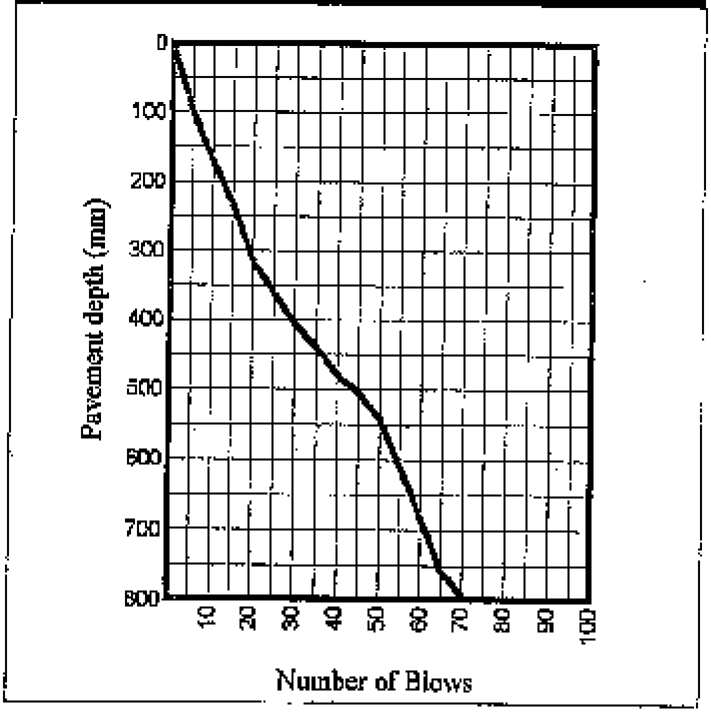
** Weighted average penetration rate*

*** California Bearing Ratio*

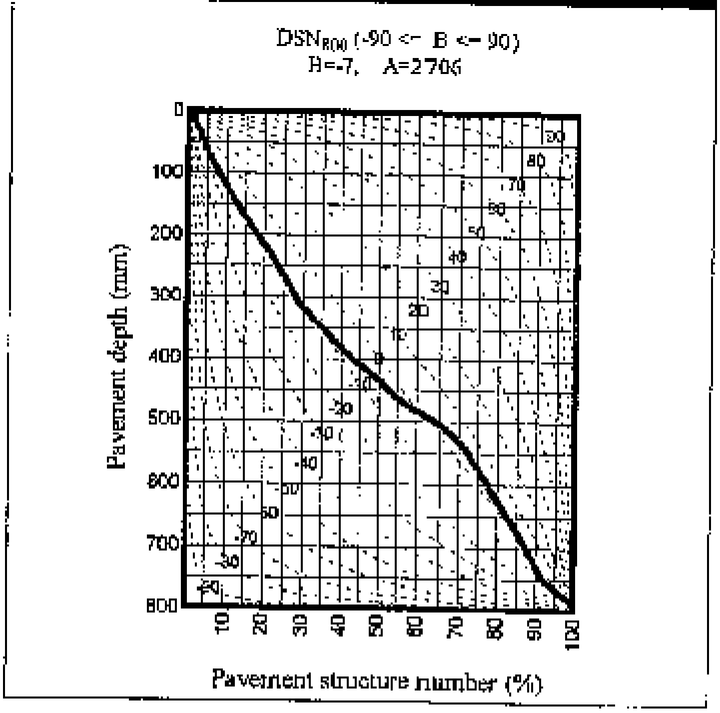
**** Unconfined Compressive Strength*

P = Percentile value in %

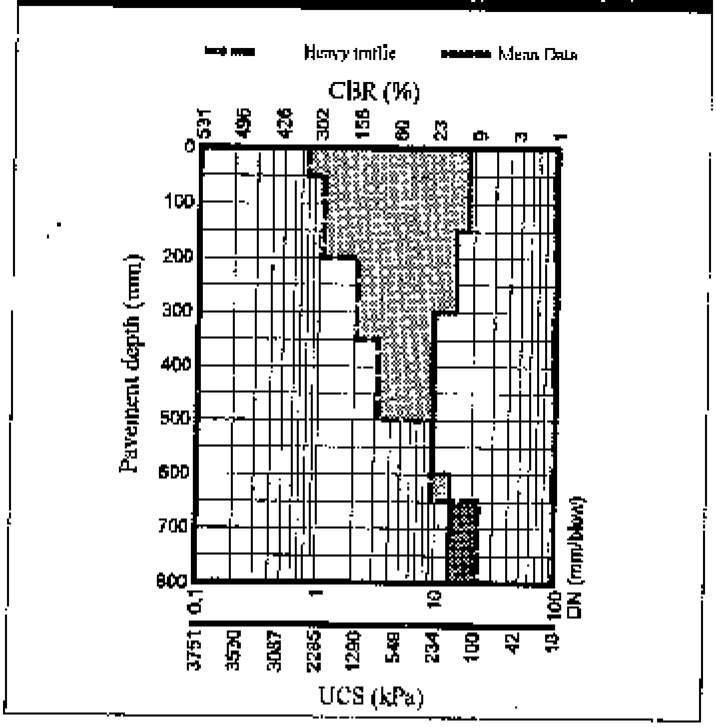
DCP Field Curve



DCP Balance Curve



Layer Strength Diagram (LSD)(Existing Structure)



E-Moduli (MPa) and Layer Strength Diagram (Existing Pavement Structure)

Depth (mm)	Ave. E-Moduli (MPa)	E-Moduli Range (MPa) 10P - 90P MPa	CBR (%)	UCS (kPa)
0 - 150	51	23 - 117	11	119
151 - 300	66	29 - 151	14	155
301 - 450	106	46 - 241	25	253
451 - 600	102	45 - 233	24	245
601 - 800	72	31 - 163	16	168

APPENDIX G

SOIL PROFILE SHEETS

Civilab
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LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

LEGEND Sheet 1 of 1

JOB NUMBER: HP/B 76-27

	GRAVEL	{SA02}
	SAND	{SA04}
	SANDY	{SA05}
	SILT	{SA06}
	SILTY	{SA07}
	CLAY	{SA08}
	GRANITE	{SA17}{SA44}
Name ●	DISTURBED SAMPLE	{SA38}

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY :
TYPE SET BY : ACOWAN
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 09/05/06 12:53
TEXT : ..F:\HENNOPS\BOTHAS~1.DOC

ELEVATION :
X-COORD :
Y-COORD :

LEGEND
SUMMARY OF SYMBOLS

D014

Civilab

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LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 1 Sheet 1 of 1

JOB NUMBER: HP/B 76-27

Scale 1:10

0.00	Slightly Moist, Light brown, Medium Dense, Silty, Sand.	**REMARKS: With fine roots and Scattered rubble & fill**
0.40	Slightly Moist, Greyish white speckled orange, Loose Very Dense, Silty Sand Gravel.	**REMARKS: Scattered soft rock; Refusal on hole, dry**
1.10		

CONTRACTOR: Civilab - Hennopspark
MACHINE: TLB CAT 428c
DRILLED BY: -
PROFILED BY: STANLEY PULLEN

INCLINATION: Vertical
DIAM: -
DATE: -
DATE: 21/04/2005

ELEVATION:
X-COORD:
Y-COORD:

TYPE SET BY: ACOWAN
SETUP FILE: STANDARD.SET

DATE: 09/05/05 12:53
TEXT: ..F\HENNOPS\BOTHAS~1.DOC

HOLE No: TP 1
BOTHASFONTEIN

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LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 2 Sheet 1 of 1

JOB NUMBER: HP/B 76-27

Scale 1:10

0.00	Moist, Dark brown, Medium Dense, Sand Granite Gravel.	REMARKS: With roots and scattered fill
0.20	Slightly Moist, Blue grey stained orange, Light brown, Dense, Gravel Gobbles Silty Sand.	REMARKS:
1.10	Slightly Moist, Brown speckled white, Medium Dense Very Dense, Silty Sand Granite.	REMARKS:
2.00		

TP2:25767

TP2:25768

NOTES

1) Disturbed samples TP2:25767 taken from 0,200–1,100 and TP2:25768 taken from 1,100–2,000.

CONTRACTOR : Civilab - Hennopspark
MACHINE : TLB CAT 428c
DRILLED BY : -
PROFILED BY : STANLEY PULLEN
TYPE SET BY : ACOWAN
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM : -
DATE : -
DATE : 21/04/2005
DATE : 09/05/05 12:53
TEXT : ..F\HENNOPS\BOTHAS-1.DOC

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP 2
BOTHASFONTEIN

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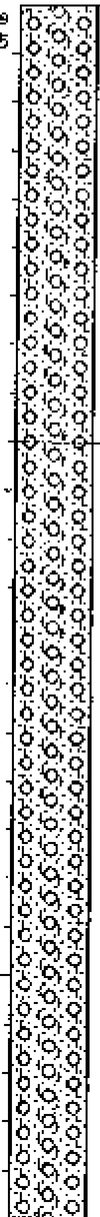
LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 3
Sheet 1 of 1

JOB NUMBER: HP/B 76-27

Scale
1:15



0.00	Slightly Moist, Yellowish brown, Medium Dense, Silty Sand Gravel.	**REMARKS:**
0.90	Slightly Moist, Gery brown orange black, Silty Sand Gravel.	**REMARKS: Refusal on coarse gravel and boulders**
2.50		

CONTRACTOR : Civitab - Hennopspark
MACHINE : TLB CAT 428c
DRILLED BY : -
PROFILED BY : STANLEY PULLEN

TYPE SET BY : ACOWAN
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM : -
DATE : -
DATE : 21/04/2005

DATE : 09/05/05 12:53
TEXT : ..F:\HENNOPS\BOTHAS~1.DOC

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP 3
BOTHASFONTEIN

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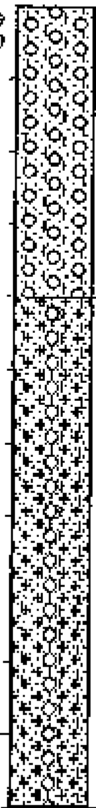
LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 4 *Sheet 1 of 1*

JOB NUMBER: HP/B 76-27

Scale 1:10



0.00	Slightly Moist, Yellowish brown, Medium Dense, Silty Sand Gravel.	**REMARKS:**
0.40	Slightly Moist, Yellowish brown orange, Dense Very Dense, Silty Sand Granite.	**REMARKS: Partial refusal**
1.10		

CONTRACTOR : Civilab - Hennopspark
MACHINE : TLB CAT 428c
DRILLED BY : -
PROFILED BY : STANLEY PULLEN
TYPE SET BY : ACOWAN
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM : -
DATE : -
DATE : 21/04/2005
DATE : 09/05/05 12:53
TEXT : ..FAHENNOPS\BOTHAS~1.DOC

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP 4
BOTHASFONTEIN

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LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 5 Sheet 1 of 1

JOB NUMBER: HP/B 76-27

Scale 1:10

0.00 – 0.35	Slightly Moist, Yellowish brown, Medium Dense, Silty Sand Gravel.	**REMARKS:**
0.35 – 1.20	Slightly Moist, Yellowish brown orange, Dense Very Dense, Silty Sand Granite.	**REMARKS: Partial refusal**

CONTRACTOR : Civilab - Hennopspark
MACHINE : TLB CAT 428c
DRILLED BY : -
PROFILED BY : STANLEY PULLEN
TYPE SET BY : ACOWAN
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM : -
DATE : -
DATE : 21/04/2005
DATE : 09/05/05 12:53
TEXT : ..F:\HENNOPS\BOTHAS-1.DOC

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP 5
BOTHASFONTEIN

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LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 6
Sheet 1 of 1

JOB NUMBER: HP/B 76-27

Scale 1:10

0.00 – 0.45	Slightly Moist, Light brown, Loose Medium Dense, Granite Gravel Silty Sand.	**REMARKS: With fine roots**
0.45 – 1.50	Slightly Moist, Orange speckled black white, Dense Very Dense, Silty Sand Granite Gravel.	**REMARKS:**

TP6:25769

NOTES

1) Disturbed sample TP6:25769 taken from 0,000--0,450 and TP6:25770 taken from 0,450--1,500.

CONTRACTOR: Civilab - Hennopspark
MACHINE: TLB CAT 428c
DRILLED BY: -
PROFILED BY: STANLEY PULLEN
TYPE SET BY: ACOWAN
SETUP FILE: STANDARD.SET

INCLINATION: Vertical
DIAM: -
DATE: -
DATE: 21/04/2005
DATE: 09/05/05 12:53
TEXT: ..F\HENNOPS\BOTHAS~1.DOC

ELEVATION:
X-COORD:
Y-COORD:

HOLE No: TP 6
BOTHASFONTEIN

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LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 7 *Sheet 1 of 1*

JOB NUMBER: HP/B 76-27

Scale 1:10

0.00 – 1.50	Slightly Moist, Orange speckled black, <u>Medium Dense Dense</u>, Silty Sand Granite Gravel.	**REMARKS: Partial refusal**

CONTRACTOR: Civilab - Hennopspark
MACHINE: TLB CAT 428c
DRILLED BY: –
PROFILED BY: STANLEY PULLEN
TYPE SET BY: ACOWAN
SETUP FILE: STANDARD.SET

INCLINATION: Vertical
DIAM: -
DATE: -
DATE: 21/04/2005
DATE: 09/05/05 12:53
TEXT: ..F:\HENNOPS\BOTHAS~1.DOC

ELEVATION:
X-COORD:
Y-COORD:

HOLE No: TP 7
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LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 8 Sheet 1 of 1

JOB NUMBER: HP/B 76-27

Scale 1:10

0.00 – 0.20	Slightly Moist, Light brown, Loose Medium Dense, Sand Granite Gravel.	REMARKS: Fine roots
0.20 – 0.35	Moist, Ligth brown, Medium Dense, Granite Gravel Sand.	REMARKS:
0.35 – 1.65	Slightly Moist, Yellowish brown orange, Dense Very Dense, Silty Sand Granite.	REMARKS: Partial refusal

CONTRACTOR : Civilab - Hennopspark
MACHINE : TLB CAT 428c
DRILLED BY : -
PROFILED BY : STANLEY PULLEN
TYPE SET BY : ACOWAN
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM : -
DATE : -
DATE : 21/04/2005
DATE : 09/05/05 12:53
TEXT : ..F:\HENNOPS\BOTHAS~1.DOC

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP 8
BOTHASFONTEIN

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LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 9
Sheet 1 of 1

JOB NUMBER: HP/B 76-27

Scale 1:10

0.00 – 0.30	Slightly Moist, Moist, Light brown, Silty Sand Granite Gravel.	**REMARKS: Fine roots**
0.30 – 0.60	Slightly Moist, Yellow brown, Medium Dense, Silty Sand Granite Gravel.	**REMARKS:**
0.60 – 1.40	Slightly Moist, Orange speckled yellow black, Dense Very Dense, Silty Sand Granite Gravel.	**REMARKS: Partial refusal**

CONTRACTOR : Civilab - Hennopspark
MACHINE : TLB CAT 428c
DRILLED BY : -
PROFILED BY : STANLEY PULLEN
TYPE SET BY : ACOWAN
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM : -
DATE : -
DATE : 21/04/2005
DATE : 09/05/05 12:53
TEXT : ..F:\HENNOPS\BOTHAS~1.DOC

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP 9
BOTHASFONTEIN

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LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 10 Sheet 1 of 1

JOB NUMBER: HP/B 76-27

Scale 1:10

0.00 – 0.20	Moist, Dark brown, Loose, Sand Granite Gravel.	REMARKS: Roots and rubble
0.20 – 0.90	Slightly Moist, Light brown, Medium Dense Dense, Granite Gravel Silty Sand.	REMARKS:
0.90 – 1.50	Slightly Moist, Orange speckled yellow black, Dense Very Dense, Silty Sand Granite Gravel.	REMARKS: Partial refusal

CONTRACTOR: Civilab - Hennopspark
MACHINE: TLB CAT 428c
DRILLED BY: -
PROFILED BY: STANLEY PULLEN
TYPE SET BY: ACOWAN
SETUP FILE: STANDARD.SET

INCLINATION: Vertical
DIAM: -
DATE: -
DATE: 21/04/2005
DATE: 09/05/05 12:52
TEXT: ..F:\HENNOPS\BOTHAS~1.DOC

ELEVATION:
X-COORD:
Y-COORD:

HOLE No: TP 10
BOTHASFONTEIN

D014

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LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 11 *Sheet 1 of 1*

JOB NUMBER: HP/B 76-27

Scale *1:10*

0.00 – 0.15	Very Moist, Orange, Medium Dense, Silty Sand.	**REMARKS: With fine roots**
0.15 – 0.40	Slightly Moist, Grey brown, Medium Dense, Silty Sand Granite Gravel.	**REMARKS: Roots**
0.40 – 0.80	Slightly Moist, Light grey brown, Loose, Granite Gravel Silty Sand.	**REMARKS: Fine roots**
0.80 – 1.20	Slightly Moist, Orange speckled black. Dense Very Dense, Silty Sand Granite.	**REMARKS: Partial refusal**

CONTRACTOR: Civilab - Hennopspark
MACHINE: TLB CAT 428c
DRILLED BY: -
PROFILED BY: STANLEY PULLEN
TYPE SET BY: ACOWAN
SETUP FILE: STANDARD.SET

INCLINATION: Vertical
DIAM: -
DATE: -
DATE: 21/04/2005
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ELEVATION:
X-COORD:
Y-COORD:

HOLE No: TP 11
BOTHASFONTEIN

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LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 12 Sheet 1 of 1

JOB NUMBER: HP/B 76-27

Scale 1:10

0.00 – 0.15	Slightly Moist, Light yellow brown, Medium Dense, Silty Sand Quartz Gravel.	REMARKS: Fine roots
0.15 – 1.40	Orange speckled yellow black, Dense Very Dense, Silty Sand Granite Gravel.	REMARKS: Fine roots, Partial refusal

CONTRACTOR : Civilab - Hennopspark
MACHINE : TLB CAT 428c
DRILLED BY : -
PROFILED BY : STANLEY PULLEN
TYPE SET BY : ACOWAN
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM : -
DATE : -
DATE : 21/04/2005
DATE : 09/05/05 12:52
TEXT : ..P\HENNOPS\BOTHAS~1.DOC

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP 12
BOTHASFONTEIN

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LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 13 Sheet 1 of 1

JOB NUMBER: HP/B 76-27

Scale 1:15

0.00 – 0.15	Moist, Dark brown, Medium Dense, Silty Sand.	REMARKS:
0.15 – 0.40	Moist, Light brown, Medium Dense, Silty Sand Granite Gravel.	REMARKS:
0.40 – 0.55	Moist, Light grey brown, Granite Gravel Sand.	REMARKS:
0.55 – 2.60	Slightly Moist, Orange speckled black white, Medium Dense Dense, Silty Sand Granite Gravel.	REMARKS: Scattered angular fine to coarse rock, Refusal

CONTRACTOR : Civilab - Hennopspark
MACHINE : TLB CAT 428c
DRILLED BY : -
PROFILED BY : STANLEY PULLEN
TYPE SET BY : ACOWAN
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM : -
DATE : -
DATE : 21/04/2005
DATE : 09/05/05 12:52
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ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP 13
BOTHASFONTEIN

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LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 14 *Sheet 1 of 1*

JOB NUMBER: HP/B 76-27

Scale 1:10

0.00 – 0.10	Moist, Light brown, Medium Dense, Silty Sand Granite Gravel.	**REMARKS: Fine roots**
0.10 – 1.15	Slightly Moist, Yellowish brown orange, Dense Very Dense, Silty Sand Granite.	**REMARKS: Partial refusal**

CONTRACTOR : Civilab - Hennopspark
MACHINE : TLB CAT 428c
DRILLED BY : -
PROFILED BY : STANLEY PULLEN
TYPE SET BY : ACOWAN
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM : -
DATE : -
DATE : 21/04/2005
DATE : 09/05/05 12:52
TEXT : ..F\HENNOPS\BOTHAS-1.DOC

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP 14
BOTHASFONTEIN

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LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 15
Sheet 1 of 1

JOB NUMBER: HP/B 76-27

Scale 1:10

0.00 – 0.20	Moist, Light brown, Loose Medium Dense, Silty Sand Granite Gravel.	**REMARKS: Scattered soft rock and fine roots**
0.20 – 1.50	Slightly Moist, Orange speckled black, Medium Dense Dense, Silty Sand Granite Gravel.	**REMARKS: Partial refusal**

CONTRACTOR : Civilab - Hennopspark
MACHINE : TLB CAT 428c
DRILLED BY : -
PROFILED BY : STANLEY PULLEN

TYPE SET BY : ACOWAN
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM : -
DATE : -
DATE : 21/04/2005

DATE : 09/05/05 12:52
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ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP 15
BOTHASFONTEIN

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LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 16 Sheet 1 of 1

JOB NUMBER: HP/B 76-27

Scale 1:10

0.00	Moist, Light brown, Granite Gravel Silty Sand.	REMARKS:
0.30	Slightly Moist, Orange speckled pale yellow, <u>Medium Dense</u>, Silty Sand Granite Gravel.	REMARKS: Partial refusal
2.00		

TP16:25771

NOTES

1) Disturbed sample TP16:25771 taken from 0,300–2,500.

CONTRACTOR : Civilab - Hennopspark
MACHINE : TLB CAT 428c
DRILLED BY : -
PROFILED BY : STANLEY PULLEN
TYPE SET BY : ACOWAN
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM : -
DATE : -
DATE : 21/04/2005
DATE : 09/05/05 12:52
TEXT : ..F:\HENNOPS\BOTHAS-1.DOC

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP 16
BOTHASFONTEIN

D014

dot.PLOT 4005 J&W

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LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 17 *Sheet 1 of 1*

JOB NUMBER: HP/B 76-27

Scale *1:10*

0.00

Slightly Moist, Light brown speckled black orange, Medium Dense Dense, Silty Sand Granite.

REMARKS: Partial refusal

2.00

CONTRACTOR : Civilab - Hennopspark
MACHINE : TLB CAT 428c
DRILLED BY : -
PROFILED BY : STANLEY PULLEN
TYPE SET BY : ACOWAN
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM : -
DATE : -
DATE : 21/04/2005
DATE : 09/05/05 12:52
TEXT : ..F:\HENNOPS\BOTHAS~1.DOC

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP 17
BOTHASFONTEIN

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LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 18 *Sheet 1 of 1*

JOB NUMBER: HP/B 76-27

Scale 1:10

0.00 – 0.28	Slightly Moist, Light grey brown, Medium Dense, Sand Granite Gravel.	**REMARKS:**
0.28 – 0.45	Slightly Moist, Light grey brown, Loose, Granite Gravel.	**REMARKS: Sand with roots**
0.45 – 1.30	Slightly Moist, Light whitish brown speckled orange black, Dense Very Dense, Silty Sand Granite Gravel.	**REMARKS: Partial refusal**

TP18:25772

NOTES

1) Disturbed sample TP18:25772 taken from 0,450--1,300.

CONTRACTOR: Civilab - Hennopspark
MACHINE: TLB CAT 428c
DRILLED BY: -
PROFILED BY: STANLEY PULLEN
TYPE SET BY: ACOWAN
SETUP FILE: STANDARD.SET

INCLINATION: Vertical
DIAM: -
DATE: -
DATE: 21/04/2005
DATE: 09/05/05 12:62
TEXT: ..F\HENNOPS\BOTHAS~1.DOC

ELEVATION:
X-COORD:
Y-COORD:

HOLE No: TP 18
BOTHASFONTEIN

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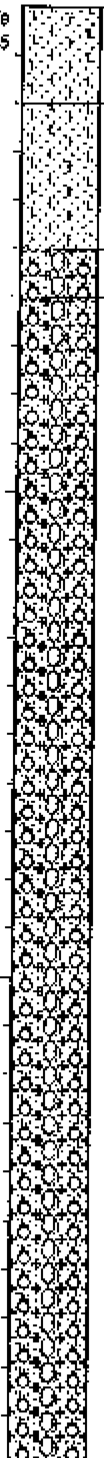
LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 19 *Sheet 1 of 1*

JOB NUMBER: HP/B 76-27

Scale 1:15



0.00–0.20	Moist, Dark grey speckled black, Silty Sand.	**REMARKS: Roots, Topsoil**
0.20–0.50	Moist, Light grey brown, Medium Dense, Silty Sand.	**REMARKS:**
0.50–0.60	Moist, Light grey brown, Granite Gravel Silty Sand.	**REMARKS:**
0.60–3.00	Moist, Light orange grey brown, Medium Dense Dense, Silty Sand Granite Gravel.	**REMARKS: Hole stopped, dry**

CONTRACTOR : Civilab - Hennopspark
MACHINE : TLB CAT 428c
DRILLED BY : -
PROFILED BY : STANLEY PULLEN
TYPE SET BY : ACOWAN
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM : -
DATE : -
DATE : 21/04/2005
DATE : 09/05/05 12:52
TEXT : ..F:\HENNOPS\BOTHAS~1.DOC

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP 19
BOTHASFONTEIN

Civilab

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LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 20
Sheet 1 of 1

JOB NUMBER: HP/B 76-27

Scale 1:10

0.00 – 0.15	Moist, Orange speckled grey brown, Loose Medium Dense, Clay Silty Sand Granite Gravel.	REMARKS: Fine roots
0.15 – 0.30	Slightly Moist, Grey brown, Loose, Clay Silty Sand.	REMARKS: Roots
0.30 – 0.85	Slightly Moist, Grey brown orange, Medium Dense, Silty Sand Granite Gravel.	REMARKS: Electric cable in sleeve
0.85 – 2.00	Slightly Moist, Orange speckled yellow olive, Dense Very Dense, Silty Sand Granite Gravel.	REMARKS: Partial refusal

CONTRACTOR : Civilab - Hennopspark
MACHINE : TLB CAT 428c
DRILLED BY : -
PROFILED BY : STANLEY PULLEN

TYPE SET BY : ACOWAN
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM : -
DATE : -
DATE : 21/04/2005

DATE : 09/05/05 12:52
TEXT : ..F:\HENNOPS\BOTHAS~1.DOC

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP 20
BOTHASFONTEIN

D014

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Johannesburg 2091

LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 21
Sheet 1 of 1

JOB NUMBER: HP/B 76-27

Scale 1:10

0.00 – 0.10	Moist, Orange speckled grey brown, Loose Medium Dense, Clay Silty Sand Granite Gravel.	REMARKS: Fine roots
0.10 – 0.40	Slightly Moist, Grey brown, Medium Dense, Silty Sand Granite Gravel.	REMAKRS: Fine roots
0.40 – 1.20	Slightly Moist, Orange speckled yellow olive, Dense Very Dense, Silty Sand Granite Gravel.	REMARKS: Partial refusal

TP21:25773

NOTES

1) Disturbed sample TP21:25773 taken from 0,400--1,200.

CONTRACTOR : Civilab - Hennopspark
MACHINE : TLB CAT 428c
DRILLED BY : -
PROFILED BY : STANLEY PULLEN

INCLINATION : Vertical
DIAM : -
DATE : -
DATE : 21/04/2005

ELEVATION :
X-COORD :
Y-COORD :

TYPE SET BY : ACOWAN
SETUP FILE : STANDARD.SET

DATE : 09/05/05 12:52
TEXT : ..F:\HENNOPS\BOTHAS~1.DOC

HOLE No: TP 21
BOTHASFONTEIN

D014

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LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 22 *Sheet 1 of 1*

JOB NUMBER: HP/B 76-27

Scale 1:10

0.00 – 0.10	Slightly Moist, Light brown, Loose Medium Dense, Silty Sand Granite Gravel.	**REMARKS: Fine roots**
0.10 – 1.20	Slightly Moist, Light orange speckled yellow, Dense Very Dense, Silty Sand Granite Gravel.	**REMARKS: Partial refusal**

CONTRACTOR: Civilab - Hennopspark
MACHINE: TLB CAT 428c
DRILLED BY: -
PROFILED BY: STANLEY PULLEN
TYPE SET BY: ACOWAN
SETUP FILE: STANDARD.SET

INCLINATION: Vertical
DIAM: -
DATE: -
DATE: 21/04/2005
DATE: 09/05/05 12:52
TEXT: ..F:\HENNOPS\BOTHAS~1.DOC

ELEVATION:
X-COORD:
Y-COORD:

HOLE No: TP 22
BOTHASFONTEIN

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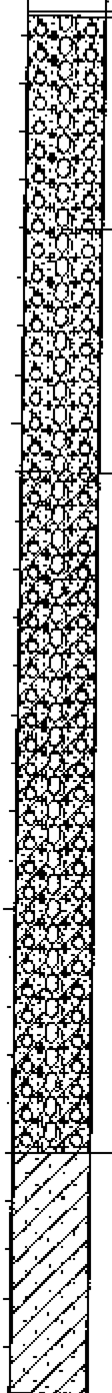
LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 23
Sheet 1 of 1

JOB NUMBER: HP/B 76-27

Scale 1:15



0.00 – 0.15	Asphalt.	REMARKS:
0.15 – 0.16	Crusher Run.	REMARKS:
0.16 – 0.50	Slightly Moist, White yellow brown speckled dark orange, <u>Loose</u>, Granite Gravel Silty Sand.	REMARKS:
0.50 – 1.10	Slightly Moist, Light grey brown speckled black, <u>Medium Dense</u>, Silty Sand Granite Gravel.	REMARKS:
1.10 – 2.50	Slightly Moist, Dark orange speckled black, <u>Medium Dense Dense</u>, Silty Sand Clay Granite Gravel.	REMARKS:
2.50 – 3.00	Moist, Light grey speckled orange, Sandy Clay.	REMARKS: Hole stopped

CONTRACTOR : Civilab - Hennopspark
MACHINE : TLB CAT 428c
DRILLED BY : -
PROFILED BY : STANLEY PULLEN

INCLINATION : Vertical
DIAM : -
DATE : -
DATE : 21/04/2005

ELEVATION :
X-COORD :
Y-COORD :

TYPE SET BY : ACOWAN
SETUP FILE : STANDARD.SET

DATE : 09/05/05 12:52
TEXT : ..F:\HENNOPS\BOTHAS~1.DOC

HOLE No: TP 23
BOTHASFONTEIN

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LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 25 *Sheet 1 of 1*

JOB NUMBER: HP/B 76-27

Scale 1:10

0.00 – 0.12	Slightly Moist, Grey brown, Loose Medium Dense, Silty Sand Granite Gravel.	**REMARKS: Roots**
0.12 – 0.25	Slightly Moist, Yellow brown, Dense, Silty Sand Granite Gravel.	**REMARKS:**
0.25 – 0.50	Slightly Moist, Light brown, Medium Dense, Silty Sand.	**REMARKS:**
0.50 – 0.75	Slightly Moist, Light brown, Dense, Granite Gravel Silty Sand.	**REMARKS:**
0.75 – 1.20	Slightly Moist, White speckled yellow, Dense Very Dense, Silty Sand Granite Gravel.	**REMARKS:**

TP25:25774

NOTES

1) Disturbed sample TP25:25774 taken from 0,750–1,200.

CONTRACTOR: Civilab - Hennopspark
MACHINE: TLB CAT 428c
DRILLED BY: -
PROFILED BY: STANLEY PULLEN
TYPE SET BY: ACOWAN
SETUP FILE: STANDARD.SET

INCLINATION: Vertical
DIAM: -
DATE: -
DATE: 21/04/2005
DATE: 09/05/05 12:52
TEXT: ..F:\HENNOPS\BOTHAS~1.DOC

ELEVATION:
X-COORD:
Y-COORD:

HOLE No: **TP 25**
BOTHASFONTEIN

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LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 26 *Sheet 1 of 1*

JOB NUMBER: HP/B 76-27

Scale 1:10

0.00 – 0.20	Slightly Moist, Grey brown, Loose Medium Dense, Silty Sand Granite Gravel.	**REMARKS: Roots**
0.20 – 0.55	Slightly Moist, Light brown, Medium Dense Dense, Silty Sand Granite Gravel.	**REMARKS:**
0.55 – 0.90	Slightly Moist, Light brown, Dense, Silty Sand Granite Gravel.	**REMARKS:**
0.90 – 1.30	Slightly Moist, Pale orange speckled black, Dense Very Dense, Silty Sand Granite.	**REMARKS: Partial refusal**

CONTRACTOR: Civilab - Hennopspark
MACHINE: TLB CAT 428c
DRILLED BY: -
PROFILED BY: STANLEY PULLEN
TYPE SET BY: ACOWAN
SETUP FILE: STANDARD.SET

INCLINATION: Vertical
DIAM: -
DATE: -
DATE: 21/04/2005
DATE: 09/05/05 12:52
TEXT: ..F\HENNOPS\BOTHAS~1.DOC

ELEVATION:
X-COORD:
Y-COORD:

HOLE No: TP 26
BOTHASFONTEIN

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LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 27 *Sheet 1 of 1*

JOB NUMBER: HP/B 76-27

Scale 1:15

0.00 – 0.02	Asphalt.	**REMARKS:**
0.02 – 0.17	Moist, Light grey brown, Gravel Sand.	**REMARKS: Crusher Run**
0.17 – 1.00	Slightly Moist, Grey brown, Dense, Silty Sand Granite Gravel.	**REMARKS:**
1.00 – 1.40	Slightly Moist, Orange, Medium Dense, Silty Sand Granite Gravel.	**REMARKS:**
1.40 – 2.70	Slightly Moist, Orange speckled white, Medium Dense Dense Very Dense, Silty Sand Granite Gravel.	**REMARKS: Partial refusal**

CONTRACTOR: Civilab - Hennopspark
MACHINE: TLB CAT 428c
DRILLED BY: -
PROFILED BY: STANLEY PULLEN
TYPE SET BY: ACOWAN
SETUP FILE: STANDARD.SET

INCLINATION: Vertical
DIAM: -
DATE: -
DATE: 21/04/2005
DATE: 09/05/05 12:52
TEXT: ..F\HENNOPS\BOTHAS~1.DOC

ELEVATION:
X-COORD:
Y-COORD:

HOLE No: TP 27
BOTHASFONTEIN

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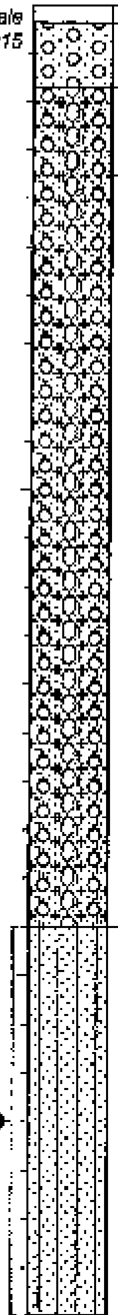
LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 28 *Sheet 1 of 1*

JOB NUMBER: HP/B 76-27

Scale 1:15



TP28:25775

0.00 – 0.03	Asphalt.	**REMARKS**
0.03 – 0.17	Moist, Light grey brown, Gravel Sand.	**REMARKS: Crusher Run**
0.17 – 0.35	Slightly Moist, Grey brown, Dense, Silty Sand Granite Gravel.	**REMARKS:**
0.35 – 1.90	Slightly Moist, Pale orange speckled white, Medium Dense Dense, Silty Sand Granite Gravel.	**REMARKS:**
1.90 – 2.70	Slightly Moist, Grey brown, Loose, Sand Silt.	**REMARKS: Hole stopped**

NOTES

1) Disturbed sample TP28:25775 taken from 1,900–2,700.

CONTRACTOR: Civilab - Hennopspark
MACHINE: TLB CAT 428c
DRILLED BY: -
PROFILED BY: STANLEY PULLEN
TYPE SET BY: ACOWAN
SETUP FILE: STANDARD.SET

INCLINATION: Vertical
DIAM: -
DATE: -
DATE: 21/04/2005
DATE: 09/05/05 12:52
TEXT: ..F:\HENNOPS\BOTHAS~1.DOC

ELEVATION:
X-COORD:
Y-COORD:

HOLE No: TP 28
BOTHASFONTEIN

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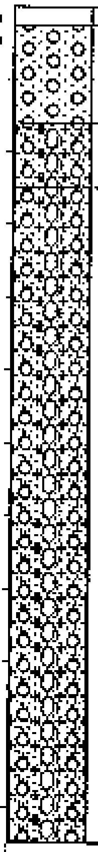
LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 29 *Sheet 1 of 1*

JOB NUMBER: HP/B 76-27

Scale 1:10



0.00 – 0.02	Asphalt.	**REMARKS:**
0.02 – 0.16	Moist, Light grey brown, Gravel Sand.	**REMARKS: Crusher Run**
0.16 – 0.26	Slightly Moist, Light brown, Dense, Granite Gravel Silty Sand.	**REMARKS:**
0.26 – 1.15	Slightly Moist, Orange speckled yellow olive, Dense Very Dense, Silty Sand Granite Gravel.	**REMARKS: Partial refusal**

CONTRACTOR: Civilab - Hennopspark
MACHINE: TLB CAT 428c
DRILLED BY: -
PROFILED BY: STANLEY PULLEN
TYPE SET BY: ACOWAN
SETUP FILE: STANDARD.SET

INCLINATION: Vertical
DIAM: -
DATE: -
DATE: 21/04/2005
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TEXT: ..FAHENNOPS\BOTHAS~1.DOC

ELEVATION:
X-COORD:
Y-COORD:

HOLE No: TP 29
BOTHASFONTEIN

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LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 30 *Sheet 1 of 1*

JOB NUMBER: HP/B 76-27

Scale 1:10

0.00 – 0.02	Asphalt.	**REMARKS:**
0.02 – 0.19	Moist, Light grey brown, Gravel Sand.	**REMARKS: Crusher Run**
0.19 – 0.40	Moist, Orange blotched light brown, Dense, Silty Sand Granite Gravel.	**REMARKS:**
0.40 – 0.70	Slightly Moist, Light brown, Dense, Granite Gravel Silty Sand.	**REMARKS:**
0.70 – 1.60	Slightly Moist, Orange speckled yellow olive, Dense Very Dense, Silty Sand Granite Gravel.	**REMARKS: Partial refusal**

CONTRACTOR: Civilab - Hennopspark
MACHINE: TLB CAT 428c
DRILLED BY: -
PROFILED BY: STANLEY PULLEN

TYPE SET BY: ACOWAN
SETUP FILE: STANDARD.SET

INCLINATION: Vertical
DIAM: -
DATE: -
DATE: 21/04/2005

DATE: 09/05/05 12:53
TEXT: ..F:\HENNOPS\BOTHAS~1.DOC

ELEVATION:
X-COORD:
Y-COORD:

HOLE No: TP 30
BOTHASFONTEIN

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LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 31 Sheet 1 of 1

JOB NUMBER: HP/B 76-27

Scale 1:10

0.00 – 0.60	Slightly Moist, Orange, Medium Dense, Silty Sand Granite Gravel.	**REMARKS:**
0.60 – 0.85	Slightly Moist, Light grey brown, Granite Gravel Silty Sand.	**REMARKS: Fine roots**
0.85 – 1.65	Moist, Orange speckled white, Dense Very Dense, Silty Sand Granite.	**REMARKS: Partial refusal**

CONTRACTOR : Civilab - Hennopspark
MACHINE : TLB CAT 428c
DRILLED BY : -
PROFILED BY : STANLEY PULLEN
TYPE SET BY : ACOWAN
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM : -
DATE : -
DATE : 21/04/2005
DATE : 09/05/05 12:53
TEXT : ..FAHENNOPS\BOTHAS~1.DOC

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP 31
BOTHASFONTEIN

Investment Facility Company 642 (Pty) Limited trading as Civilab. Registration No: 98/19071/07 dot.PLOT 4005 J&W

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LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 33 *Sheet 1 of 1*

JOB NUMBER: HP/B 76-27

Scale 1:15

0.00 – 0.02	Asphalt.	**REMARKS:**
0.02 – 0.14	Light grey brown, Stone Sand.	**REMARKS: Crusher Run, Crushed**
0.14 – 0.40	Slightly Moist, Light brown, Medium Dense Dense, Silty Sand.	**REMARKS:**
0.40 – 3.00	Slightly Moist, Orange, Medium Dense, Silty Sand Granite.	**REMARKS:**

TP33:25776

NOTES

1) Disturbed sample TP33:25776 taken from 0,400–3,000.

CONTRACTOR: Civilab - Hennopspark
MACHINE: TLB CAT 428c
DRILLED BY: -
PROFILED BY: STANLEY PULLEN
TYPE SET BY: ACOWAN
SETUP FILE: STANDARD.SET

INCLINATION: Vertical
DIAM: -
DATE: -
DATE: 21/04/2005
DATE: 09/05/05 12:53
TEXT: ..F:\HENNOPS\BOTHAS~1.DOC

ELEVATION:
X-COORD:
Y-COORD:

HOLE No: TP 33
BOTHASFONTEIN

D014

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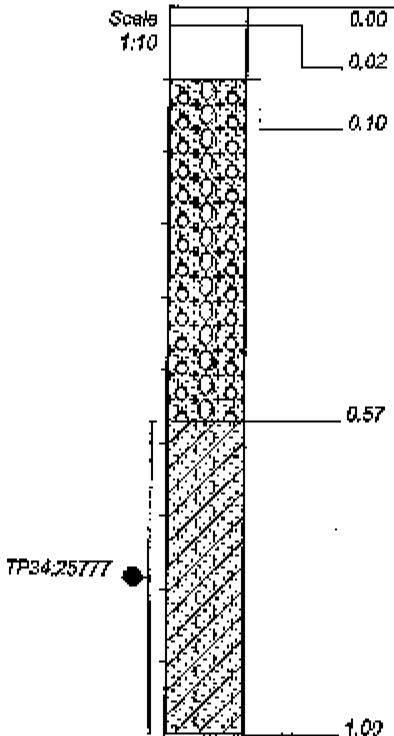
LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 34 *Sheet 1 of 1*

JOB NUMBER: HP/B 76-27

Scale 1:10



0.00 – 0.02	Asphalt.	**REMARKS:**
0.02 – 0.10	Crusher Run.	**REMARKS:**
0.10 – 0.57	Slightly Moist, Light brown speckled orange, <u>Dense</u>, Silty Sand Granite Gravel.	**REMARKS:**
0.57 – 1.00	Slightly Moist, Greyish white speckled orange, <u>Dense Very Dense</u>, Silty Sand Clay.	**REMARKS: Partial refusal**

NOTES

1) Disturbed sample TP34:25777 taken from 0,570–1,000.

CONTRACTOR: Civilab - Hennopspark
MACHINE: TLB CAT 428c
DRILLED BY: -
PROFILED BY: STANLEY PULLEN
TYPE SET BY: ACOWAN
SETUP FILE: STANDARD.SET

INCLINATION: Vertical
DIAM: -
DATE: -
DATE: 21/04/2005
DATE: 09/05/05 12:53
TEXT: ..F:\HENNOPS\BOTHAS-1.DOC

ELEVATION:
X-COORD:
Y-COORD:

HOLE No: TP 34
BOTHASFONTEIN

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LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 35
Sheet 1 of 1

JOB NUMBER: HP/B 76-27

Scale 1:10

0.00 – 0.03	Asphalt.	**REMARKS:**
0.03 – 0.17	Crusher Run.	**REMARKS:**
0.17 – 0.30	Slightly Moist, Orange, Granite Gravel Silty Sand.	**REMARKS:**
0.30 – 1.20	Slightly Moist, Orange speckled white, Dense Very Dense, Silty Sand Granite Gravel.	**REMARKS: Partial Refusal**

NOTES

1) mm Concrete pipe - 0,400 below surface

CONTRACTOR: Civilab - Hennopspark
MACHINE: TLB CAT 428c
DRILLED BY: -
PROFILED BY: STANLEY PULLEN
TYPE SET BY: ACOWAN
SETUP FILE: STANDARD.SET

INCLINATION: Vertical
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DATE: -
DATE: 21/04/2005
DATE: 09/05/05 12:53
TEXT: ..F:\HENNOPS\BOTHAS~1.DOC

ELEVATION:
X-COORD:
Y-COORD:

HOLE No: TP 35
BOTHASFONTEIN

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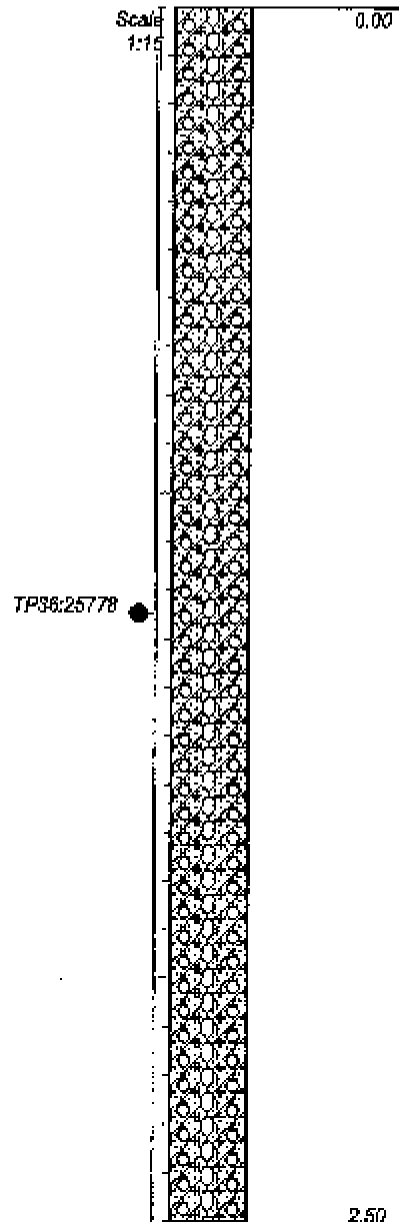
LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 406-JR

HOLE No: TP 36 *Sheet 1 of 1*

JOB NUMBER: HP/B 76-27

Scale 1:15



Moist, Light brown, Medium Dense, Clay Silty Sand Granite Gravel.

REMARKS: Boulders, Refusal on pipe

NOTES

1) Disturbed sample TP36:25778 taken from 0–2,500.

CONTRACTOR: Civilab - Hennopspark
MACHINE: TLB CAT 428c
DRILLED BY: -
PROFILED BY: STANLEY PULLEN
TYPE SET BY: ACOWAN
SETUP FILE: STANDARD.SET

INCLINATION: Vertical
DIAM: -
DATE: -
DATE: 21/04/2005
DATE: 09/05/05 12:53
TEXT: ..F:\HENNOPS\BOTHAS~1.DOC

ELEVATION:
X-COORD:
Y-COORD:

HOLE No: TP 36
BOTHASFONTEIN

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LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 37
Sheet 1 of 1

JOB NUMBER: HP/B 76-27

Scale 1:10

0.00 – 0.10	Slightly Moist, Light brown, Loose Medium Dense, Silty Sand Granite Gravel.	REMARKS: Roots
0.10 – 0.45	Moist, Orange, Dense, Granite Gravel Silty Sand.	REMARKS:
0.45 – 1.60	Slightly Moist, Orange speckled black, Dense Medium Dense, Silty Sand Granite.	REMARKS: Partial refusal

CONTRACTOR : Civilab - Hennopspark
MACHINE : TLB CAT 428c
DRILLED BY : -
PROFILED BY : STANLEY PULLEN
TYPE SET BY : ACOWAN
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM : -
DATE : -
DATE : 21/04/2005
DATE : 09/05/05 12:53
TEXT : ..F:\HENNOPS\BOTHAS~1.DOC

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP 37
BOTHASFONTEIN

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Civilab

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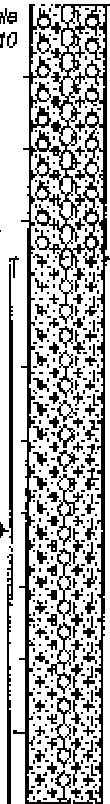
86/88 Fourth Street, Booysens Reserve, Johannesburg 2091

LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 39 *Sheet 1 of 1*

JOB NUMBER: HP/B 76-27

Scale 1:10



TP39:25779

0.00 – 0.35	Slightly Moist, Light brown, Loose, Granite Gravel Silty Sand.	**REMARKS: Roots**
0.35 – 1.10	Slightly Moist, Orange blotched olive brown, Medium Dense Very Dense, Silty Sand Granite.	**REMARKS: Partial refusal**

NOTES

1) Disturbed sample TP39:25779 taken from 0,350–1,100.

CONTRACTOR: Civilab - Hennopspark
MACHINE: TLB CAT 428c
DRILLED BY: -
PROFILED BY: STANLEY PULLEN
TYPE SET BY: ACOWAN
SETUP FILE: STANDARD.SET

INCLINATION: Vertical
DIAM: -
DATE: -
DATE: 21/04/2005
DATE: 09/05/05 12:53
TEXT: ..F:\HENNOPS\BOTHAS-1.DOC

ELEVATION:
X-COORD:
Y-COORD:

HOLE No: TP 39
BOTHASFONTEIN

Civilab
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LIDWALA CONSULTING ENGINEERS
RE/2 OF THE FARM BOTHASFONTEIN 408-JR

HOLE No: TP 40 Sheet 1 of 1

JOB NUMBER: HP/B 76-27

Scale 1:15

0.00 – 0.40	Slightly Moist, Light brown, Loose, Granite Gravel Silty Sand.	REMARKS: Roots
0.40 – 1.10	Moist, Orange speckled white, Medium Dense, Silty Sand Granite Gravel.	REMARKS:
1.10 – 2.50	Slightly Moist, Orange blotched olive dark red, Dense Very Dense, Silty Sand Granite.	REMARKS: Hole stopped

TP40:25780

NOTES

1) Disturbed sample TP40:25780 taken from 1,100–2,500.

CONTRACTOR : Civilab - Hennopspark
MACHINE : TLB CAT 428c
DRILLED BY : -
PROFILED BY : STANLEY PULLEN
TYPE SET BY : ACOWAN
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM : -
DATE : -
DATE : 21/04/2005
DATE : 09/05/05 12:53
TEXT : ..F:\HENNOPS\BOTHAS~1.DOC

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP 40
BOTHASFONTEIN

D014

ANNEXURE E3:
LANDSCAPE ECOLOGICAL STUDY

A LANDSCAPE ECOLOGICAL ASSESMENT OF THE SITE FOR THE PROPOSED ESTABLISHMENT OF A TOWNSHIP ON THE REMAINING EXTENT OF PORTION 2 AND A PART OF PORTION 88 (A PORTION OF PORTION 2) OF THE FARM BOTHASFONTEIN 408 JR, MIDRAND, GAUTENG

PREPARED FOR:

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SEF Ref: 500068

July 2006

EXECUTIVE SUMMARY

Strategic Environmental Focus have been appointed as independent environmental consultants and impact assessors by Erf 51 Melville CC to undertake a landscape ecological assessment for the proposed development of a township on the remainder of portion 2 and a part of portion 88 (a portion of portion 2) of the farm Bothasfontein 408 IR Midrand, Gauteng.

According to the Ridge Policy and C-Plan 2 a Class three ridge occurs on the site (GDACE, 2005; GDACEL, 2001)(see Figure 3 & Figure 4). Ridges are recognised as important conservation features due to their value with respect to ecological processes and as potential wildlife corridors. The site is also bordered by two ephemeral drainage lines, one of which has a confirmed population of the **nationally Red Data *Metisella meninx* (Marsh Sylph)** (buffer zones around which will have implications for the development if enforced) and the perennial Jukskei River (Figure 3 & Figure 4). These important landscape features are also recognised as being of great importance with respect to landscape ecological processes. Therefore the Strategic Environmental Focus Specialist Unit was asked to

- Determine ecologically sensitive features present on the site, and map them;
- Provide an assessment of the loss of open space on the site should the proposed development proceed;
- Provide an assessment of how migration corridors might be affected should the proposed development proceed.

This was achieved through a site investigation, which allowed for the delineation and mapping of sensitive zones. It was concluded that the development will reduce open space and impact negatively on wildlife corridors. These impacts will be able to be satisfactorily mitigated if the recommendations included in section 5 are followed.

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1 INTRODUCTION

Landscape ecology theory includes the landscape stability principle, which emphasizes the importance of landscape structural heterogeneity in developing resistance to disturbances, recovery from disturbances, and promoting total system stability (Forman & Godron., 1986). This principle is a major contribution to general ecological theories which highlight the importance of relationships among the various components of the landscape. Integrity of landscape components helps maintain resistance to external threats, including development and land transformation by human activity (Turner *et al.*, 2001).

Ecological processes such as plant and animal population dynamics, nutrient fluxes and so forth, largely depend upon landscape composition and spatial configuration. Flora and fauna react to local physical conditions (soil, climate...) as well as to land use practices directed towards the production or management of such features, such as field boundaries or road verges (e.g. plowing, mowing, grazing, fertilizer and pesticide applications). Movements (pollen and seed dispersal for plants, food and mate search, and migration) are therefore constrained by the landscape mosaic. Thus when developing an area it is very important that landscape features associated with these movements are not unnecessarily blocked or destroyed. In this report these principals are discussed within the context of this proposed development.

1.1 Brief Project Description

Erf 51 Melville CC proposes to establish a development of mixed use commercial and residential components. The ultimate philosophy advocated is one of a comprehensive and sustainable retail centre satisfying the shopping and business needs of the local community.

The Strategic Environmental Focus Specialist Unit, as independent environmental specialists have been appointed by Erf 51 Melville CC to undertake an assessment of the ecological processes present on the site, and how the proposed development may impact upon the present ecologically important landscape features present on the site.

1.2 Terms of Reference

The terms of reference for this assessment were:

- To determine ecologically sensitive features present on the site and map them;
- To provide an assessment of the loss of open space on the site should the proposed development proceed;

- To provide an assessment of how migration corridors might be affected should the proposed development proceed.

1.3 Limitations

Ideally to conduct a thorough assessment, the area should be surveyed across all seasons and over an extended period of time to ensure that all species are accounted for and that species of flora and fauna that may render certain portions of the site sensitive are able to be taken into consideration. Some species may not be easily observed at certain periods of the year and stand a larger chance of being observed through repeated assessments across different seasons. However due to time constraints such long term studies are not feasible.

Due to the study being requested in the most inefficient timeframe for floral and faunal studies this study will take sensitive landscape features as well as present and past land uses as the major environmental criterion from which sensitivity classifications are made.

2 BACKGROUND INFORMATION

2.1 Location

The site is situated on the remaining extent of portion 2 and a part of portion 88 (a portion of portion 2) of the farm Bothasfontein 408 IR, Midrand, Gauteng. Allandale Road borders the site to the north-east and the Jukskei River forms the south-western border of the site (Figure 1).

2.2 Land use

Currently the area is used as a composting business with portions of the site being used to dump garden refuse. A horse riding school occupies another small portion of the site and a Eucalyptus forest occupies the balance of the site.

2.3 Climate

The area has a typical Highveld climate characterised by warm, wet summers and cool dry winters. The summer rainfall averages between 650 – 750 mm/yr and temperatures range from -12°C to 39°C with an average of 16°C (Low & Rebelo, 1996).

2.4 Geology and soils

The site is underlain by migmatite and ultramafic rocks of the Halfway house granite formation. This Swazian Era geology is characterised by gneiss, migmatite and porphyritic granodiorite. The soils are predominantly brown/grey course sand and loam with a weak block structure.

2.5 Topography

The site forms part of the gently rolling hills of the central portion of Gauteng typical of the Midrand area. It has a southerly aspect and slopes towards the Jukskei River which forms the south-western border of the site, on the south-eastern boundary of the site is an ephemeral drainage line that flows into the perennial Jukskei system, and to the north-west is another ephemeral drainage line that also flows into the Jukskei. The majority of the site constitutes the higher ground between these two.

2.6 Regional ecology

The study area falls into the regional classification of the Rocky Highveld grassland. This is a transitional vegetation type between grasslands of the high inland plateau and the bushveld of the lower plateau. The characteristic grass and forb species of this vegetation type are *Trachpogon spicatus, Schizachyrium sanguineum, Andropogon schirensis, Senecio venosus, Xerophyta retinervus, Indigofera comosa, Vernonia oligosephala* and *Loudetia simplex*. The grasslands also have a strong afromontane influence characterised by *Harpochloa flax, Alloteropsis semilata, Rhus discolour* and *Vernonia natalensis*. The woody vegetation of Zambezian and Afromontane affinity occurs in sheltered areas of mountain bushveld. Typical species include *Rhus zeyheri, Eretia rigida, Zanthoxylum capense* and *Englerophytum magaliesmontanum* (Low & Rebelo, 1996).

2.7 Local site ecology

Please refer to paragraph 4.1 below.

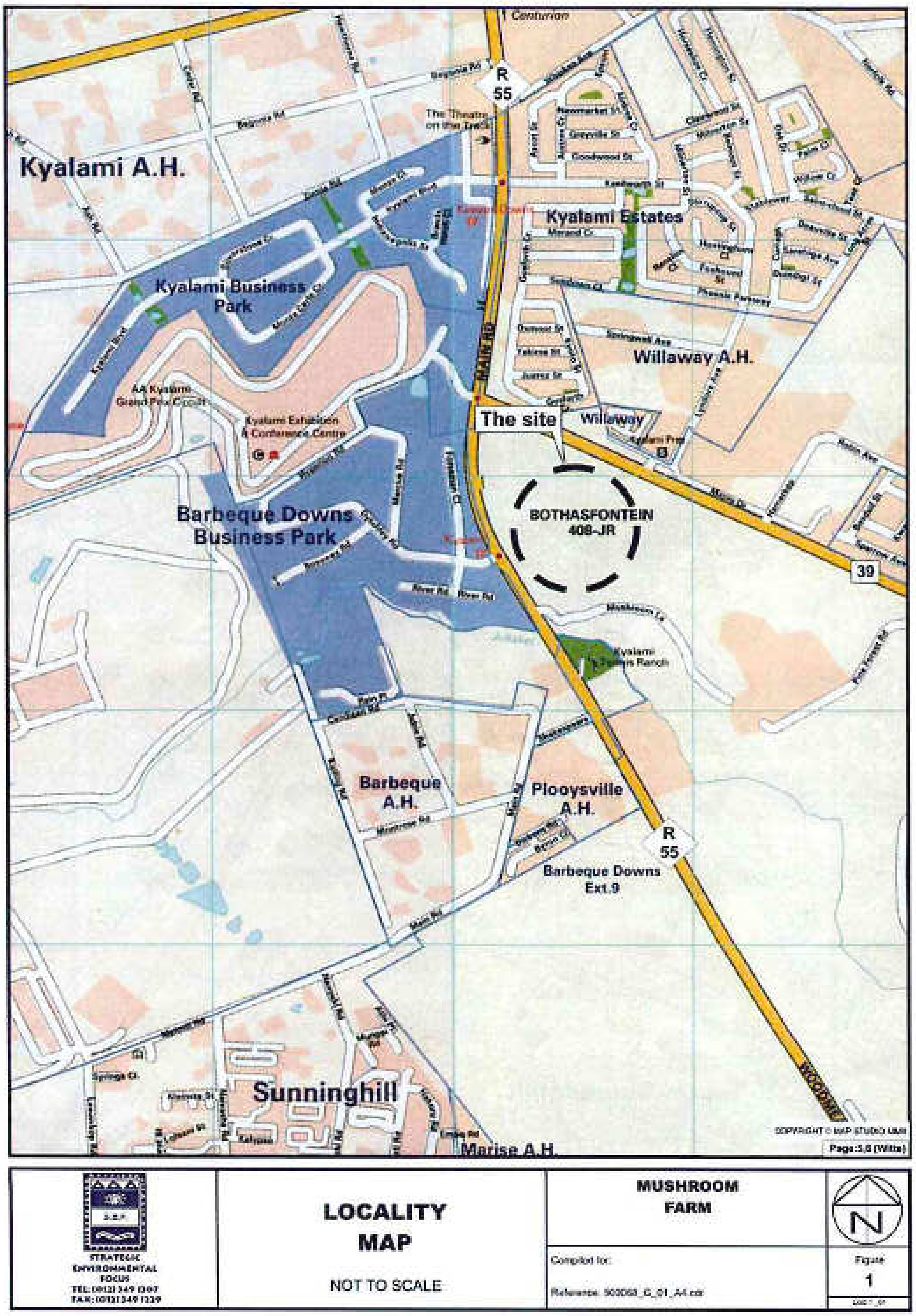

Figure 1: Locality map of the study area

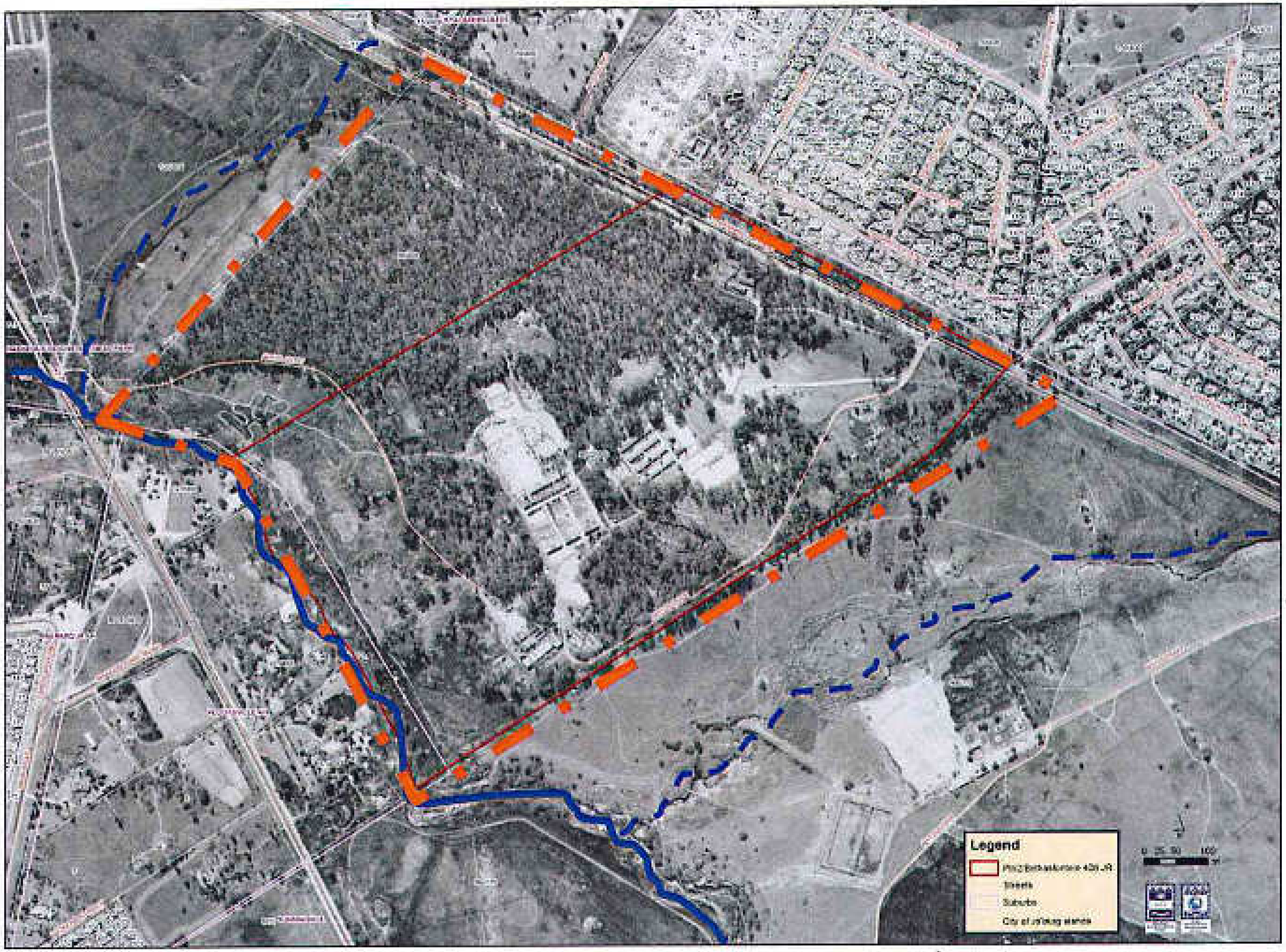

Figure 2: Orthophoto showing the site, this image gives a good approximation of the site as it is at present. All the trees on the site are *Eucalyptus camaldulensis*, The dashed line includes the whole site.

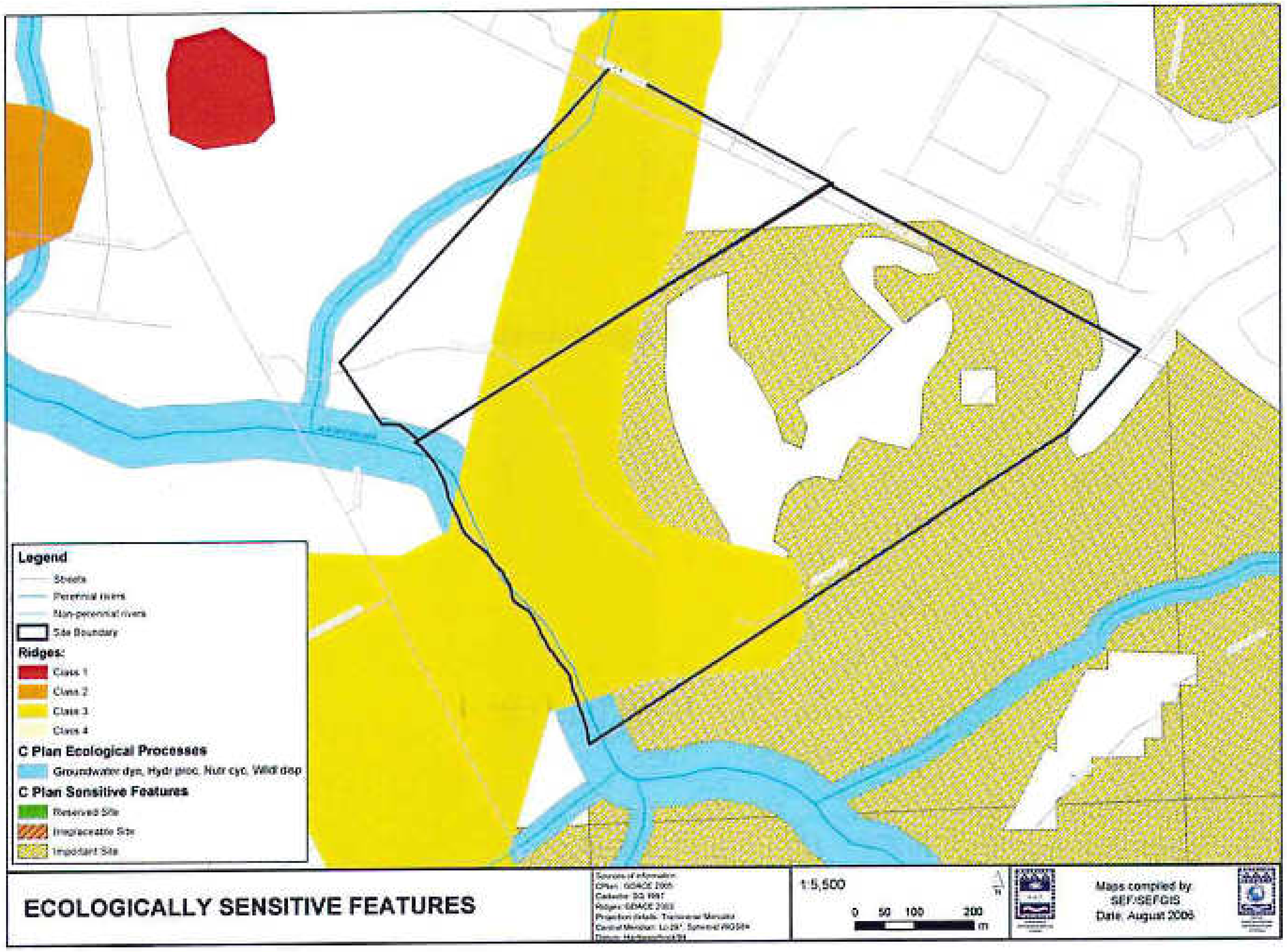

Figure 3: Ecologically sensitive features on or close to the site, showing their relationship with other adjacent properties as depicted by our Geographical Information System.

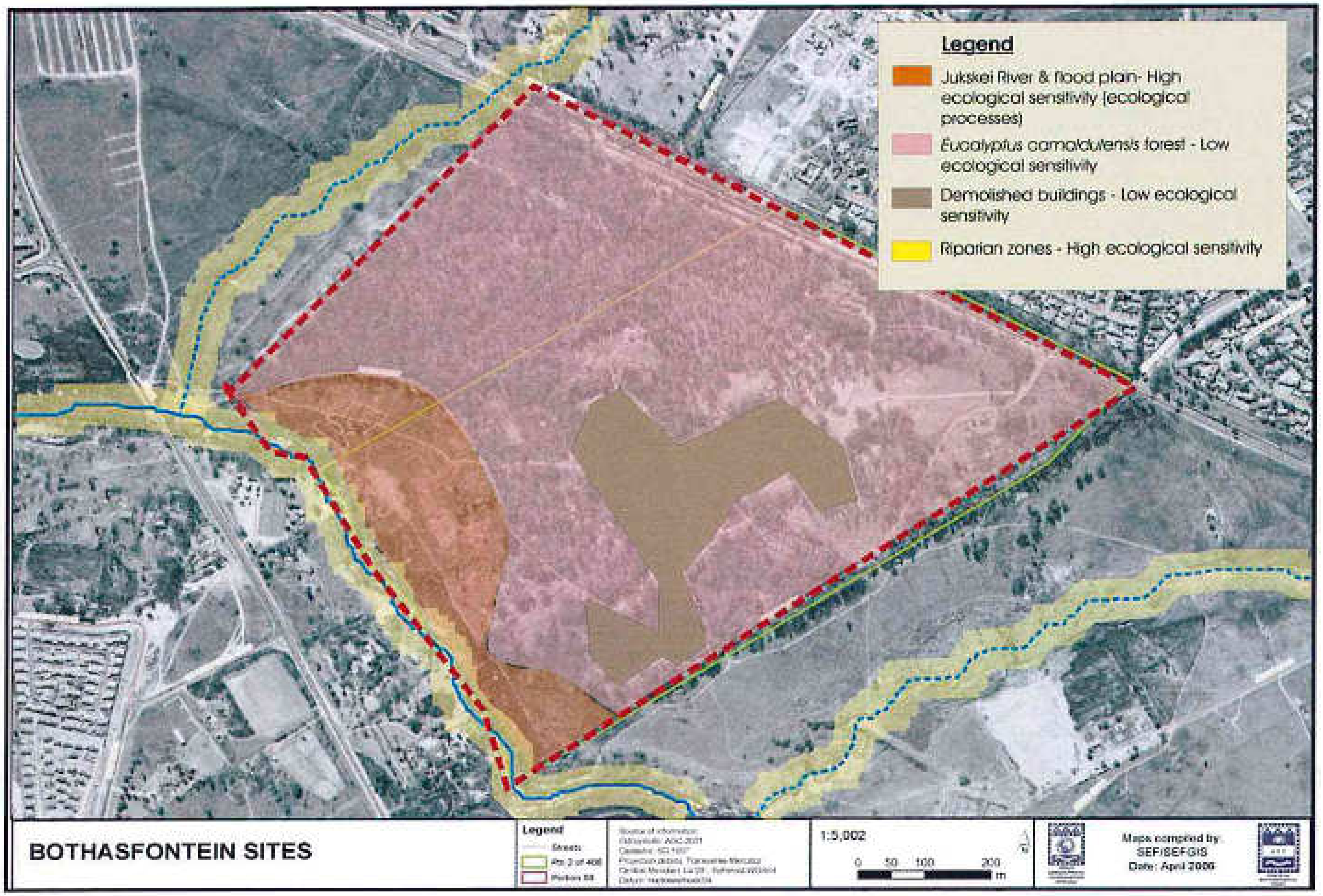

Figure 4: Ecological Sensitivity Map.

3 METHODOLOGY

A site visit was conducted on the 25th of July to determine the following:

- Ecologically sensitive features present on the site and map them;
- To provide an assessment of the loss of open space on the site should the proposed development proceed;
- To provide an assessment of how migration corridors might be affected should the proposed development proceed.

Before the site inspection 1:10 000 orthophoto's were used to delineate areas of uniform vegetation structure and to determine the presence of important landscape elements that may play a role in the determination of the above.

Random transects were then undertaken across the entire study site to ensure that all the habitat types on the site were investigated for the possibility of sensitive species or sensitive landscape features that may occur.

The classification of landscape units was based on orthophotographs, the predominant vegetation composition as well as landscape features such as rivers, ridges etc. The ecological sensitivity for each habitat (refer to Figure 4) was determined according to its ecological function and conservation status as defined below. The ecological function describes the intactness of the structure and function of an ecosystem and the ecological conservation importance gives an indication of the necessity to conserve areas based on the presence of a high diversity, rare or endemic species and areas that are protected by legislation. The criteria are defined as follows:

Ecological function

- *High* – Sensitive ecosystems with either low inherent resistance or resilience towards disturbance factors or highly dynamic systems considered being stable and important for the maintenance of ecosystem integrity. Most of these systems represent late successional ecosystems with high connectivity to other important ecological systems.
- *Medium* – These systems occur at disturbances of low-medium intensity and are representative of secondary successional stages with some degree of connectivity with other ecological systems.
- *Low* – Degraded and highly disturbed systems with little ecological function.

Conservation importance

- *High* – Ecosystems with high species diversity and usually provide suitable habitat for a number of threatened species. These areas should be protected.

- *Medium* – Ecosystems with intermediate levels of species diversity without any threatened species.
- *Low* – Areas with little or no conservation potential and usually species poor (most species are usually exotic).

4 RESULTS

4.1 The Ecology of the Site

4.1.1 Ecologically Sensitive Features Present on or Near the Site

Please refer to Figure 4 for a reference of ecologically sensitive features on the site.

Ridges

According to the Ridge Policy and C-Plan 2 a Class three ridge occurs on the site (GDACE, 2005; GDACEL, 2001)(see Figure 3 & Figure 4). Ridges are recognised as important conservation features due to their value with respect to ecological processes, and as potential wildlife corridors. This is due to the connectivity that ridge systems share within a landscape mosaic, as well as the importance of the ridge systems to various forms of fauna because of their habitat, microclimates or the habitat niches that they provide (GDACEL, 2001).

Although it was evident that the slope of the site may be indicative of a ridge system, the habitat was no longer consistent with habitat associated with ridge systems, this is evident from the orthophoto (Figure 2). The ridge system as displayed in Figure 3 is also incorrectly depicted as in reality it is not contiguous with the slope depicted on the southern side of the Jukskei River. The steepest slope of the ground was in fact consistent with terrain forming the riverbank of the Jukskei River i.e. leading from the higher ground of the site to the floodplain of the perennial Jukskei River. This is important because the vegetation and habitat differ widely from those that are common to ridges, and thus should not be confused with the advantages that contiguous ridge systems bestow. Floodplains are however, also vitally important with respect to the function that they perform within the context of their correct designation as zones adjacent to riparian habitat.

The quality of the habitat on this portion of the site was poor and eroded in areas. Some portions of this zone appeared as though artificial manmade impacts have occurred. A single rocky outcrop occurred within this portion, the vegetation of which consisted primarily of exotic weedy species. Due to the burned nature of this portion of the site a meaningful species list was not able to be compiled. Although this was the case, remnant vegetation included clumps of *Hyparrhenia hirta* which most probably formed the major component of the vegetation on the floodplain.

The remainder of the site which included the balance of the ridge system (as depicted in Figure 3) was primarily vegetated by stands of *Eucalyptus camaldulensis*. Therefore it is unlikely that ecological processes associated with ridge systems can fruitfully occur. This is due to the habitat and vegetation alteration that has occurred on the site. The images that follow depict the condition of this portion of the site at the time of the site visit.

Photo 1: Image taken looking towards the northeast of the site, the Jukskei River flows behind the photographer. Note the *Eucalyptus camaldulensis* trees in the background, these cover the remainder of the site.

Photo 2: Image taken standing on the top of the hillslope (suggested class 3 ridge) looking down towards the Jukskei River which forms the south western border of the site.

Photo 3: Image taken of the only rocky outcrop that formed a portion of the suggested class 3 ridge.

Rivers

The site is bordered by two ephemeral drainage lines and the perennial Jukskei River (Figure 3 & Figure 4). These important landscape features are also recognised as being of great importance with respect to landscape ecological processes. This is due to the connectivity that riparian systems share within a landscape mosaic, the habitat and 10
habitat microclimates that they provide and the nutrient cycling ability of rivers.

River floodplains are very important because if they are in a good ecological condition they will allow faunal species to utilise these areas as conduits for movement and genetic exchange, they will also reduce toxins, sediment and other dissolved pollutants from entering the river through root absorption as well as by trapping sediments. Thus they can be rated as very sensitive areas in any condition and should be safeguarded against development.

The vegetation occurring along the floodplain of the Jukskei River was open and in its unburned state must resemble anthropogenically modified grassland with *Hyparrhenia hirta* being the most dominant species present. Few if any tree species, including *Eucalyptus camaldulensis* (which is dominant over the balance of the site) were evident here.

The riparian vegetation zone was not very wide and consisted predominantly of large specimens of *Combretum erythrophyllum; Celtis africana; Rhus pyroides and Meytenus heterophylla*. Some exotic species also occupied the riparian zone and include *Salix babylonica and Melia azedarach* but these were not dominant and infestation was low. Please refer to the image below for an indication of the vegetation structure on the banks of the Jukskei at the time of the site visit.

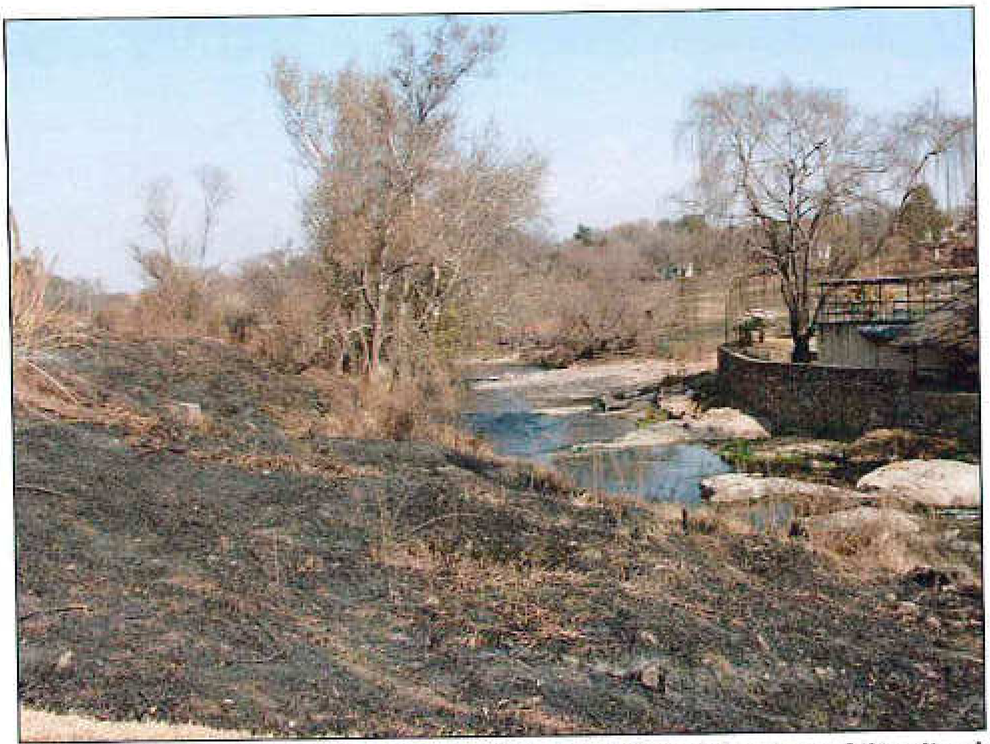

Photo 4: Image showing the state of the riparian vegetation at the time of the site visit.

The ephemeral streams that flow parallel to the south-eastern and north-western boundaries of the site are on areas not included within the realm of this site. They should however be considered in conjunction with this report as they are inextricably linked together by landscape processes. The ephemeral stream to the north-west of the site has however been hugely impacted upon by construction activity within the Erf forming the north-western neighbour of the site. Therefore it has possibly lost much of its important landscape ecological value. The ephemeral stream to the south-east of the site is still in good ecological condition and is known to contain a population of the **nationally Red Data *Metisella meninx (Marsh Sylph)***, it is thus important. Due to these ephemeral streams both being off the site in question the development will have little influence over these however, the buffer zones suggested by GDACE (300m[1]) around the population of this species will impact on this development and thus should be taken into consideration by the decision making authorities.

Flora

According to the Gauteng Department of Agriculture, Conservation, and Environment (GDACE) sensitivity classification C-Plan 2, most of the site is classified as an important site (GDACE, 2005) due to its proximity to the adjacent property which contains primary grasslands and numerous Red Data and protected plants.

[1] GDACE Aquatic Services Unit (2005) Gauteng Wetlands Guideline Document. Version 1.4 of 2005.

As this site in underlain by granite, Egoli granite grasslands originally may have occurred on the site. In pristine condition these are recognised to be of high conservation value by the authorities. Where, according to J. G. Bredenkamp *(pers comm.)* Egoli granite grasslands, in their pristine (i.e. non-disturbed through anthropogenic activities) state are dominated by *Trachypogon spicatus, Schizachyrium sanguinium, Panicum natalense* and occasionally *Loudetia simplex*. Pristine Egoli granite grasslands also have a rich and diverse layer of forbs. When these grasslands experience disturbance *Hyparrhenia hirta* becomes the dominant grass species. This tall bunch grass causes a lower forb diversity due to competition through over-shading. Once these grasslands have entered this secondary state it becomes near impossible to revert back to their original condition.

Although, the neighbouring farm to the south-east of the site may contain elements of this grassland, the site itself was evenly covered by stands of *Eucalyptus camaldulensis* which have either been planted there or have over a number of years gradually taken over the site (please refer to Figure 2). The vegetative structure of the site was largely as follows:

Structural :Layers	**Predominant vegetation**
Tree layer (2-10m)	Almost exclusively *Eucalyptus camaldulensis*
Grass layer (0-2m)	*Hyparrhenia hirta and Eragrostis spp*
Forb layer (0-2m)	Weedy species (mostly exotic)

Much of the vegetation in the 0-2m height interval was burned, thus it was impossible to be able to determine the full species composition of the site. However, clumps of moribund vegetation that managed to escape incineration were evident giving a clue as to the former physiology of the site.

From these moribund vegetation clumps and given the land use history of the site, it is deducted that it is very unlikely that any remnants of Egoli Granite Grasslands occur on the site. Furthermore, any forb species that may be remnant of the Egoli Granite Grassland assemblage are likely to have been shaded out and out-competed by the weed species on the site. It is also unlikely that any protected or Red Data plant species occupy the site for the same reasons.

A large central portion of the site was previously occupied by buildings and other infrastructure, these have now been demolished and are left as large piles of rubble on the site. A compost manufacturing concern is now also running from the site, this has implications for the botanical composition on site in that householders are, for a fee, invited to dump garden refuse on the site, in order to be composted. This has the effect of allowing many exotic domestic plant species onto the site which may root or seed over the site, further compromising the ecological integrity of the site.

Fauna

Due to the site being converted from its historical physiology, the mono-typical nature and structure of the site as well as its relationship to the increasingly urban environment that surrounds the site, the majority of species that utilise the site will be species that have a strong commensal relationship with humans or will be species that are catholic in their habitat requirements. Although having said this, some raptors may utilise the large *Eucalyptus* trees on the site to roost, and the extensive grassland to the east of the site to forage.

4.1.2 An Assessment of the Loss of Open Space on the Site Should the Proposed Development Proceed

Impact	Site	Extent	Duration	Intensity	Probability of occurrence	Significance		Confidence
						WOM*	WM*	
Loss of open space	Whole site	Local	Permanent	High	Definite	High	Medium	High

Open space will be lost on the site due to the development. However the loss of ecologically valuable open space can be acceptably reduced if certain mitigatory actions are implemented. Ecologically valuable open space, is open space in which ecological processes can continue due to the inclusion of valuable habitat that incorporates food plants, breeding habitat and other factors that contribute to the healthy interaction between abiotic and biotic factors within the environment.

The reduction of open space due to development is inevitable, thus the position should be one of how can the loss of ecologically valuable open space be mitigated. This is done by providing conditions of development that integrate ecologically valuable open space into the development plan of the site and should include consideration of those measures given in section 5 below.

4.1.3 An Assessment of How Migration Corridors Might Be Affected Should the Proposed Development Proceed

Impact	Site	Extent	Duration	Intensity	Probability of occurrence	Significance		Confidence
						WOM*	WM*	
Loss of migration corridors	River	Provincial	Permanent	High	Definite	High	Low	High

The loss of the ability for ecological processes to continue effectively is very real unless certain mitigatory actions are employed. Rivers and ridges are seen as particularly important open spaces as they primarily allow for the movement of faunal species between areas of natural habitat and often contain unique habitat, these are also often referred to as migration corridors. This is important to the continued conservation of species because it allows faunal species to react to external pressures (such as development) by migrating to areas that may be more suitable for its survival and persistence. If these corridors are blocked off, the migration of the faunal species will be impeded and the animal may no longer be able to sustain viable breeding populations.

5 DISCUSSION

Spatial patterns in the matrix of the urban infrastructure are very important in ensuring the continuation of faunal and floral species. It is no longer acceptable to look at each development in isolation from the next. Since the environment is a continuum and what happens to one geographical area impacts on all those surrounding it. Some of these impacts can be mitigated with wise planning and by keeping the following principals in mind.

5.1 Mitigatory measures suggested to reduce the impact of development on open spaces and corridor function

1. The attached sensitivity map (see Figure 4) **must** be used as a decision tool to guide the layout design of the proposed development. Development should be restricted to areas identified as being of low or medium ecological sensitivity and should incorporate the following mitigatory measures. Where areas on the site are rated as having a high ecological sensitivity, the development should not proceed into these areas and in fact improve on any ecological degradation that has occurred on these areas.
2. Construction activities should be carried out during the dry season (winter) when disturbance to faunal species will be minimal and the potential for erosion to occur as a result of rainfall events will be minimised,

3. An area of habitat of suitable size and incorporating all the sensitive habitats (i.e. rivers, river floodplain and rocky outcrop) on the site be set aside and managed as an urban open space, this area must have connectivity with adjacent natural open spaces. Public open spaces should be carefully integrated with natural open space keeping the following principals in mind:
   - Smaller, intervening patches of surviving habitat can also serve as "stepping stones" that link fragmented ecosystems by ensuring that certain ecological processes are maintained within and between groups of habitat fragments.
   - Create ecological corridors that contribute to the conservation of biodiversity by:
     - Supporting connections between remaining natural habitat
     - Supporting connections between large, intact areas of natural vegetation and adjacent open space systems to facilitate unrestricted dispersal and movement of biota,
     - Including a diverse array of natural habitats, including wetlands
     - Ensuring that landscaping is done with indigenous plant species,
     - Ensuring that barriers between properties are permeable to wildlife e.g. Palisade fencing,
     - Ensuring that road curbs and other such infrastructure are wildlife compatible e.g. easily crossed with road underpasses and or overpasses etc.
4. Existing degradation should be mitigated / rehabilitated, including the removal of rubble and litter of any kind;
5. An eradication and monitoring programme must be implemented to control current areas invaded by weeds and exotic plants and to prevent future invasions. Such an eradication programme should also include areas not directly affected by the proposed development and must provide for the implementation of a follow-up and monitoring programme;
6. A management plan must be compiled to provide landscaping guidelines that require that landscaping associated with the development include forage and host plants required by pollinators and other fauna;
7. All storm water management features should be constructed in a manner that will ensure the continued functioning of natural landscape, as any changes in surface water flow quality or quantity, has significant impacts of the surrounding vegetation that in turn affects associated animal groups. With this in mind the amount of hard surface on the site can be reduced by incorporating pervious paving that allows rainwater to infiltrate and percolate into the ground rather than running off;
8. No faunal species may unnecessarily be handled, killed, hunted or harassed during the construction period;

9. If any Red Data faunal species is found during the construction phase, this species must be relocated to the nearest conservation area of natural open space with suitable habitat for the particular species to continue its life history. This should be done with the full knowledge and approval of Gauteng Department of Agriculture, Conservation and Environment (GDACE), although in-situ (i.e. on site) conservation is preferred and may be required;
10. Road crossings over any drainage lines must be planned with the utmost care. Provision should be made for the continued undisrupted dispersal of fauna along any drainage lines;
11. Access to the site must be clearly demarcated, and to be used at low speed to avoid excessive dust and soil erosion, particularly during construction;
12. All construction activities should be limited to daylight hours, because most of the mammal species are nocturnal in behaviour; and
13. Littering or illegal disposal of construction waste must not be permitted

6 REFERENCES

Forman R. T. T. & Godron. M. (1986) *Landscape Ecology*. John Wiley and Sons, Inc., NY.

GDACE (2005) Conservation Plan (C-Plan), version 2, GIS Data.

GDACEL (2001) Development Guidelines for Ridges. Department of Agriculture, Conservation, Environment and Land Affairs.

Low A. B. & Rebelo T. G. (1996) *Vegetation of South Africa, Lesotho and Swaziland.* Dept. of Environmental Affairs and Tourism, Pretoria, Pretoria, South Africa.

Turner M. G., Gardner R. H. & R. V. O'Neill R. V. (2001) *Landscape Ecology in Theory and Practice.* Springer-Verlag, NY, USA.

7 LIST OF DEFINITIONS

Alien Species: Plant taxa in a given area, whose presence there, is due to intentional or accidental introduction as a result of human activity.

.Biodiversity: Biodiversity is the variability among living organisms from all sources including inter alia terrestrial, marine and other aquatic ecosystems and ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.

Biome: A major biotic unit consisting of plant and animal communities having similarities in form and environmental conditions, but not including the abiotic portion of the environment.

Climax: Species that are perennial plants under normal optimal conditions without experiencing any disturbance events. The ultimate stage of succession.

Conservation: The management of the biosphere so that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations. The wise use of natural resources to prevent loss of ecosystem function and integrity.

Critically Endangered: A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future.

Ecosystem: Organisms together with their abiotic environment, forming an interacting system, inhabiting an identifiable space.

Endangered: A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future.

Exotic Plant taxa in a given area, whose presence there, is due to intentional or accidental introduction as a result of human activity.

Environment: NEMA defines "environment" as "the surroundings within which humans exist and that are made up of the land, water and atmosphere of the earth; microorganisms, plant and animal life; any interrelationships among and between them and the physical, chemical aesthetic and cultural properties and conditions that influence human health and well-being".

Fauna: The animal life of a region.

Flora: The plant life of a region.

Forb: Herbaceous plant other that grasses.

Grassland: A natural vegetation formation type in which grasses and forb species are dominant.

Habitat: Type of environment in which a plant lives.

Indigenous: Any species of plant, shrub or tree that occurs naturally in South

Africa.

Invasive species: Naturalised alien plants that have the ability to reproduce, often in large numbers. Aggressive invaders can spread and invade large areas.

Medicinal: Used to prevent or cure illnesses and diseases.

Pioneer species: Hardened, annual plants, which can grow in very unfavourable conditions. Benefits of having these species include less run-off and more available moisture, cooler soil surfaces and less evaporation, protection against wind and build up of organic matter thereby increased enrichment of the soil.

Protected plant: According to the Transvaal Nature Conservation Ordinance of 1983 (No 12 of 1983), no one is allowed to sell, buy, transport, or remove this plant without a permit from the responsible authority.

Rare species: Species, which have naturally small populations, and species, which have been reduced to small (often unstable) populations by man's activities.

Threatened species: Species, which have naturally small populations, and species, which have been reduced to small (often unstable) populations by man's activities.

Red Data: A list of species, fauna and flora that require environmental protection. Based on the IUCN definitions.

Secondary: An early to mid successional stage in a plant community, usually disturbed.

Soil: A mixture of organic and inorganic substances, the composition and structure of the latter is derived from the parent rock material. Soil also contains bacteria, fungi, viruses and micro-arthropods, nematodes and worms.

Species diversity: A measure of the number and relative abundance of species (see biodiversity).

Species richness: The number of species in an area or habitat.

ANNEXURE E4:

FAUNAL ASSESSMENT

FAUNAL ASSESMENT ON THE REMAINING EXTENT OF PORTION 2 AND PART OF PORTION 88 (A PART OF PORTION 2) OF THE FARM BOTHASFONTEIN 408 JR, MIDRAND, GAUTENG
KYALAMI GARDENS EXT 27
(PREVIOUSLY KNOWN AS MUSHROOM FARM)

SEF Reference No. 503653

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S.E.F
STRATEGIC ENVIRONMENTAL FOCUS

October 2010

Declaration of Independence by Ecologist

I, Pieter I. Olivier, in my capacity as a specialist consultant, hereby declare that I -

- Act as an independent consultant;
- Do not have any financial interest in the undertaking of the activity, other than remuneration for the work performed in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- Have and will not have 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, to the competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- Will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not;
- As a registered member of the South African Council for Natural Scientific Professions, will undertake my profession in accordance with the Code of Conduct of the Council, as well as any other societies to which I am a member;
- Based on information provided to me by the project proponent, and in addition to information obtained during the course of this study, have presented the results and conclusion within the associated document to the best of my professional judgement; and
- Undertake to have my work peer reviewed on a regular basis by a competent specialist in the field of study for which I am registered.

Pieter I. Olivier
Candidate Professional Natural Scientist
Ecologist – Faunal Specialist
SACNASP Reg. No.: Pending

Date

EXECUTIVE SUMMARY

The proposed development ~~are~~ is located on a Portion of the Remainder of Portion 2 and on the Remaining Extent of Portion 88 of the farm Bothasfontein 408 JR, south west of Vorna Valley and on the southern side of Allandale Road. The site is currently vacant and derelict and is abutted by several other developments. The development is currently known as Kyalami Gardens Extension 27 (previously known as Mushroom Farm).

In July 2006, an ecological assessment for the site was undertaken by Strategic Environmental Focus. The historic ecological assessment indicated that the site was largely disturbed and that most of the vegetation was invaded by *Eucalyptus* trees. However, a faunal assessment has never been undertaken. Subsequently, this faunal assessment was undertaken on 13 October 2010, to assess the possible occurrence of species of conservation concern.

The terms of reference for this assessment were:

- Identification of the faunal habitat types on the site;
- Assess the possibility of the occurrence of Red Data species on site with specific reference to mammals associated with riverine habitats;
- Classification of the faunal sensitive areas of the site;
- Determine possible impacts associated with the proposed development; and
- Identify mitigation measures to limit impacts on the aquatic resources.

The site comprised of disturbed grassland, a small patch of Egoli Granite Grassland, Eucalyptus trees and a narrow riparian zone along the Jukskei River. The study site was highly disturbed, with illegal rubbish dumping and patches of Eucalyptus trees making up the majority of the available faunal habitat. The riparian zone was the area with the highest ecological sensitivity rating with suitable habitat for a number of common species (e.g. Cape Clawless Otter, Slender Mongoose) as well as potentially occurring Red List species (e.g. Water Rat). Information collected during the survey also indicated that a number of animals, specifically bushpigs, frequent the study site, possibly to forage here at night. These findings suggest that the riparian zone might act as a wildlife corridor through which animals and birds can disperse or move through to forage undetected from nearby areas. Therefore, a 32m buffer zone must be delineated from the edge of the riparian zone where no construction, dumping or erection of any structures should take place.

The study area does not have any fatal flaws that would influence the proposed development. The patch of Egoli Granite Grassland is most likely too small and isolated to provide suitable habitat where sub-populations of faunal species can persist. The secondary grassland, disturbed grassland and Eucalyptus patches can be considered for development as they have been impacted on by anthropogenic activities. However, the mitigation measures suggested in this report must be adhered to, to prevent further degradation of the study site.

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1. INTRODUCTION

1.1 Project Description

Erf 51 Melville CC proposes to establish a development of mixed use commercial and residential components. The ultimate philosophy advocated is one of a comprehensive and sustainable retail centre satisfying the shopping and business needs of the local community.

Strategic Environmental Focus (SEF), as independent environmental specialists have been appointed by Erf 51 Melville CC to undertake a faunal assessment of the site, and determine how the proposed development may impact upon the habitat, and the species themselves present on the site.

1.2 Terms of Reference

The terms of reference for the current study were as follows:

- Identification of the faunal habitat types on the site;
- Assess the possibility of the occurrence of Red Data species on site with specific reference to mammals associated with riverine habitats;
- Classification of the faunal sensitive areas of the site;
- Determine possible impacts associated with the proposed development; and
- Identify mitigation measures to limit impacts on the aquatic resources.

This report presents the findings obtained following an assessment of the fauna associated with the site of the proposed development. The field survey was conducted on the 14th of October 2010.

1.3 Assumptions and Limitations

The following assumptions and limitations have been applied for this assessment:

- In order to obtain a comprehensive understanding of the dynamics of faunal communities and the status of endemic, rare or threatened species in an area, ecological studies should ideally be replicated over several seasons and over a number of years. However, due to project time constraints, such long-term studies were not feasible.

1.4 List of Abbreviations

Table 1: Abbreviations used in the report

Abbreviation	Description
GDACE	Gauteng Department of Agriculture, Conservation and Environment
QDGS	Quarter Degree Grid Square

2. DESCRIPTION OF THE ENVIRONMENT

2.1 Location

The site is situated on the remaining extent of portion 2 and a part of portion 88 (a portion of portion 2) of the farm Bothasfontein 408 IR, Midrand, Gauteng. Allandale Road borders the site to the north-east and the Jukskei River forms the south-western border of the site (Figure 1).

2.2 Biophysical description

2.2.1 Geology and Soils

The site is underlain by migmatite and ultramafic rocks of the Halfway house granite formation. This Swazian Era geology is characterised by gneiss, migmatite and porphyritic granodiorite. The soils are predominantly brown/grey course sand and loam with a weak block structure.

2.2.2 Topography

The site forms part of the gently rolling hills of the central portion of Gauteng typical of the Midrand area. It has a southerly aspect and slopes towards the Jukskei River which forms the south-western border of the site, on the south-eastern boundary of the site is an ephemeral drainage line that flows into the perennial Jukskei system, and to the north-west is another ephemeral drainage line that also flows into the Jukskei. The majority of the site constitutes the higher ground between these two.

2.2.3 Climate

The area has a typical Highveld climate characterised by warm, wet summers and cool dry winters. The summer rainfall averages between 650 – 750 mm/yr and temperatures range from -12˚C to 39˚C with an average of 16˚C (Mucina & Rutherford, 2006).

2.2.4 Land use

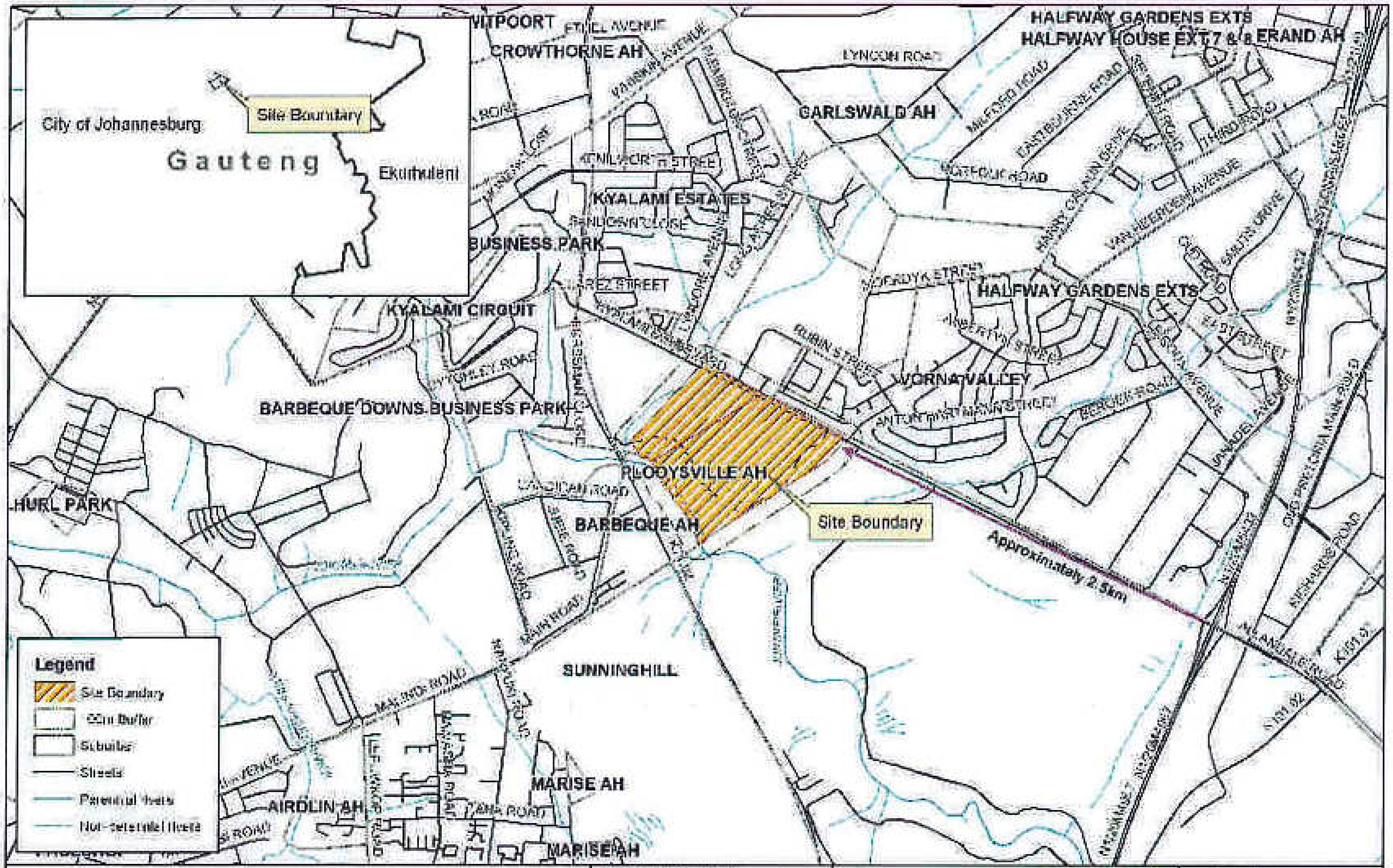
Currently the area is unoccupied with some portions of the site being used to dump garden refuse. A horse riding school used to occupy a small portion of the site, but the buildings have decayed into ruins. Eucalyptus forest patches are present throughout the site.

2.3 Regional vegetation

The study area falls into the regional classification of Egoli Granite Grassland (see Mucina & Rutherford, 2006).

2.4 Associated Water Courses

The perennial Jukskei River borders the western boundary of the study site. There is also a non-perennial 'spruit' that intersects with the northern boundary.



KYALAMI EXTENSION 27

LOCALITY MAP

Sources of Information:

1:30,000

900 450 0 900 m

S.E.F

3. RESULTS

3.1 Faunal Habitat Types

3.1.1 Riparian Vegetation

The western boundary of the site comprises the Jukskei River as well as an associated floodplain. The riparian vegetation zone was not very wide and consisted predominantly of large specimens of *Combretum erythrophyllum, Celtis africana, Searsia pyroides and Gymnosporia heterophylla*. In addition, some exotic species also occupied the riparian zone and included *Persicaria* species, *Rorippa nasturtium-aquaticum, Pennisetum clandestinum* (Kikuyu Grass), *Salix babylonica* and *Melia azedarach.*[1]

3.1.2 Egoli Granite Grassland

The majority of the site was primarily vegetated by stands of the declared weed *Eucalyptus camaldulensis*. In addition, vast areas were covered with illegal dumping and the remains of derelict buildings. The dominant grass in these areas was *Hyparrhenia hirta* (Thatch Grass) which is indicative of disturbed Egoli Granite Grassland. A small patch of undisturbed Egoli Granite Grassland was found in the north-eastern portion of the site, but it is most likely too small and isolated to provide any meaningful habitat for any faunal species sub-populations.[1]

Photographs: Faunal habitats on the study site: a) riparian vegetation along the Jukskei River and b) Egoli Granite Grassland surrounded by rubble and *Eucalyptus camaldulensis* (b).

[1] For a detailed habitat assessment please refer to the Vegetation Verification Report as well as the Wetland Delineation Report which was undertaken at the same time as this faunal assessment (SEF, 2010)

Photographs: Some of the animal signs encountered on the study site: a) burrows located in man made depression across the site and b) tracks found along the Jukskei River.

3.1 Mammals

The study was conducted with specific reference to determine the probability of occurrence of mammals associated with wetland and riverine habitats (GDACE, 2009).

3.2.1 Rough-haired Golden Mole *Chrysospalax villosus*

The Rough-haired Golden Mole is classified as Critically Endangered in South Africa. They occur in undisturbed grassland and have preference for dry, sandy ground on the fringes of marshes or vleis. They do not make surface runs like other golden moles, but excavate burrows, the entrances to which are characterised by loose piles of soil at the sides and back which are left open when they leave the burrows to forage. They live in chambers within their burrow systems from which they emerge only after rain. Tracks lead from the entrances to feeding areas, which are marked by the disturbance of the soil from rooting with the horny pad on their noses.

Likelihood of occurrence

Burrows were encountered throughout the study site. Burrows were also found in the sandy substrate adjacent the Jukskei River and within man-made depressions where rainwater and sewage water seemed to accumulate and drain over time. Disturbed, recently burnt grassland was mostly present on the study site and human disturbance in the form of rubbish dumping was evident everywhere. It is most likely that the burrows encountered were those of the Common Mole Rat (*Cryptomys hottentots*) that are known to be often associated with human habitation. The possibility of occurrence of the Rough-Haired Golden Mole can not totally be discarded - it is however highly unlikely to occur within the study area.

3.2.2 White-tailed Mouse *Mystromys albicaudatus*

The White-tailed Mouse is classified as Endangered in South Africa. In the eastern parts of the country their distribution follows the grassland biome very closely, but they are not necessarily confined to this (Skinner & Chimimba, 2005). They have been recorded in areas with dense grass and sandy soils, but also from rocky areas with good grass cover. Specimens have also been caught from short sparse grassland on a gentle stony slope (Taylor, 1998). They are nocturnal and terrestrial and live in burrows or cracks in the soil and have a well-documented swimming ability (Hickman & Machiné, 1986). Their diet includes insects, seeds and green vegetable matter (Skinner & Chimimba, 2005).

Likelihood of occurrence

The grassland found on site was patchily distributed, recently burnt and affected by human disturbances such as rubbish dumping. Vegetation along the river did provide suitable habitat such as rocks, trees, and holes in the river bank. However, no signs of nets were encountered here. It is highly unlikely that the white-tailed mouse would occur on the study site.

3.2.3 Spotted-necked Otter *Lutra maculicollis*

The Spotted-necked Otter is classified as Near-Threatened in South Africa. This aquatic species is confined to the larger rivers, lakes and swamps that have extensive areas of open water. They are confined more closely to this habitat than the African clawless otter and they do not undertake forays far from its margins. Perrin & D'Inzillo Carranza (2000) recorded habitats in descending order of use: impoundments and oxbow lakes (55%), rivers (40%), swamps (3%) and minor streams (2%). They are diurnal with activity peaks during the early morning and late afternoon. Resting places and dens are close to water, in dense vegetation cover, excavations under the roots of trees, holes under rock ledges, or holes occasionally excavated by the otters themselves where there is suitable alluvial soil (Rowe-Rowe, 1992).

Average home range size is 8.7km^2 for males, 3.4km for females and 6.0km2 overall. The mean lengths of rivers within home ranges are 14.8km (Perrin *et al.*, 2000). They establish latrines similar to those of African Clawless Otters *Aonyx capensis* and even sometimes found at the same site. Latrines are close to water and are usually in grass above river banks or lake shores, on earth ledges in river banks, on islands or on rocks. The faeces are dark brown fading to cream if containing mainly crab, or dark brown fading to light grey if consisting of mainly fish remains (Rowe-Rowe, 1992). Clear water seems to be associated with the species as they hunt only by sight. They feed mainly on fish and crabs supplemented by frogs and some aquatic insects (Skinner & Chimimba, 2005).

Likelihood of occurrence

The part of the Jukskei River that bordered the study site was relatively narrow and shallow. A scattering of trees, mainly willows, rocks and rubble were present along the river bank that might provide adequate habitat cover for spotted-necked otters. However, suitable fish species that might act as prey species for Spotted-necked Otters were generally absent (see SEF Aquatic assessment) and the water here was not particularly clear – an important habitat requisite for Spotted-necked Otters. The prevailing habitat conditions were thus not those usually associated with the occurrence of spotted-necked otters and it is highly unlikely that the species could be found on the study site.

Tracks found along the river bank and interviews with people that live on the site and use the river daily suggested that African Clawless Otters might occur in this part of the river, or could use the river here for foraging.

3.2.4 Highveld Golden Mole *Amblysomus septentrionalis*

The Highveld Golden Mole is classified as Near-Threatened in South Africa. They prefer grasslands and vleis in the Grassland biome above the eastern escarpment (Bronner, 1995). They are usually found in thickets of oldwood trees (*Leucosidae sericea*) near streams but they avoid scrubby vegetation in kloofs. They construct two-tier burrow systems, comprising deeper (15-30 cm) tunnels connecting grass-lined nests and subsurface tunnels used for foraging. Activity peaks at night and decreases after dawn, when individuals enter torpor until later afternoon (Skinner & Chimimba, 2005). Adults are solitary and feed on soil dwelling invertebrates, especially earth worms and pupae.

Likelihood of occurrence

The grassland on the site was probably not extensive enough to provide habitat for Highveld Golden Moles. In addition, there were no thickets of oldwood trees that are normally associated with highveld golden moles. It is therefore highly unlikely that they would occur on the study site.

3.2.5 African Marsh Rat *Dasymys incomtus*

The African Marsh Rat is classified as Near-Threatened in South Africa. They are associated throughout their wide distribution range with a wet habitat, where they occur in reed beds and among semi-aquatic grasses in swampy areas or along rivers and streams, and in grassy or bracken-covered areas close to water. They are predominantly crepuscular and nocturnal, but also diurnal. They swim well. They scatter grass and reed cuttings about their feeding areas. Nests are constructed in a depression on sloping ground bordering the swampy edge of a river. They are predominantly vegetarian, living on the succulent stems and fruiting heads of semi-aquatic grasses, reeds and other vegetation, but stomachs often contain insect remains (Skinner & Chimimba, 2005).

Likelihood of occurrence

The African Marsh Rat is an opportunistic species which has the ability to adapt to a variety of wet habitats. Although the river bank and the surrounding environment are subjected to varying degrees of disturbance, its presence can not be ruled out. The river bank could provide suitable roosting and foraging habitat for this species - irrespective of the current land uses being employed here.

3.2.6 Other mammal species observations

Confirmation of mammal species occurring on the study site was through direct sightings, indirect signs such as scat and track identification and interviews with people that lived on, or within the vicinity of the study site.

The Scrub Hare *Lepus saxatilis,* was the only mammal species that was directly observed during the survey. Slender Mongoose *Galerella sanguinea* and African Clawless Otter tracks were encountered along the river bank. Tracks made by some species of pig were also found close to the water. After conducting interviews with people who live on the study site, it was gathered that bushpigs *Potamochoerus porcus koiropotamus* are often encountered on the study site, and that it is most likely their tracks that were found during the survey. While it is unlikely that bushpigs are resident on the study site, they are known to move large distance at night to forage. The dumping that takes place on the site could possibly play a role in attracting them here from nearby areas such as the Rietfontein Ridge Nature Reserve.

Other species identified by the interviewees to occur on the study site includes: Springhares *Pedetes capensis,* Scrub Hares *Lepus saxatilis,* Suricates *Suricata`suricatta* and otters (most likely African Clawless Otters, see earlier discussion paragraph 4.2.3). A list of potential mammal species that could also possibly occur on the study site is presented in Appendix II.

3.3 Birds

It is highly unlikely that any bird species of conservation concern prioritized by GDACE occur on the study site. This assumption seems even more probable when taken into account that no bird species of conservation concern have, as off yet, been recorded in the nearby Beaulieu Bird Sanctuary. However, bird species of conservation concern that has been recorded in the QDGS and for which there were suitable habitats on the study site is discussed below.

3.3.1 Half-collard kingfisher *Alcedo semitorquata*

The Half-collard Kingfisher is considered Near-Threatened in South Africa. Recent decreases in the abundance of the species have been noted especially in Kwa-Zulu Natal and the Western Cape. The widespread degradation of clear fast flowing rivers fringed with riparian growth that comprise the habitat of the species by siltation, erosion, pollution, water extraction and the clearing of riparian vegetation are the most likely causes of the decline (Barnes, 2000).

Half-collard kingfishers prefer clear, fast-flowing perennial streams as well as rivers and estuaries that are narrow and secluded with dense marginal vegetation often near rapids (Hockey *et al.,* 2007). They are patchily distributed and are fairly uncommon even in prime habitat (Clancey, 1992). Their diet consists mainly of fish but also sometimes crabs and other aquatic insects.

Likelihood of occurrence

Half-collard Kingfishers are more likely to occur in areas where the river systems are managed for good water quality and where the infestation of alien trees is low. The study site does not comprise prime habitat for the species as a result of anthropogenic disturbances, pollution and a lack of fish species. However, alien plant infestation was minimal; there was generally good natural cover along the river banks as well as fast flowing water with small rapids. It is thus not inconceivably that Half-collard Kingfishers could potentially occur here. There could be an even greater possibility of occurrence if the river bank is rehabilitated and pollution reduced.

3.3.2 Other bird species

A comprehensive list of species that could potentially occur on the study site as well as their probability of occurrence is presented in Appendix III. Seventeen species were either seen or heard on the study site (see Table 2), none of which were species of conservation concern. Furthermore, no other species of conservation concern are expected to occur on the study site, even though such species have been recorded in the QDGS (see Appendix III).

Table 2: Bird species encountered on the study site (LC: Least Concern).

Spp. No	Species Name	Common Name	Conservation Status
63	*Ardea melanocephala*	Black Headed Heron	LC
93	*Plegadis falcinellus*	Glossy Ibis	LC
94	*Bostrychia hagedash*	Hadeda Ibis	LC
104	*Anas undulate*	Yellow-billed Duck	LC
203	*Numida meleagris*	Helmeted Guineafowl	LC
354	*Streptopelia capicola*	Cape Turtle Dove	LC
355	*Streptopelia senegalensis*	Laughing dove	LC
373	*Corythaixoides concolor*	Grey Go-Away Bird	LC
255	*Vanellus coronatus*	Crowned Lapwing	LC
258	*Vanellus armatus*	Blacksmith Lapwing	LC
424	*Colius striatus*	Speckled Mousebird	LC
438	*Merops apiaster*	European Bee-eater	LC
460	*Tockus alboterminatus*	African Grey Hornbill	LC
473	*Trachyphonus vailantii*	Crested Barbet	LC
526	*Hirundo spilodera*	Greater Striped Swallow	LC
568	*Pycnonotus tricolour*	Dark-capped Bulbul	LC

815	*Ploceus intermedius*	Southern Masked Weaver	LC

3.4 Herpetofauna

Reptiles and amphibians are generally shy and extremely sensitive to habitat destruction and transformation (Branch, 1998). A comprehensive herpetofauna species list specific to the study area could not be determined. However, it was considered for the reptile assemblages to have been altered considering the nature of the site and the amount of urban development surrounding the study area. Therefore, it was considered that common and cosmopolitan species (which do not have requirements for rocky terrain) could be present within the area. These include lizards and common snakes such as the Brown House *Lamprophis fuliginosus* and Mole snake *Pseudaspis cana*. During the survey, no reptile species were observed.

Amphibians are reliant on water bodies for their survival and are impacted on by environmental factors such as rainfall, temperature and humidity (Du Preez & Carruthers, 2009). The study area features a river as well as a narrow strip of riverine vegetation which could provide habitat for amphibian species. Suitable habitat for Giant Bullfrogs *Pyxicephalus adspersus* was not present within the study area.

3.5 Invertebrates

Common invertebrate species which are cosmopolitan were expected to be present within the study area. Such invertebrates include spiders, grasshoppers, crickets and flies which were observed during the assessment.

4. ECOLOGICAL SENSITIVITY: CONSERVATION IMPORTANCE AND ECOLOGICAL FUNCTION

4.1.1 Ecological Function and Sensitivity

The ecological function of a habitat type relates to the inherent resistance or resilience that a system can accommodate during perturbation periods. Therefore, highly sensitive systems will be unable to resist disturbance factors and are thus classified as sensitive. Secondly, it relates to the degree of ecological connectivity between systems within a landscape matrix. Therefore, systems with a high degree of landscape connectivity among each other are perceived to be more sensitive. Three categories were used to describe ecological function (sensitivity):

- High – Sensitive ecosystems with either low inherent resistance or resilience towards disturbance factors or highly dynamic systems considered being stable and important for the maintenance of ecosystem integrity. Most of these systems represent late successional ecosystems with high connectivity with other important ecological systems;

- Medium – These systems occur at disturbances of low-medium intensity and representative of secondary successional stages with some degree of connectivity with other ecological systems and

- Low – Degraded and highly disturbed systems with little ecological function.

4.1.2 High Ecological Sensitivity – Riparian vegetation

Wetlands and river systems are protected under the National Water Act 1998 [Act 36 of 1998] and are to be delineated by a 100m buffer zone from the edge of the riparian zone for rivers/streams outside the urban edge and a 32m buffer zone from the edge of the riparian zone for rivers and streams within the urban edge (GDACE, 2009). The buffer areas are considered sensitive as it forms part of the greater river system.

Buffer zones continue the hydrological, biological and socio-economic benefits to the wetland by maintaining wetland functions. Sediments and pollutants from surface water runoff as well as contaminants from upland sources can be removed or detained by the buffer zone. In addition, the buffer zone maintains aquatic, semi-aquatic and terrestrial habitats for faunal species and could serve as movement corridors and animal refugia.

The Jukskei River and its surrounding habitat were identified as having high ecological function and conservation importance since it was associated with activities of a number of faunal species. These included mole hills and burrows as well as possible habitat for African Marsh Rat and African Clawless Otters. It also creates a corridor of movement for faunal dispersal in the greater area as well as providing habitat for the roosting, foraging and breeding of a number of birds, and possible reptile and amphibian species.

4.1.3 Medium Ecological Importance – Egoli Granite Grassland

The small intact patch of Egoli Granite Grassland Grassland was recognized as having medium ecological function and conservation importance. The area contained various plant species associated with this habitat type which could provide suitable habitat for a number of faunal species. However, the small size and relative isolation of the patch suggest that this habitat would only be occupied temporary, and therefore unlikely to sustain a resident sub-population of any faunal species.

4.1.4 Low Ecological Importance – Disturbed Grassland and *Eucalyptus* patches

This habitat type was recognized as having low ecological function and conservation importance. It was highly degraded by anthropogenic activities and could only be considered marginal habitat for some common and opportunistic faunal species.

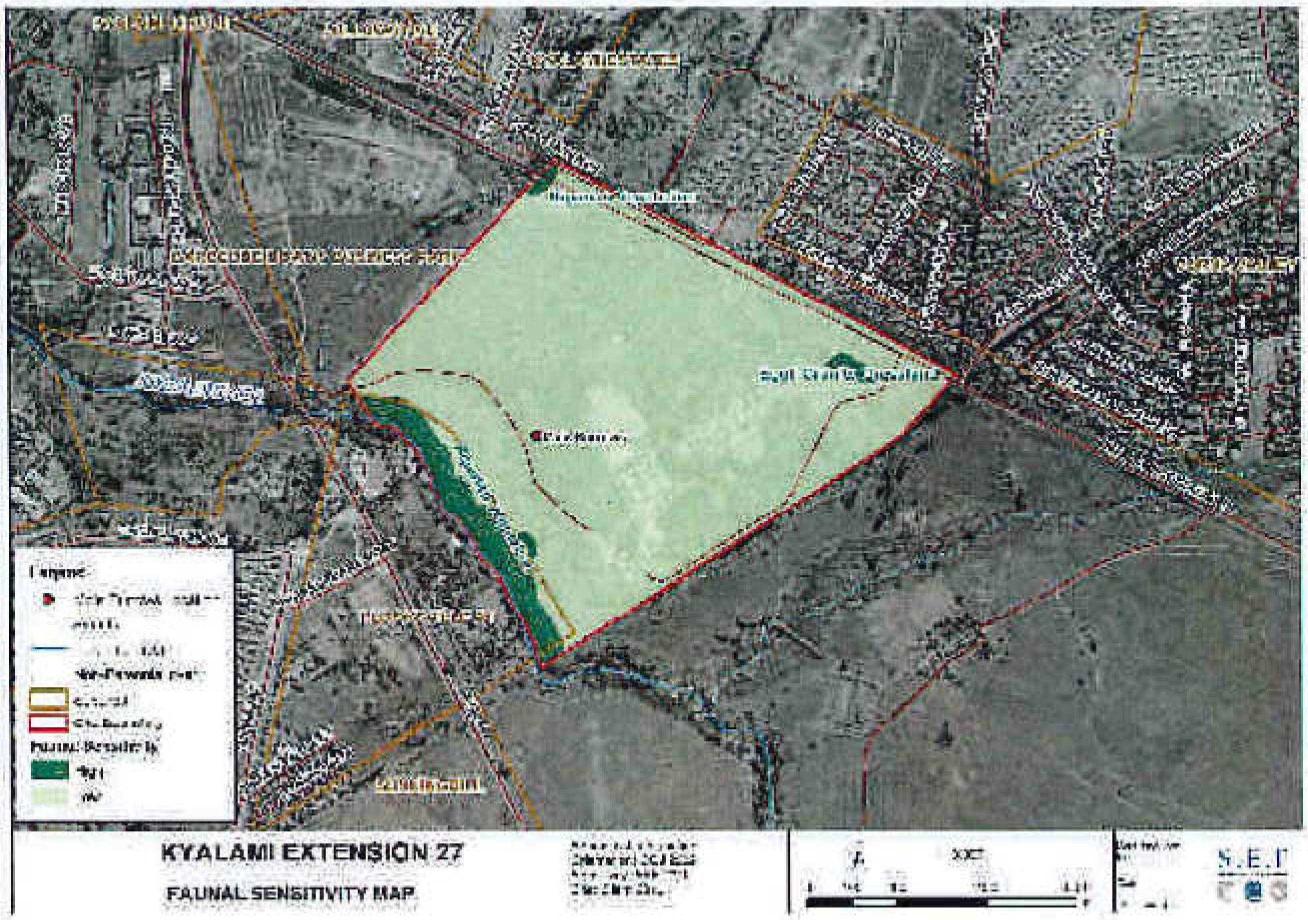


Figure 2: Faunal sensitivity map.

5. IMPACT ASSESMENT AND MITIGATION

Any development in a natural system will impact on the surrounding environment, usually in a negative way. The purpose of this phase of the project was therefore to identify and assess the significance of the impacts likely to arise during the construction and the operational phases of the project, and provide a short description of the mitigation required so as to limit the impact of the proposed development on the natural environment.

5.1 Assessment Criteria

The environmental impacts are assessed with mitigation measures (WMM) and without mitigation measures (WOMM) and the results presented in impact tables which summarise the assessment. Mitigation and management actions are also recommended with the aim of enhancing positive impacts and minimising negative impacts.

In order to assess these impacts, the proposed development has been divided into two project phases, namely the construction and operation phase. The criteria against which these activities were assessed are discussed below.

5.1.1 Nature of the Impact

This is an appraisal of the type of effect the project would have on the environment. This description includes what would be affected and how and whether the impact is expected to be positive or negative.

5.1.2 Extent of the Impact

A description of whether the impact will be local (extending only as far as the servitude), limited to the study area and its immediate surroundings, regional, or on a national scale.

5.1.3 Duration of the Impact

This provides an indication of whether the lifespan of the impact would be short term (0-5 years), medium term (6-10 years), long term (>10 years) or permanent.

5.1.4 Intensity

This indicates the degree to which the impact would change the conditions or quality of the environment. This was qualified as low, medium or high.

5.1.5 Probability of Occurrence

This describes the probability of the impact actually occurring. This is rated as improbable (low likelihood), probable (distinct possibility), highly probable (most likely) or definite (impact will occur regardless of any prevention measures).

5.1.6 Degree of Confidence

This describes the degree of confidence for the predicted impact based on the available information and level of knowledge and expertise. It has been divided into low, medium or high.

5.2 Impact Assessment

Possible impacts associated with the proposed development and their sources are provided in Table 3 (Construction phase) and Table 4 (Operation phase).

Table 3: Possible impacts arising during construction phase

Possible impact	Source of impact
Destruction of faunal habitat	Construction workers and activities
Prevention of wildlife dispersal	Construction activities
Increased erosion and deposition of sediments in the Jukskei River	Construction activities which result in bare soils
Loss of ecological function of the Jukskei river system	Construction activities

Table 4: Possible impacts arising during operation phase

Possible impact	Source of impact
Unsuitability of area as a corridor through which wildlife can disperse	Building structures and associated human activities
Contamination of sensitive areas	Chemicals and fertilisers used within open spaces
Increased stormwater runoff	Hard surfaces and structures

5.2.1 Construction Phase

5.2.1a Destruction of faunal habitat

Extent	Duration	Intensity	Probability of occurrence	Significance		Confidence
				WOMM	WMM	
Site	Permanent	Medium	Definite	High	Medium	High

Description of Impact

Faunal habitat of high and medium sensitivity on site includes areas along the Jukskei River and a small patch of Egoli Granite Grassland respectively. Although anthropogenic impacts on these areas have been high, they still contribute towards ecosystem functioning as well as providing habitats for species to occur or to use to disperse through towards other more suitable habitats. Construction activities will have an impact on the habitats within the study area with high confidence of destruction occurring. However, with the appropriate mitigation measures, this impact can be considered to be of medium significance.

Mitigation Measures:

- The Jukskei River system is to be delimited by a 32m buffer from the edge of the riparian zone to the construction activity. The 32m buffer zone is considered sensitive as it forms part of the greater river system and no construction activities should take place here.
- The edge of the watercourse must be clearly demarcated in the field with pegs or poles that will last for the duration of the construction phase, colour coded as follows:
    - RED – Indicating the edge of the riparian zone (these should be placed along the entire length of the site
    - ORANGE – Indicating the edge of the buffer zone (32m)
    - Construction or any construction activities within the buffer zone should be avoided.
- Faunal species located on site should be moved in an ecologically sensitive manner to an appropriate area. The relocation of faunal species found on site should be discussed with a faunal specialist;
- A comprehensive surface runoff and stormwater management plan should be compiled, indicating how all surface runoff generated as a result of the development (during both the construction and operational phases) will be managed; and
- An Environmental Management Plan must be implemented with the aid of an Environmental Control Officer to ensure mitigation measures are implemented.

5.2.1b Prevention of wildlife dispersal

Extent	Duration	Intensity	Probability of occurrence	Significance		Confidence
				WOMM	WMM	
Site	Permanent	Medium	Definite	High	Low	High

Description of impact

Several faunal species possibly use the area, and specifically the river system, as a corridor through which to disperse and forage. Beaulieu Bird Sanctuary and Rietfontein Ridge Nature Reserve are located 2.5km North West and 4.3km South West off the study site respectively and could act as sources from which animals disperse. Construction activities will have an impact on animal movements - however suitable mitigation measures may limit the impact.

Mitigation Measure:

- A 32m buffer zone should be designated from the edge of the riparian zone. Buffer zones are essential to ensure healthy functioning and maintenance of aquatic ecosystems and also function as wildlife corridors and refugia. The riparian zone along the river act as the main route of dispersal for most animals that occur on and around the study site. The protection of the riparian zone should therefore preserve continual animal movements.

5.2.1c Increased erosion and deposition of sediments in watercourses

Extent	Duration	Intensity	Probability of occurrence	Significance		Confidence
				WOMM	WMM	
Site	Medium	High	Definite	High	Medium	High

Description of Impact

During the construction phase, vegetation will be periodically removed. Consequently, the soil surface will be prone to erosion as a result of exposure to rainfall and high winds which can cause mechanical erosion. Sediments and rubbish dumped on the site could be washed into the Jukskei River and affect faunal habitat and ecological processes here.

Mitigation Measure:

- The removal of vegetation should be phased to occur during the non-rainy season, reducing the opportunities for erosion to occur from rainfall events;
- Areas where erosion is likely to occur should be stabilised effectively;

- Soil surfaces should not be left open to erosion for lengthy time periods;
- Hard, paved surfaces should be kept to a minimum; and
- An ecologically sensitive stormwater management plan should be designed and implemented.

5.2.1d Loss of ecological function in the Jukskei River

Extent	Duration	Intensity	Probability of occurrence	Significance		Confidence
				WOMM	WMM	
Site	Permanent	High	Probable	High	Low	High

Description of Impact

During construction, the possibility exists for the landscape to be altered. This may affect hydrological regimes which could impact on the functionality of the river system and its ability to provide habitat for faunal species. In addition, construction activities could degrade or damage the hydrophilic vegetation which will result in similar consequences.

Mitigation Measures:

- The 32m buffer zone should remain undisturbed and the boundary clearly marked so that no construction or dumping takes place within this area;
- Areas close to the riparian buffer zone which have been impacted on by construction activities should be rehabilitated; and
- Construction activities on the site must be managed by an Environmental Management Plan.

5.2.2 Operational Phase

5.2.2a Unsuitability of area as a corridor through which wildlife can disperse

Extent	Duration	Intensity	Probability of occurrence	Significance		Confidence
				WOMM	WMM	
Site	Permanent	Medium	Definite	High	Low	High

Description of impact

During the operational phase the site could be altered in such a way to prevent i) functioning of the aquatic ecosystem, ii) any future animal dispersal. Human activities usually have a negative impact on animal occurrence and movements, but the implementation of appropriate mitigation measures it may lessen future impacts.

Mitigation measures:

- The Jukskei River system is to be delimited by a 32m buffer from the edge of the riparian zone to the construction site. The 32m buffer zone is considered sensitive as it forms part of the greater river system and no construction or operation phase activities should take place here; and
- Care should be taken to prevent illegal dumping of garden rubbish and construction materials in the buffer zone.

5.2.2b Contamination of sensitive areas

Extent	Duration	Intensity	Probability of occurrence	Significance		Confidence
				WOMM	WMM	
Regional	Long Term / Permanent	Medium	Probable	Medium	Low	Medium

Description of Impact

Garden fertilizers, other chemicals and rubbish dumped on the site could be washed into the watercourses and impact on water quality and river system functionality. Such activities could result in habitat destruction, as well as high mortality rates for some species. These factors will result in the disappearance of most faunal species from the study site.

Mitigation Measures:

- The use of chemicals and fertilizers should be kept to a minimum;
- Residents should be discouraged from dumping garden and other waste materials into the river system; and
- The environmental management plan should contain guidelines for safe and appropriate waste disposal actions from residents and business owners in the development.

5.2.2c Increased stormwater runoff

Extent	Duration	Intensity	Probability of occurrence	Significance		Confidence
				WOMM	WMM	
Site	Short / medium term	High	Definite	High	Medium	High

Description of Impact

The construction may result in the removal of vegetation and an increase in hard surfaces, which will result in more stormwater runoff into the watercourses. This will alter hydrological flow and impact on faunal habitat.

Mitigation Measure:

- Where possible, natural vegetation should be maintained or re-instated during the construction phase. Hard, impermeable surfaces should be avoided; and

- An ecologically sound stormwater management plan should be implemented and maintained.

6. CONCLUSION AND RECOMMENDATION

The site comprised of disturbed grassland, a small patch of Egoli Granite Grassland, *Eucalyptus* trees and a narrow riparian zone along the Jukskei River. The study site was highly disturbed, with illegal rubbish dumping and patches of *Eucalyptus* trees making up the majority of the available faunal habitat. The riparian zone was the area with the highest ecological sensitivity rating with suitable habitat for a number of common species (e.g. African Clawless Otter, Slender Mongoose) as well as potentially occurring Red List species (e.g. African Marsh Rat). Information collected during the survey also indicated that a number of animals, specifically bush pigs, frequent the study site, possibly to forage here at night. These findings suggest that the riparian zone might act as a wildlife corridor through which animals and birds can disperse or move through to forage undetected from nearby areas. Therefore, a 32m buffer zone must be delineated from the edge of the riparian zone where no construction, dumping or erection of any structures should take place.

From a faunal perspective, the study area does not have any fatal flaws that would influence the proposed development. The patch of Egoli Granite Grassland is most likely too small and isolated to provide suitable habitat where sub-populations of faunal species can persists. The secondary grassland, disturbed grassland and Eucalyptus patches can be considered for development as they have been impacted on by anthropogenic sources. However, the mitigation measures suggested in this report must be adhered to, in order to prevent further degradation of the study site.

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9. GLOSSARY OF TERMS

Alien species	Taxa in a given area, whose presence there, is due to the intentional or accidental introduction as a result of human activity.
Biodiversity	Biodiversity is the variability among living organisms from all sources including inter alia terrestrial, marine and other aquatic ecosystems and ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.
Biome	A major biotic unit consisting of plant and animal communities having similarities in form and environmental conditions, but not including the abiotic portion of the environment.
Buffer zone	A collar of land that filters edge effects.
Conservation	The management of the biosphere so that it may yield the greatest sustainable benefit to present generation while maintaining its potential to meet the needs and aspirations of future generations. The wise use of natural resources to prevent loss of ecosystems function and integrity. Critically Endangered A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future.
Ecosystem	Organisms together with their abiotic environment, forming an interacting system, inhabiting an identifiable space.
Ecological Corridors	Corridors are roadways of natural habitat providing connectivity of various patches of native habitats along or through which faunal species may travel without any obstructions where other solutions are not feasible.
Endangered	A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future.
Exotic species	Plant taxa in a given area, whose presence there, is due to the intentional or accidental introduction as a result of human activity.
Fauna	The animal life of a region.
Flora	The plant life of a region.
Habitat	Type of environment in which plants and animals live.
Indigenous	Any species of plant, shrub or tree that occurs naturally in South Africa.
Invasive species	Naturalised alien plants that have the ability to reproduce, often in large numbers. Aggressive invaders can spread and invade large areas.
Primary vegetation	Vegetation state before any disturbances such as cultivation, overgrazing or soil removal
Protected plant	According to the Transvaal Nature Conservation Ordinance of 1983 (No 12 of 1983), no one is allowed to sell, buy, transport, or remove this plant without a permit from the responsible authority.
Threatened	Species that have naturally small populations, and species which have been reduced to small (often unsustainable) population by man's activities.
Red Data	A list of species, fauna and flora that require environmental protection. Based on the IUCN definitions.

Species diversity	A measure of the number and relative abundance of species.
Species richness	The number of species in an area or habitat.
Vulnerable	A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future.

10. APPENDICES

Appendix I	Methodology
Appendix II	Mammal species that occur and that could potentially occur on the study site
Appendix III	Bird species that occur and that could potentially occur on the study site

Appendix I: Methodology

1. Desktop Surveys

1.1 Mammals and Herpetofauna

The majority of mammals, reptiles and amphibians that occur within close proximity to humans and their activities are nocturnal by nature; therefore the presence of suitable habitat (a habitat assessment) was used to determine the probability of occurrence of these species through various field guides and atlases.

The probability of occurrence of mammal, reptile and amphibian species was based on their respective geographical area of occupancy and habitat suitability. High probability of occurrence would be applicable to a species with an area of occupancy within the geographic locality of the study site as well as the presence of suitable habitat occurring in the study site. Medium probability of occurrence refers to species whose area of occupancy is marginal to the study site or its habitat is found to be within the surroundings of the study area. Lastly, a low probability of occurrence will indicate that the species' occupy an area surrounding the study area and that unsuitable habitat exists on site.

1.2 Birds

Bird species expected to occur on the study site were informed through data of the South African Bird Atlas 1 & 2 (http:\\sabap2.adu.org.za). The BIRP (Birds in Reserve Project http://birp.adu.org.za) database was also used to obtain a list of bird species that occur in the Beaulieu Bird Sanctuary located 2.5km North-west of the study site.

The probability of birds occupying the study site was estimated for all observed and expected species according to the following:

- High probability of occurrence - >50% chance of occurrence;
- Medium probability of occurrence - 10 - 50% chance of occurrence; and
- Low probability of occurrence - <10% chance of occurrence;

2 Field Surveys

During the survey period, specific areas of habitat structure were selected and surveyed for specific taxonomic groups according to the methodology described below:

2.1 Mammals

Random transect walks were done whereby mammal species were identified by visual sightings as well as by means of spoor, droppings and roosting sights. Only diurnal searches were carried out. In addition, local people that lived on the site were questioned about the presence and occurrence of certain mammal species on the study site. Identification of mammal species was carried out by using Stuart and Stuart (2001) and Skinner and Chimimba (2005).

2.2 Birds

Bird species were identified and verified using Sinclair & Hockey (2005). Identifications were supplemented using other means such as calls, feathers, roosting sites, nests and droppings

2.3 Herpetofauna

Possible burrows or reptile habitats (rocks and stumps) were inspected for inhabitants. Reptiles were identified using Branch (1998). Amphibians were identified through likely habitat types (water features or drainage lines) using Du Preez & Carruthers (2009).

2.4 Invertebrates

Random searches were carried to determine the presence of any invertebrates of conservation concern on the study site.

Appendix II: Mammal species that occur and that could potentially occur on the study site. Conservation status: E – Endangered, V – Vulnerable, NT – Near Threatened, LC – Least Concern, DD – Data Deficient).

Scientific Name	Common Name	Conservation Status	Habitat	Presence determined on site by:
LAGAMORPHA				
Lepus saxatilis	Scrub Hare	LC	Savanna, grassland, desert	Direct sighting
INSECTIVORA				
Crocidura cyanea	Reddish-grey Musk Shrew	DD	All latitudes, broad habitat tolerance	Suitable habitat
Crocidura hirta	Lesser Red Musk Shrew	DD	All latitudes, broad habitat tolerance	Suitable habitat
RODENTIA				
Cryptomys hottentotus	Common Mole-rat	LC	Wide variety	Burrows encountered
Mastomys coucha	Multimammate Mouse	LC	Wide variety	Suitable habitat
Mastomys natalensis	Natal Multimammate Mouse	LC	Cosmopolitan	Suitable habitat
Pedetes capensis	Springhare	LC	Savanna, Desert, Grassland, Wide variety	Suitable habitat, reports of presence
Steatomys krebsii	Krebs' Fat Mouse	LC	Wide variety	Suitable habitat
Thryonomys swinderianus	Greater Cane Rat	LC	Moist swampy areas and reed beds, seldom found far from water	Suitable habitat
CARNIVORA				

Scientific Name	Common Name	Conservation Status	Habitat	Presence determined on site by:
Aonyx capensis	Cape Clawless Otter	LC	Permanent rivers/streams/creeks, rocky shores, estuarine waters, coastal freshwater lagoons, ponds, wastewater treatment areas, canals drainage chanals and ditches	Tracks, reports of presence
Atilax paludinosus	Water Mongoose	LC	Permanent freshwater lakes, seasonal freshwater marshes and pools, rivers, streams, creeks, wetlands	Suitable habitat
Galerella sanguinea	Slender Mongoose	LC	Savanna, grassland, desert, urban areas	Suitable habitat
Genetta genetta	Small-spotted Genet	LC	Savanna, shrubland, desert, rural gardens, urban areas	Suitable habitat
Suricata`suricatta	Suricate	LC	Savanna, shrubland, grassland, desert	Suitable habitat, reports of presence
ARTIOTACTYLA				
Potamochoerus porcus koiropotamus	Bushpig	LC	Rooting omnivorous opportunist	Tracks, reports of presence
Sylvicapra grimmia	Common Duiker	LC	Broad habitat tolerance	Suitable habitat

Appendix III: Bird species occurring in the Midrand area (QDGS JOHANNESBURG 2628AA). Species in bold have been recorded in the nearby Beaulieu Bird Sanctuary. Conservation Status: (E – Endangered, V – Vulnerable, NT – Near Threatened). Endemic status: (E – South African endemic species, NE – Near endemic species).

Species Code	Scientific Name	Common Name	Conservation Status	Endemic Status
6	*Podiceps cristatus*	Great Crested Grebe		
7	***Podiceps nigricollis***	**Black-necked Grebe**		
8	***Tachybaptus ruficollis***	**Little Grebe**		
55	***Phalacrocorax lucidus***	**White-breasted Cormorant**		
58	***Phalacrocorax africanus***	**Reed Cormorant**		
60	***Anhinga rufa***	**African Darter**		
62	***Ardea cinerea***	**Grey Heron**		
63	***Ardea melanocephala***	**Black-headed Heron**		
64	***Ardea goliath***	**Goliath Heron**		
65	***Ardea purpurea***	**Purple Heron**		
66	*Egretta alba*	Great Egret		
67	***Egretta garzetta***	**Little Egret**		
68	***Egretta intermedia***	**Yellow-billed Egret**		
69	*Egretta ardesiaca*	Black Heron		
71	***Bubulcus ibis***	**Cattle Egret**		
72	***Ardeola ralloides***	**Squacco Heron**		
74	***Butorides striata***	**Green-backed Heron**		
76	***Nycticorax nycticorax***	**Black-crowned Night Heron**		
78	*Ixobrychus minutes*	Little Bittern		
81	***Scopus umbretta***	**Hamerkop**		
83	*Ciconia ciconia*	White Stork		
84	*Ciconia nigra*	Black Stork	NT	
85	*Ciconia abdimii*	Abdim's Stork		
88	*Ephippiorhynchus senegalensis*	Saddle-billed Stork	EN	
89	*Leptoptilos crumeniferus*	Marabou Stork	NT	
90	*Mycteria ibis*	Yellow-billed Stork	NT	
91	***Threskiornis aethiopicus***	**African Sacred Ibis**		
93	***Plegadis falcinellus***	**Glossy Ibis**		
94	***Bostrychia hagedash***	**Hadeda Ibis**		
95	***Platalea alba***	**African Spoonbill**		
96	*Phoenicopterus rubber*	Greater Flamingo	NT	
97	*Phoenicopterus minor*	Lesser Flamingo	NT	
99	***Dendrocygna viduata***	**White-faced Duck**		
100	***Dendrocgna bicolour***	**Fulvous Duck**		

101	***Thalassornis leuconotus***	**White-backed Duck**		
102	***Alopochen aegyptiacus***	**Egyptian Goose**		
103	***Tadorna cana***	**South African Shelduck**		
104	***Anas undulate***	**Yellow-billed Duck**		
105	***Anas sparsa***	**African Black Duck**		
106	*Anas capensis*	Cape Teal		
107	*Anas hottentota*	Hottentot Teal		
108	***Anas erythrorhyncha***	**Red-billed Teal**		
112	***Anas smithii***	**Cape Shoveler**		
113	***Netta erythrophthalma***	**Southern Pochard**		
115	*Sarkidiornis melanotos*	Comb Duck		
116	***Plectropterus gambensis***	**Spur-winged Goose**		
117	*Oxyura maccoa*	Maccoa Duck		
118	*Sagittarius serpentarius*	Secretarybird	NT	
122	*Gyps coprotheres*	Cape Vulture	VU	
127	***Elanus caeruleus***	**Black-shouldered Kite**		
128	*Aviceda cuculoides*	African Cuckoo Hawk		
131	*Aquila verreauxii*	Verreaux's Eagle		
135	*Aquila wahlbergi*	Wahlberg's Eagle		
136	*Aquila pennatus*	Booted Eagle		
138	*Aquila ayresii*	Ayres Hawk-Eagle	NT	
139	*Lophaetus occipitalis*	Long-crested Eagle		
140	*Polemaetus bellicosus*	Martial Eagle	VU	
142	*Circaetus cinereus*	Brown Snake Eagle		
143	*Circaetus pectoralis*	Black-chested Snake Eagle		
148	***Haliaeetus vocifer***	**African Fish Eagle**		
149	***Buteo vulpinus***	**Steppe Buzzard**		
152	*Buteo rufofuscus*	Jackal Buzzard		
154	*Kaupifalco monogrammicus*	Lizard Buzzard		
156	***Accipter ovampensis***	**Ovambo Sparrowhawk**		
157	***Accipter minullus***	**Little Sparrowhawk**		
158	***Accipter melanoleucus***	**Black Sparrowhawk**		
159	***Accipter badius***	**Shikra**		
161	*Melierax gabar*	Gabar Goshawk		
165	*Circus ranivorus*	African Marsh-Harrier	VU	
172	*Falco biarmicus*	Lanner Falcon	NT	
173	*Falco subbuteo*	Eurasian Hobby		
179	*Falco vespertinus*	Red-footed Falcon		
180	*Falco amurensis*	Amur Falcon		
181	*Falco rupicolis*	Rock Kestrel		

182	*Falco rupicoloides*	Greater Kestrel		
183	*Falco naumanni*	Lesser Kestrel	VU	
188	*Peliperdix coqui*	Coqui Francolin		
192	*Scleroptila levaillantii*	Red-winged Francolin		
193	*Scleroptila levaillantoides*	Orange River Francolin		
199	***Pternistis swainsonii***	**Swainson's Spurfowl**		
200	*Coturnix coturnix*	Common Quail		
203	***Numida meleagris***	**Helmeted Guineafowl**		
205	*Turnix sylvaticus*	Kurrichane Buttonquail		
208	*Anthropoides paradiseus*	Blue Crane	VU	
210	***Rallus caerulescens***	**African Rail**		
211	*Crex crex*	Corn Crake	VU	
212	*Crecopsis egregia*	African Crake		
213	*Amaurornis flavirostris*	Black Crake		
217	*Sarothrura rufa*	Red-chested Flufftail		
223	*Porphyrio madagascariensis*	African Purple Swamphen		
226	***Gallinula chloropus***	**Common Moorhen**		
228	***Fulica cristata***	**Red-knobbed Coot**		
233	*Eupodotis barrowii*	White-bellied Korhaan	VU	
239	*Afrotis afraoides*	Black Korhaan		
240	*Actophilornis africanus*	African Jacana		
242	*Rostratula benghalensis*	Greater Painted-snipe	NT	
245	*Charadrius hiaticula*	Common Ringed Plover		
248	*Charadrius pecuarius*	Kittlitz's Plover		
249	***Charadrius tricollaris***	**Three-banded Plover**		
255	***Vanellus coronatus***	**Crowned Lapwing**		
258	***Vanellus armatus***	**Blacksmith Lapwing**		
260	***Vanellus senegallus***	**African Wattled Lapwing**		
264	*Actitis hypoleucos*	Common Sandpiper		
266	***Tringa glareola***	**Wood Sandpiper**		
269	*Tringa stagnatilis*	Marsh Sandpiper		
270	***Tringa nebularia***	**Common Greenshank**		
272	*Calidris ferruginea*	Curlew Sandpiper		
274	*Calidris minuta*	Little Stint		
284	*Philomachus pugnax*	Ruff		
286	*Gallinago nigripennis*	African Snipe		
287	*Limosa lapponica*	Black-tailed Godwit		
288	*Limosa lapponica*	Bar-tailed Godwit		
291	*Phalaropus lobatus*	Red Phalarope		
294	*Recurvirostra avosetta*	Pied Avocet		

295	*Himantopus himantopus*	Black-winged Stilt		
297	***Burhinus capensis***	**Spotted Thick-knee**		
300	*Cursorius temminckii*	Temminck's Courser		
305	*Glareola nordmanni*	Black-winged Prantincole	NT	
313	*Larus fuscus*	Lesser Blackbacked Gull		
315	***Larus cirrocephalus***	**Grey-headed Gull**		
317	*Larus pipixan*	Franklin's Gull		
338	*Chlidonias hybrida*	Whiskered Tern		
339	*Chlidonias leucopterus*	White-winged Tern		
348	***Columba livia***	**Rock Dove**		
349	***Columba guinea***	**Speckled Pigeon**		
350	***Columba arquatrix***	**African Olive Pigeon**		
352	***Streptopelia semitorquata***	**Red-eyed Dove**		
354	***Streptopelia capicola***	**Cape Turtle-Dove**		
355	***Streptopelia senegalensis***	**Laughing Dove**		
356	*Oena capensis*	Namaqua Dove		
366	*Psittacula krameri*	Rose-ringed Parakeet		
373	***Corythaixoides concolor***	**Grey Go-away-bird**		
374	*Cuculus canorus*	Common Cuckoo		
375	*Cuculus gularis*	African Cuckoo		
377	***Cuculus solitarius***	**Red-chested Cuckoo**		
378	*Cuculus clamosus*	Black Cuckoo		
382	*Oxylophus jacobinus*	Jacobin Cuckoo		
385	*Chrysococcyx klaas*	Klaas's Cuckoo		
386	***Chrysococcyx caprius***	**Diderick Cuckoo**		
391	*Centropus burchelli*	Burchell's Coucal		
392	***Tyto alba***	**Barn Owl**		
393	*Tyto capensis*	African Grass Owl	VU	
395	***Asio capensis***	**Marsh Owl**		
396	*Otus senegalensis*	African Scops-Owl		
397	*Ptilopsis granti*	Southern White-faced Owl		
401	*Bubo africanus*	Spotted Eagle-Owl		
402	*Bubo lacteus*	Verreaux's Eagle Owl		
404	*Caprimulgus europaeus*	European Nightjar		
405	*Caprimulgus pectoralis*	Fiery-necked Nightjar		
406	*Caprimulgus rufigena*	Rufous-cheeked Nightjar		
408	*Caprimulgus tristigma*	Freckled Nightjar		
411	*Apus apus*	Common Swift		
412	*Apus barbatus*	African Black Swift		
415	***Apus caffer***	**White-rumped Swift**		

416	*Apus hours*	Horus Swift		
417	***Apus affinis***	**Little Swift**		
418	*Tachymarptis melba*	Alpine Swift		
421	***Cypsiurus parvus***	**African Palm-Swift**		
424	***Colius striatus***	**Speckled Mousebird**		
425	*Colius colius*	White-backed Mousebird		
426	***Urocolius indicus***	**Red-faced Mousebird**		
428	***Ceryle rudis***	**Pied Kingfisher**		
429	***Megaceryle maximus***	**Giant Kingfisher**		
430	*Alcedo semitorquata*	Half-collard Kingfisher	NT	
431	***Alcedo cristata***	**Malachite Kingfisher**		
433	*Halcyon senegalensis*	Woodland Kingfisher		
435	***Halcyon albiventris***	**Brown-hooded Kingfisher**		
438	***Merops apiaster***	**European Bee-eater**		
440	*Merops persicus*	Blue-cheeked Bee-eater		
443	*Merops bullockoides*	White-fronted Bee-eater		
444	*Merops pusillus*	Little Bee-eater		
446	*Coracias garrulous*	European Roller		
447	*Coracias caudatus*	Lilac-breasted Roller		
449	*Coracias naevius*	Purple Roller		
451	***Upupa Africana***	**African Hoopoe**		
452	***Phoeniculus purpureus***	**Green Wood-Hoopoe**		
454	*Rhinopomastus cyanomelas*	Common Scimitarbill		
457	*Tockus nasutus*	African Grey Hornbill		
459	*Tockus leucomelas*	Southern Yellow-billed Hornbill		
464	***Lybius torquatus***	**Black-collared Barbet**		
465	*Tricholaema leucomelas*	Acacia Pied Barbet		
473	***Trachyphonus vaillantii***	**Crested Barbet**		
474	***Indicator indicator***	**Greater Honeyguide**		
476	***Indicator minor***	**Lesser Honeyguide**		
478	*Prodotiscus regulus*	Brown-backed Honeybird		
483	*Campethera abingoni*	Golden-tailed Woodpecker		
486	*Dendropicos fuscescens*	Cardinal Woodpecker		
487	*Dendropicos namaquus*	Bearded Woodpecker		
489	***Jynx ruficollis***	**Red-throated Wryneck**		
492	*Mirafra cheniana*	Melodious Lark	NT	
494	***Mirafra Africana***	**Rufous-naped Lark**		
498	*Calendulauda sabota*	Sabota Lark		
506	*Chersomanes albofasciata*	Spike-heeled Lark		
507	*Calandrella cinerea*	Red-capped Lark		

508	*Spizocorys conirostris*	Pink-billed Lark		
515	*Eremopterix leucotis*	Chestnut-backed Sparrowlark		
518	***Hirundo rustica***	**Barn Swallow**		
520	***Hirundo albigularis***	**White-throated Swallow**		
523	*Hirundo smithii*	Pearl-breasted Swallow		
524	***Hirundo semirufa***	**Red-breasted Swallow**		
526	***Hirundo cucullata***	**Greater Striped Swallow**		
527	***Hirundo abyssinica***	**Lesser Striped Swallow**		
528	***Hirundo spilodera***	**South African Cliff-Swallow**		
529	***Hirundo fuligula***	**Rock Martin**		
530	***Delichon urbicum***	**Common House Martin**		
532	*Riparia riparia*	Sand Martin		
533	***Riparia paludicola***	**Brown-throated Martin**		
534	***Riparia cincta***	**Banded Martin**		
538	*Campephaga flava*	Black Cuckooshrike		
541	*Dicrurus adsimilis*	Fork-tailed Drongo		
543	*Oriolus oriolus*	Eurasian Golden-Oriole		
545	***Oriolus larvatus***	**Black-headed Oriole**		
547	***Corvus capensis***	**Cape Crow**		
548	***Corvus albus***	**Pied Crow**		
560	*Turdoides jardineii*	Arrow-marked Babbler		
567	*Pycnonotus nigricans*	African Red-eyed Bulbul		
568	***Pycnonotus tricolour***	**Dark-capped Bulbul**		
576	***Turdus libonyanus***	**Kurrichane Thrush**		
577	*Turdus olivaceus*	Olive Thrush		
580	***Psophocichla litsitsirupa***	**Groundscaper Thrush**		
581	*Monticola rupestris*	Cape Rock-Thrush		
586	*Oenanthe monticola*	Mountain Chat		
587	*Oenanthe pileata*	Capped Wheatear		
589	*Cercomela familiaris*	Familiar Chat		
593	*Thamnolaea cinnamomeiventris*	Mocking Cliff Chat		
595	*Myrmecocichla formicivora*	Ant-eating Chat		
596	***Saxicola torquatus***	**African Stonechat**		
601	***Cossypha caffra***	**Cape Robin-Chat**		
615	*Cercotrichas paean*	Kalahari Scrub-Robin		
619	*Sylvia borin*	Garden Warbler		
620	*Sylvia communis*	Common Whitethroat		
621	*Parisoma subcaeruleum*	Chestnut-vented Tit-Babbler		
625	*Hippolais icterina*	Icterine Warbler		
628	***Acrocephalus arundinaceus***	**Great Reed-Warbler**		

631	***Acrocephalus baeticatus***	**African Reed Warbler**		
633	***Acrocephalus palustris***	**Marsh Warbler**		
634	***Acrocephalus schoenobaenus***	**Sedge Warbler**		
635	***Acrocephalus gracilirostris***	**Lesser Swamp-Warbler**		
638	***Bradypterus baboecala***	**Little Rush-Warbler**		
643	*Phylloscopus trochilus*	Willow Warbler		
645	*Apalis thoracica*	Bar-throated Apalis		
651	*Sylvietta rufescens*	Long-billed Crombec		
653	*Eremomela icteropygialis*	Yellow-bellied Eremomela		
661	***Sphenoecus afer***	**Cape Grassbird**		
664	***Cisticola juncidis***	**Zitting Cisticola**		
665	*Cisticola aridulus*	Desert Cisticola		
666	*Cisticola textrix*	Cloud Cisticola		
667	*Cisticola ayresii*	Wing-snapping Cisticola		
670	*Cisticola lais*	Wailing Cisticola		
672	*Cisticola chiniana*	Rattling Cisticola		
677	***Cisticola tinniens***	**Levaillant's Cisticola**		
679	*Cisticola aberrans*	Lazy Cisticola		
681	***Cisticola fulvicapilla***	**Neddicky**		
683	***Prinia subflava***	**Tawny-flanked Prinia**		
685	***Prinia flavicans***	**Black-chested Prinia**		
689	*Muscicapa striata*	Spotted Flycatcher		
694	*Malaenornis pammelaina*	Southern Black-Flycatcher		
695	*Bradornis mariquensis*	Marico Flycatcher		
698	***Sigelus silens***	**Fiscal Flycatcher**		
701	*Batis molitor*	Chinspot Batis		
706	*Stenostira scita*	Fairy Flycatcher		
710	*Terpsiphone viridis*	African Paradise Flycatcher		
711	*Motacilla aquimp*	African Pied Wagtail		
713	***Motacilla capensis***	**Cape Wagtail**		
716	***Anthus cinnamomeus***	**African Pipit**		
717	*Anthus similes*	Long-billed Pipit		
718	*Anthus leucophrys*	Plain-backed Pipit		
719	*Anthus vaalensis*	Buffy Pipit		
720	*Anthus lineiventris*	Striped Pipit		
727	*Macronyx capensis*	Cape Longclaw		
731	*Lanius minor*	Lesser Grey Shrike		
732	***Lanius collaris***	**Common Fiscal**		
733	*Lanius collurio*	Red-backed Shrike		
736	***Laniarius ferrugineus***	**Southern Boubou**		

739	*Laniarius atrococcineus*	Crimson-breasted Shrike		
740	***Dryoscopus cubla***	**Black-backed Puffback**		
741	*Nilaus afer*	Brubru		
743	*Tchagra australis*	Brown-crowned Tchagra		
744	*Tchagra senegalus*	Black-crowned Tchagra		
746	***Telophorus zeylonus***	**Bokmakierie**		
751	*Malaconotus blanchoti*	Grey-headed Bush Shrike		
753	*Prionops plumatus*	White-crested Helmet Shrike		
758	***Acridotheres tristis***	**Common Myna**		
759	***Spreo bicolour***	**Pied Starling**		
760	***Creatophora cinerea***	**Wattled Starling**		
761	*Cinnyricinclus leucogaster*	Violet-backed Starling		
764	***Lamprotornis nitens***	**Cape Glossy Starling**		
769	***Onychognathus morio***	**Red-winged Starling**		
775	*Nectarinia famosa*	Malachite Sunbird		
779	*Cinnyris mariquensis*	Marico Sunbird		
785	*Cinnyris afer*	Greater Double-collared Sunbird		
787	***Cinnyris talatala***	**White-bellied Sunbird**		
792	***Chalcomitra amethystine***	**Amethyst Sunbird**		
796	*Zosterops virens*	Cape White-eye		
799	*Plocepasser mahali*	White-browed Sparrow-Weaver		
801	***Passer domesticus***	**House Sparrow**		
803	***Passer melanurus***	**Cape Sparrow**		
804	*Passer diffuses*	Southern Grey-headed Sparrow		
805	*Petronia superciliaris*	Yellow-throated Petronia		
806	*Sporopipes squamifrons*	Scaly-feathered Finch		
807	***Amblyospiza albifrons***	**Thick-billed Weaver**		
811	*Ploceus cucullatus*	Village Weaver		
813	***Ploceus capensis***	**Cape Weaver**		
814	***Ploceus velatus***	**Southern Masked-Weaver**		
820	*Anomalospiza imberbis*	Cuckoo Finch		
821	***Quelea quelea***	**Red-billed Quelea**		
824	***Euplectes orix***	**Southern Red Bishop**		
826	***Euplectes afer***	**Yellow-crowned Bishop**		
829	*Euplectes albonotatus*	White-winged Widowbird		
831	***Euplectes ardens***	**Red-collard Widowbird**		
832	***Euplectes progne***	**Long-tailed Widowbird**		
840	*Lagonostica rubricata*	African Firefinch		
841	*Lagonostica rhodopareia*	Jameson's Firefinch		
842	*Lagonostica senegala*	Red-billed Firefinch		

844	*Uraeginthus angolensis*	Blue Waxbill		
846	***Estrilda astrild***	**Common Waxbill**		
850	*Coccopygia melanotis*	Swee Waxbill		
852	***Ortygospiza atricollis***	**African Quailfinch**		
854	*Sporaeginthus subflavus*	Orange-breasted Waxbill		
856	*Amadina erythrocephala*	Red-headed Finch		
857	*Spermestes cucullatus*	Bronze Mannikin		
860	***Vidua macroura***	**Pin-tailed Whydah**		
862	*Vidua paradisaea*	Long-tailed Paradise-Whydah		
867	*Vidua chalybeate*	Village Indigobird		
869	***Crithagra mozambicus***	**Yellow-fronted Canary**		
870	***Crithagra atrogularis***	**Black-throated Canary**		
872	*Serinus canicollis*	Cape Canary		
878	*Crithagra flaviventris*	Yellow Canary		
881	***Crithagra gularis***	**Streaky-headed Seedeater**		
884	*Emberiza flaviventris*	Golden-breasted Bunting		
885	*Emberiza capensis*	Cape Bunting		
886	*Emberiza tahapisi*	Cinnamon-breasted Bunting		
888	***Milvus parasitus***	**Yellow-billed Kite**		
889	***Milvus migrans***	**Black Kite**		

ANNEXURE E5:
HERITAGE IMPACT ASSESSMENT

CULTURAL HERITAGE IMPACT ASSESSMENT FOR THE PROPOSED KYALAMI GARDENS EXTENTION 27 MIXED USE DEVELOPMENT, MIDRAND, JOHANNESBURG

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ACRONYMS AND ABBREVIATIONS

NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NHRA	National Heritage Resources Act, 1999 (Act No. 25 of 1999)
PHRA-G	Provincial Heritage Resources Authority Gauteng
SEF	Strategic Environmental Focus (Pty) Ltd
EIA	Environmental Impact Assessment
HIA	Heritage Impact Assessment
ESA	Early Stone Age
MSA	Middle Stone Age
LSA	Later Stone Age
IA	Iron Age
EIAP	Early Iron Age
MIA	Middle Iron Age
LIA	Late Iron Age

EXECUTIVE SUMMARY

The aim of the cultural heritage survey was to locate, identify and document sites of heritage and archaeological significance that may occur on the site where the Kyalami Gardens Extension 27 Mixed Use Development in Midrand is proposed. An assessment of the impact of the development on such resources is provided. Where the impact is negative, alternatives and mitigation plans is considered.

However, the Phase I Heritage Survey, maps and aerial photograph investigation has revealed no heritage resources on the footprint and in the immediate vicinity of the site. The proposed establishment of the Kyalami Gardens Extension 27 Mixed Use Development can hence proceed from a heritage point of view on condition that, in the event that heritage or archaeological resources are unearthed either during the construction of structures/buildings or the associated infrastructure, work must stop immediately, pending investigation by a heritage professional from the Provincial Heritage Resources Authority Gauteng.

1 INTRODUCTION

The planned mixed use development, which will be known as Kyalami Gardens Extension 27, is proposed to be established on a portion of the remainder of Portion 2 and that of the remaining extent of Portion 88 of the Farm Bothasfontein No. 408 JR. The proposed development is situated in Midrand, Johannesburg and will consist of:

- Offices;
- Security gatehouse and related facilities;
- Places of public worship and residential;
- Retail and commercial facilities including restaurants;
- Access roads, public road and parking area; and
- Public open spaces.

Strategic Environmental Focus (Pty) Ltd was commissioned by Erf 51 Melville cc to undertake an Environmental Impact Assessment (EIA) in this regard. A Heritage Impact Assessment (HIA) was carried out in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) as amended, and it is based on the requirements of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA).

According to Section 3 (2) of the NHRA, the heritage resources of South Africa include:

"*a. places, buildings, structures and equipment of cultural significance;*

b. places to which oral traditions are attached or which are associated with living heritage;

c. historical settlements and townscapes;

d. landscapes and natural features of cultural significance;

e. geological sites of scientific or cultural importance;

f. archaeological and palaeontological sites;

g. graves and burial grounds, including-

i. ancestral graves;

ii. royal graves and graves of traditional leaders;

iii. graves of victims of conflict;

iv. graves of individuals designated by the Minister by notice in the Gazette;

v. historical graves and cemeteries; and

vi. other human remains which are not covered in terms of the Human Tissue Act, 1983 (Act No. 65 of 1983);

h. sites of significance relating to the history of slavery in South Africa;

i. movable objects, including-

i. objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens;

ii. objects to which oral traditions are attached or which are associated with living heritage;

iii. ethnographic art and objects;

iv. military objects;

v. objects of decorative or fine art;

vi. objects of scientific or technological interest; and

vii. books, records, documents, photographic positives and negatives, graphic, film or video material or sound recordings, excluding those that are public records as defined in section 1(xiv) of the National Archives of South Africa Act, 1996 (Act No. 43 of 1996)."

In terms of Section 3 (3) of the NHRA, a place or object is to be considered part of the national estate if it has cultural significance or other special value because of:

"a. its importance in the community, or pattern of South Africa's history;

b. its possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage;

c. its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage;

d. its importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects;

e. its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;

f. its importance in demonstrating a high degree of creative or technical achievement at a particular period;

g. its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons;
h. its strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa; and
i. sites of significance relating to the history of slavery in South Africa."

The aim of the investigation was to identify, verify and analyze heritage issues and to recommend how to manage them within the context of the proposed establishment of the mixed use development.

The objectives of the investigation were:

- Identifying and analyzing heritage places, objects, buildings, structures, etc.;
- Assessing broad cultural significance of identified sites, places, buildings, structures and objects within the site;
- Surveying and mapping of significance/sensitivity issues and opportunities/constraints issues;
- Reviewing of the general compatibility of the proposed establishment of the mixed use development with heritage policy planning frameworks;
- Undertaking a preliminary assessment of the acceptability of the proposed establishment of the mixed use development from a heritage perspective;
- Identifying the need for alternatives, if necessary; and
- Recommending appropriate initial management measures to conserve significant heritage elements and reduce the impact on heritage resources.

2 BACKGROUND INFORMATION TO THE PROJECT

Table 1 Background Information

Consultant:	Mamoluoane Seliane
Type of development:	Establishment of Kyalami Gardens Mixed Use Development, Midrand, Johannesburg
Rezoning or subdivision:	Rezoning
Terms of reference	To carry out an HIA
Legislative requirements:	The HIA was carried out in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and following the requirements of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA)

2.1 Details of the study area

Footprint: See Figure 1

<u>Current land use</u>: The Kyalami Gardens Extension 27 mixed use development is planned on land that has been used for illegal dumping in the past with a significant amount of building rubble being present. (Figure 2). This site is also highly populated with alien vegetation such as *Eucalyptus camadulensis* (Red River gum). This site was previously used to provide specialized care of horses.

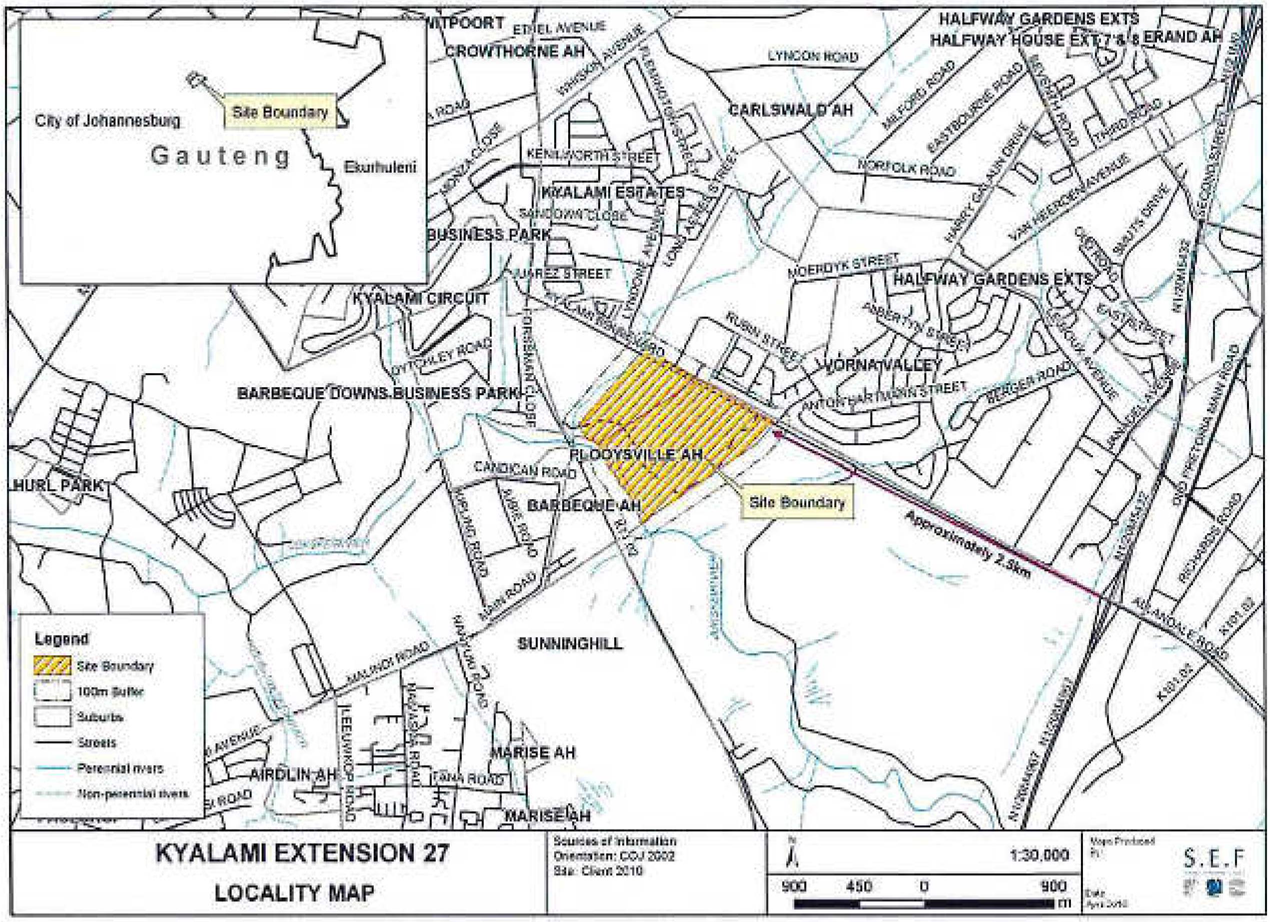

Figure 1 Location of study area

Figure 2 Building rubble dumped on site

3 BACKGROUND INFORMATION ~~TO~~ of THE SURVEY

3.1 Methodology

3.1.1 Details of the site visit

The site visit for the proposed Kyalami Gardens Extension 7 Mixed Use Development was conducted on the 7 July 2010. The survey was undertaken by means of both walking and driving throughout the study area to:

- search for, locate and identify objects and structures of heritage and/or archaeological significance in accordance with accepted archaeological practices; and

- document all heritage/archaeological sites, objects and structures according to minimum standards accepted by the archaeological profession.

3.1.2 Literature Review

A brief literature review pertaining to the prehistory and history of the study area was undertaken.

3.1.3 Field work

This field survey was conducted in line with accepted heritage and archaeological standards and procedures.

3.2 Restrictions to the survey

3.2.1 Visibility

Visibility during the survey was very poor due to the site being invaded by alien vegetation and also due to the wide spread building rubble dumps on the site.

3.2.2 Disturbance

No disturbance of any potential archaeological stratigraphy or heritage features was noted.

3.3 Details of the equipment used during the survey

- GPS: Garmin Etrek; and
- Digital camera: Canon Powershot A460.

All readings were taken using the GPS. Accuracy was to a margin of error of 5 m.

4 ARCHAEOLOGICAL HISTORY OF THE AREA

The Gauteng archaeological history is one of the best studied in South Africa. The province's archaeological heritage spans from more than two million years ago until recently. Evidence from the archaeological sites in Gauteng indicates that the sites are representative of a long and substantial cultural history belonging to different time periods and cultural traditions. The earliest evidence for stone tool manufacture and use in Southern Africa is found within the Gauteng Province at sites in the Cradle of Humankind. The 'Cradle' and its environs have been proclaimed of World Heritage Status owing to the vast palaeontological, physical anthropological and archaeological evidence from the discovery of hominid fossils and associated cultural material that has made a considerable contribution to the body of scientific knowledge of the subject of the origin of humanity and human evolution.

4.1 Stone Age

The Stone Age is comprised of three (3) industries namely, the Early Stone Age (ESA) dating to between about 2.5 million years ago to 250 000 years ago, the Middle Stone Age (MSA) dating to between 250 000 and 25 000 years ago and the Later Stone Age (LSA) which dates to between about 25 000 and 2 000 years ago (Esterhuysen, 2007).

The ESA is a period during which human ancestors began the usage of stone tools. The ESA tools were simple tools, which were, among other things, used to chop and butcher meat, de-skin animals and probably to smash animal bones to obtain bone marrow

(Esterhuysen, 2007). The MSA stone tools are in general, smaller than those of the ESA. A variety of MSA tools include blades, flakes, scrapers and pointed tools that may have been hafted onto shafts or handles and used as spearheads. Stone tool technology in the LSA is observed to display rapid stylistic change compared to the slower pace of stylistic change in the MSA (Wadley, 2007). The rapidity is more evident during the last 10 000 years. However, no Stone Age artefacts have been discovered at the proposed Kyalami Gardens Ext 27 site.

Along with the marked social transformation and technological innovation of the LSA people is the associated Rock Art panels that occur on cave walls or rock faces. Rock Art can be in the form of rock paintings or rock engravings, depending on the geology of a region. In the Magaliesberg valley of the Gauteng Province, dozens of engraved rocks can be seen today with the majority of the depictions being large game such as eland, rhinoceros, zebra and hartebeest (Pearce, 2007). However, no Rock Art has been found on the proposed Kyalami Gardens Ext 27 site.

4.2 Iron Age

A farming way of life was introduced to ~~s~~ S southern Africa about 2 000 years ago by Bantu-speaking people coming from the north. They brought with them crops such as sorghum, millet, ground beans and cow peas to be cultivated for the first time in this part of the world. Domestic animals such as cattle, sheep and goats were also part of the newly introduced farming way of life. Unlike the hunter-gatherers and herders who lived in temporary camps and led a nomadic way of life, farming necessitated sedentary life styles. Some features of the permanent settlements of these early mixed farming communities are houses, raised grain bins, underground storage pits and stock enclosures. An important feature of this time period was that they also made their own iron implements, hence the name Iron Age. The Iron Age has been divided into three periods, namely the Early Iron Age (EIA Period) (AD 200 – 900), the Middle Iron Age (MIA) (AD 900 – 1300) and the Late Iron Age (LIA) (AD 1300 – 1820) (Huffman, 2007). The investigation did not reveal any Iron Age features or artifacts in the study area.

5 DESCRIPTION OF THE STUDY AREA

5.1 Locational Data

See Figure 1

Province: Gauteng;
District Municipality: City of Johannesburg;
General coordinates: 28°5'3.045"E; 26°0'18.673"S.

5.2 Description of the materials observed

The heritage survey of the proposed site for the establishment of the Kyalami Gardens Ext 27 mixed use development revealed no heritage or archaeological resources.

5.3 Summary of the findings

This section is not applicable as no cultural heritage or archaeological resources have been found within the study area.

6 STATEMENT OF SIGNIFICANCE

The statement of significance outlines the principal values that a site or object holds to a community or sections of a community. The study revealed no heritage or archaeological resources; therefore this section is not applicable.

6.1 Field rating

Since no heritage or archaeological resources were found, field rating (Table 2) is not applicable.

Table 2 Field rating and recommended grading of sites (SAHRA 2005)

Level	Details	Action
National (Grade I)	The site is considered to be of National Significance	Nominated to be declared by SAHRA
Provincial (Grade II)	This site is considered to be of Provincial significance	Nominated to be declared by Provincial Heritage Authority
Local Grade IIIA	This site is considered to be of HIGH significance locally	The site should be retained as a heritage site
Local Grade IIIB	This site is considered to be of HIGH significance locally	Mitigation necessary, and part retained as a heritage site
Generally Protected A	High to medium significance	Mitigation necessary before destruction
Generally Protected B	Medium significance	The site needs to be recorded before destruction
Generally Protected C	Low significance	No further recording is required before destruction

7 RECOMMENDATIONS

The establishment of Kyalami Gardens Ext 27 mixed use development can proceed as planned from a heritage point of view, as no heritage or archaeological resources have been discovered.

8 RISK PREVANTATIVE MEASURES ASSOCIATED WITH CONSTRUCTION

In the event that any heritage and/or archaeological materials are unearthed during the construction of buildings/structures or associated infrastructure, work must cease immediately, and both the PHRA-G and the SEF should be contacted on (011) 355 2630 and (031) 266 1277 respectively.

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ANNEXURE E6:
WETLAND ASSESSMENT

WETLAND STUDY ON THE REMAINING EXTENT OF PORTION 2 AND A PART OF PORTION 88 (A PORTION OF PORTION 2) OF THE FARM BOTHASFONTEIN 408 JR, MIDRAND, GAUTENG

KYALAMI GARDENS EXT 27 (PREVIOUSLY KNOWN AS MUSHROOM FARM)

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OCTOBER 2010

EXECUTIVE SUMMARY

Strategic Environmental Focus (Pty) Ltd. (SEF) was appointed to conduct a wetland assessment for the proposed development on a Portion of the Remainder of Portion 2 and on the Remaining Extent of Portion 88 of the farm Bothasfontein 408 JR. In order to have a holistic understanding of the ecological sensitivities on the site, the wetland report should be read in conjunction with other specialist reports pertaining to the site.

This report focuses on the wetland assessment segment of the ecological study and is supplementary to the aquatic, floral and faunal assessments. The purpose of this wetland study was to delineate the wetlands and assess their sensitivity. This entailed the following:

- To describe wetlands and their functionality within the study boundary.
- To recommend suitable buffer zones and mitigation measures for different wetland habitats.

This report presents the findings obtained following a desktop assessment, literature review and field work conducted on the 13 of October 2010 within the designated study area. Different types of wetland areas were classified within the study boundary and were categorised into hydro-geomorphic (HGM) units. These included an artificial depression, a natural depression and a hillslope seepage wetland not feeding a watercourse. A total of 3 hydro-geomorphic units were delineated and classified within the study area with a combined surface area of less than one hectare. Further to the hydro-geomorphic units delineated, a riparian zone along the Jukskei River was also delineated which represented an important component of the study area.

From a functional perspective, the riparian zone performs a variety of functions that are of value to society, especially the protection and enhancement of water resources, and provision of habitat for plant and animal species. Some of these functions include:

- store water and help reduce floods;
- stabilize streambanks;
- improve water quality by trapping sediments and nutrients;
- maintain natural water temperature for aquatic species;
- provide shelter and food for birds and other animals;
- provide corridors and movement and migration of different species; and
- act as a buffer between aquatic ecosystems and adjacent land uses.

When considering wetland management and protection, it is fundamental to consider the management of the supporting hydrology. Non wetland areas are therefore as important to consider as the wetlands themselves, as for the most part they are the sources of water that emerge in the wetlands. A wetland sensitive approach is recommended for any development proposal for the study area. The protection of the riparian zone and identified hydrological sensitivities also complement the rocky outcrop sensitivities as identified within the vegetation report. An appropriate open space plan which serves as flood protection, wildlife corridor and wetland buffer should be designed and incorporated into the potential development layout.

According to DWAF, Section 21(c) and (i) Water use authorisation application process, any development within 500m of a wetland or a watercourse is subject to a water use application.

Declaration of Independence by Ecologist

I, **Willem Lubbe,** in my capacity as a specialist consultant, hereby declare that I -

- Act as an independent consultant;
- Do not have any financial interest in the undertaking of the activity, other than remuneration for the work performed in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- Have and will not have 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, to the competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- Will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not;
- As a registered member of the South African Council for Natural Scientific Professions, will undertake my profession in accordance with the Code of Conduct of the Council, as well as any other societies to which I am a member;
- Based on information provided to me by the project proponent, and in addition to information obtained during the course of this study, have presented the results and conclusion within the associated document to the best of my professional judgement; and
- Undertake to have my work peer reviewed on a regular basis by a competent specialist in the field of study for which I am registered.

Willem Lubbe (Cand. Sci. Nat.) Ecologist SACNASP Reg. No. 100064/08	Date

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1. INTRODUCTION

With South Africa being a contracting party to the Ramsar Convention on Wetlands, the South African government has taken a keen interest in the conservation, sustainable utilisation and rehabilitation of wetlands in South Africa. This aspect is also reflected in various pieces of legislation controlling development in and around wetlands and other water resources, of which the most prominent may be the National Water Act, Act 36 of 1998. As South Africa is an arid country, with a mean annual rainfall of only 450mm in relation to the world average of 860mm (DWAF, 2003), water resources and the protection thereof becomes critical to ensure their sustainable utilisation. Wetlands perform various important functions related to water quality, flood attenuation, stream flow augmentation, erosion control, biodiversity, harvesting of natural resources, and others, highlighting their importance as an irreplaceable habitat type. Determining the location and extent of existing wetlands, as well as evaluating the full scope of their ecosystem services, form an essential part in striving towards sustainable development and protection of water resources.

1.1 Project Description

The proposed development ~~are~~ is located on a Portion of the Remainder of Portion 2 and on the Remaining Extent of Portion 88 of the farm Bothasfontein 408 JR, south west of Vorna Valley and on the southern side of Allandale Road. The site is currently vacant and derelict and is abutted by several other developments such as Waterfall Country Lifestyle Village (east of the site) and Kyalami Glen Estate to the south located on the R55/Woodmead Drive (Figure 1). The development is currently known as Kyalami Gardens Extension 27 (previously known as Mushroom Farm).

Strategic Environmental Focus (Pty) Ltd. (SEF) was appointed to conduct a wetland assessment for the proposed development. In order to have a holistic understanding of the ecological sensitivities on the site, the wetland report should be read in conjunction with other specialist reports pertaining to the site.

1.2 Terms of Reference

This report focuses on the wetland assessment segment of the ecological study and is supplementary to the aquatic, floral and faunal assessments. The purpose of this wetland study was to delineate the wetlands and assess their sensitivity. This entailed the following:

- To describe wetlands and their functionality within the study boundary.
- To recommend suitable buffer zones and mitigation measures for different wetland habitats. This report presents the findings obtained following a desktop assessment, literature review and field work within the designated study area.

1.3 Assumptions and Limitations

In order to obtain definitive data regarding the biodiversity, hydrology and functioning of particular wetlands, studies should ideally be conducted over a number of seasons and over a number of years. However, cost implications and time constraints prevent such long-term studies, and reliance was placed on information gained during field surveys conducted during a single season, desktop information for the area, information obtained from provincial conservation authorities and similar organisations, as well as professional judgement and experience gained during similar assessments conducted within the general area.

Historic anthropogenic impacts and disturbances culminated in obscuring potential original (pre-impacted) wetland footprints. This was especially evident in some sections where *Eucalyptus* plantations and pioneer species such as *Tagetes minuata* (Khaki Weed) and *Bidens pilosa* formed tall almost impenetrable stands as well as large areas where the original soil profile has been disturbed through excavations and dumping. The identification and classification of soils at the soil form level were therefore significantly jeopardized.

1.3 Methodology

A field survey was undertaken on 13 October 2010. The wetland delineation was based on the legislatively required methodology as described by DWAF (2005). For a more comprehensive study approach and specific methodologies employed during the current study see Appendix A.

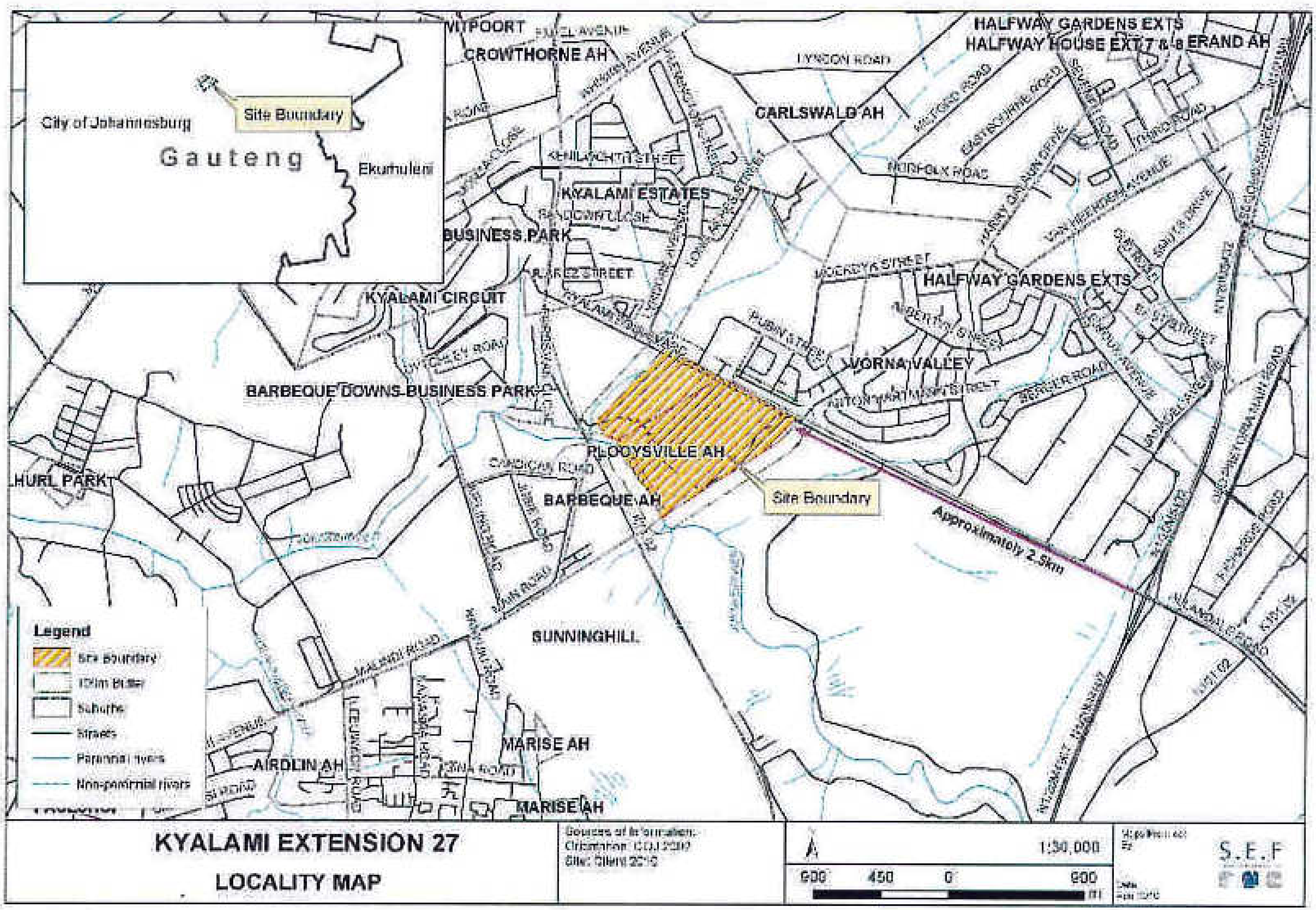


Figure 1: Locality of the Study Area

2. RESULTS

2.1 Wetland soils

According to DWAF (2005), the permanent zone of a wetland will always have either Champagne, Katspruit, Willowbrook or Rensburg soil forms present, as defined by the Soil Classification Working Group (1991).

The seasonal and temporary zones of the wetlands will have one or more of the following soil forms present (signs of wetness incorporated at the form level): Kroonstad, Longlands, Wasbank, Lamotte, Estcourt, Klapmuts, Vilafontes, Kinkelbos, Cartref, Fernwood, Westleigh, Dresden, Avalon, Glencoe, Pinedene, Bainsvlei, Bloemdal, Witfontein, Sepane, Tukulu, Montagu. Alternatively, the seasonal and temporary zones will have one or more of the following soil forms present (signs of wetness incorporated at the family level): Inhoek, Tsitsikamma, Houwhoek, Molopo, Kimberley, Jonkersberg, Groenkop, Etosha, Addo, Brandvlei, Glenrosa, Dundee (DWAF, 2005).

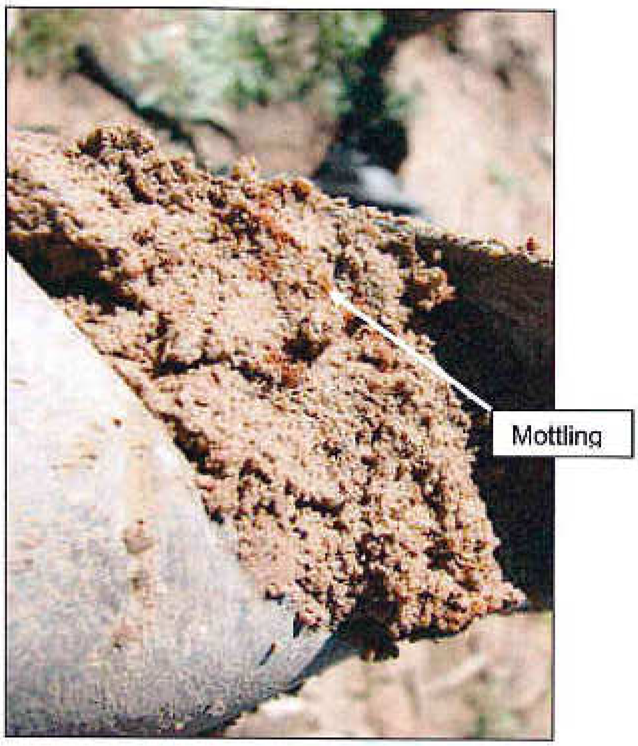
For an area to be considered a wetland, redoximorphic features must be present within the upper 500 mm of the soil profile (Collins, 2005). Redoximorphic features are the result of the reduction, translocation and oxidation (precipitation) of iron and manganese oxides that occur when soils are saturated for sufficiently long periods of time to become anaerobic. Only once soils within 50cm of the surface display these redoximorphic features can the soils be considered to be hydric (wetland) soils. Redoximorphic features typically occur in three types (Collins, 2005):

- **A reduced matrix** - i.e. an *in situ* low chroma (soil colour), resulting from the absence of Fe^{3+} ions which are characterised by "grey" colours of the soil matrix (Photograph 1).
- **Redox depletions** - the "grey" (low chroma) bodies within the soil where Fe-Mn oxides have been stripped out, or where both Fe-Mn oxides and clay have been stripped. Iron depletions and clay depletions can occur.
- **Redox concentrations** - Accumulation of iron and manganese oxides (also called mottles), (Photograph 2). These can occur as:
  - Concretions - harder, regular shaped bodies;
  - Mottles - soft bodies of varying size, mostly within the matrix, with variable shape appearing as blotches or spots of high chroma colours; and,
  - Pore linings - zones of accumulation that may be either coatings on a pore surface, or impregnations of the matrix adjacent to the pore. They are recognized as high chroma colours that follow the route of plant roots, and are also referred to as oxidised rhizospheres.

According to the DWAF guidelines for the delineation of wetlands (DWAF, 2005), soil wetness indicators (i.e. identification of redoximorphic features) are the most important indicator of wetland occurrence, due to the fact that soil wetness indicators (redoximorphic features) remain in wetland soils, even if they are degraded or desiccated. It is important to note that the presence or absence of redoximorphic features within the upper 500mm of the soil profile alone is sufficient to identify the soil as being hydric (a wetland soil) or non-hydric (non-wetland soil) (Collins, 2005).

The seepage wetland situated within the riparian zone next to the Jukskei River contained soils of which the closest soil form description matches the Dundee soil form, unfortunately roots and rocks prevented a describable soil sample. Soils within the vicinity of the seep were largely stratified alluvium in nature which further strengthens the likelihood of the soils to be of the Dundee form.

Photograph 1: An example of a soil with prolonged periods of saturation displaying a reduced matrix, as indicated by the grey colouration.



Photograph 2: Soils with prolonged periods of saturation displaying mottling.

2.2 *Wetland Vegetation*

According to the Department of Water Affairs and Forestry (2005) vegetation is regarded as a key component to be used in the delineation procedure for wetlands. Vegetation also forms a central part of the wetland definition in the National Water Act (Act 36 of 1998). Using vegetation as a primary wetland indicator however, requires undisturbed conditions (DWAF, 2005). A cautionary approach must be taken as vegetation alone cannot be used to delineate a wetland, as several species, while common in wetlands, can occur extensively outside of wetlands. When examining plants within a wetland, a distinction between hydrophilic (vegetation adapted to life in saturated conditions) and upland species must be kept in mind. There is typically a well-defined 'wetness' gradient that occurs from the centre of a wetland to its edge that is characterized by a change in species composition between hydrophilic plants that dominate within the wetland to upland species that dominate on the edges of, and outside of the wetland (DWAF, 2003). It is important to identify the vegetative indicators which determine the three wetness zones (temporary, seasonal and permanent) which characterize wetlands. Each zone is characterized by different plant species which are uniquely suited to the soil wetness within that zone.

Plant species associated with the permanent and seasonal zone of wetlands within the study site were *Persicaria* species (Knotweed / Snakeroot), *Typha capensis* (Bullrush) and the graminoids, *Eragrostis plana* (Tough Love Grass), *Paspalum dilatum* (Dallis Grass), *Agrostis lachnanta* (Bent Grass), *Phragmites australis* (Common Reed) and *Setaria pallida-fusca* (Garden Bristle Grass), photograph 3 & 4. There were also a large number of alien invasive weeds such as *Tagetes minuata* (Khaki Weed), *Flavernia bidentis* (Smelters Bush) and *Verbena brasiliensis* present within these two zones.

Photograph 3 & 4: Hydrophylic vegetation in study area.

2.3 *Delineated Wetland Areas*

The wetland delineation methodology used was according to DWAF (2005). For a detailed description of methodologies followed during the delineation process, the reader is directed to Appendix A.

According to the National Water Act (Act no 36 of 1998) a wetland is defined as, "*land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.*" Wetlands typically occur on the interface between aquatic and terrestrial habitats and therefore display a gradient of wetness – from permanent, to seasonal, to temporary zones of wetness - which is represented in their plant species composition, as well as their soil characteristics. It is important to take cognisance of the fact that not all wetlands have visible surface water. An area which has a high water table just below the surface of the soil is also a wetland, as well as a pan that only contains water for a few weeks during the year.

Hydrophytes and hydric soils are subsequently used as the two main wetland indicators. The presence of these two indicators is indicative of an area that has sufficient saturation to classify the area as a wetland. The soil form indicator examines soil forms, as defined by the Soil Classification Working Group. Typically soil forms associated with prolonged and frequent saturation by water, where present, is an indicator of wetland occurrence (DWAF, 2005). The Soil Classification Working Group has identified various soil types that typically occur within the different zones typically found within a wetland, i.e. a permanent, seasonal and temporary zone. Terrain unit refers to the terrain unit in which the wetland is found. Wetlands can occur across all terrain units from the crest to valley bottom. Many wetlands occur within valley bottoms, but wetlands are not exclusively found within depressions. Terrain unit is a useful indicator in assessing the hydro-geomorphic form of the wetland.

In practice all four indicators should be used in any wetland assessment / delineation exercise, the presence of redoximorphic features being most important, with the other indicators being confirmatory. An understanding of the hydrological processes active within the area is also considered important when undertaking a wetland assessment. Indicators should be 'combined' to determine whether an area is a wetland and to delineate the boundary of a wetland. According to the DWAF delineation guidelines, the more wetland indicators that are present, the higher the confidence of the delineation. In assessing whether an area is a wetland, the boundary of a wetland or a non- wetland area should be considered to be the point where indicators are no longer present.

2.4 Identified wetland types and characteristics

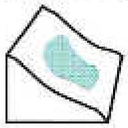
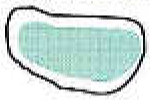
Different types of wetland areas were classified within the study boundary and were categorised into hydro-geomorphic (HGM) units. These included an artificial depression, a natural depression and a hillslope seepage wetland not feeding a watercourse. A total of 3 Hydro-geomorphic units were delineated and classified within the study area, and are presented graphically in Figure 2. The total extent of wetlands within the study area was determined to be 31.7ha, with the majority consisting of seepage wetlands.

HGM units encompass three key elements (Kotze *et al*, 2005):

(1) Geomorphic setting. This refers to the landform, its position in the landscape and how it evolved (e.g. through the deposition of river borne sediment);
(2) Water source. There are usually several sources, although their relative contributions will vary amongst wetlands, including precipitation, groundwater flow, stream flow, etc.; and
(3) Hydrodynamics, which refers to how water moves through the wetland.

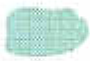
Table 1 describes the characteristics that form the basis for the classification of the HGM units in the study area.

Table 1: Wetland hydro-geomorphic types typically supporting inland wetlands in South Africa (adapted from Kotze *et al*, 2005)

Hydro-geomorphic types	Description	Source of water maintaining the wetland[1]	
		Surface	Sub-surface
Hillslope seepage not feeding a watercourse 	Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs mainly from sub-surface flow and outflow either very limited or through diffuse sub-surface and/or surface flow but with no direct surface water connection to a watercourse.	*	***
Depression (includes Pans) 	A basin shaped area with a closed elevation contour that allows for the accumulation of surface water (i.e. it is inward draining). It may also receive sub-surface water. An outlet is usually absent.	*/ ***	*/ ***

[1] Precipitation is an important water source and evapotranspiration an important output in all of the above settings

Water source: * Contribution usually small
*** Contribution usually large
*/ *** Contribution may be small or important depending on the local circumstances



Wetland

Wetland delineations on Halfway House Granites is historically rife with complexities and different interpretations even without high levels of anthropogenic disturbances which only increases the difficulty of the task at hand (Pers. comm. van der Waals *et al*, 2010) However, an important driver during the assessment process is to probe the functionality of the wetland under investigation.

According to the terrain unit indicator one could expect seepage wetlands to occur in the vicinity of the granite outcrops situated close to the perennial river, however, no seepages could be confirmed in the shallow rocky soils. Hillslope seepages could have been present historically but the high level of soil disturbance that have taken place in the direct vicinity of the granite outcrops as well as major land use changes within the catchment (*Eucalyptus* plantations) have obliterated any signs of such potential wetlands. However, the granite outcrops itself, does form depressions with shallow organic rich soils bearing *Myrothamnus* sp. (Resurrection plant),

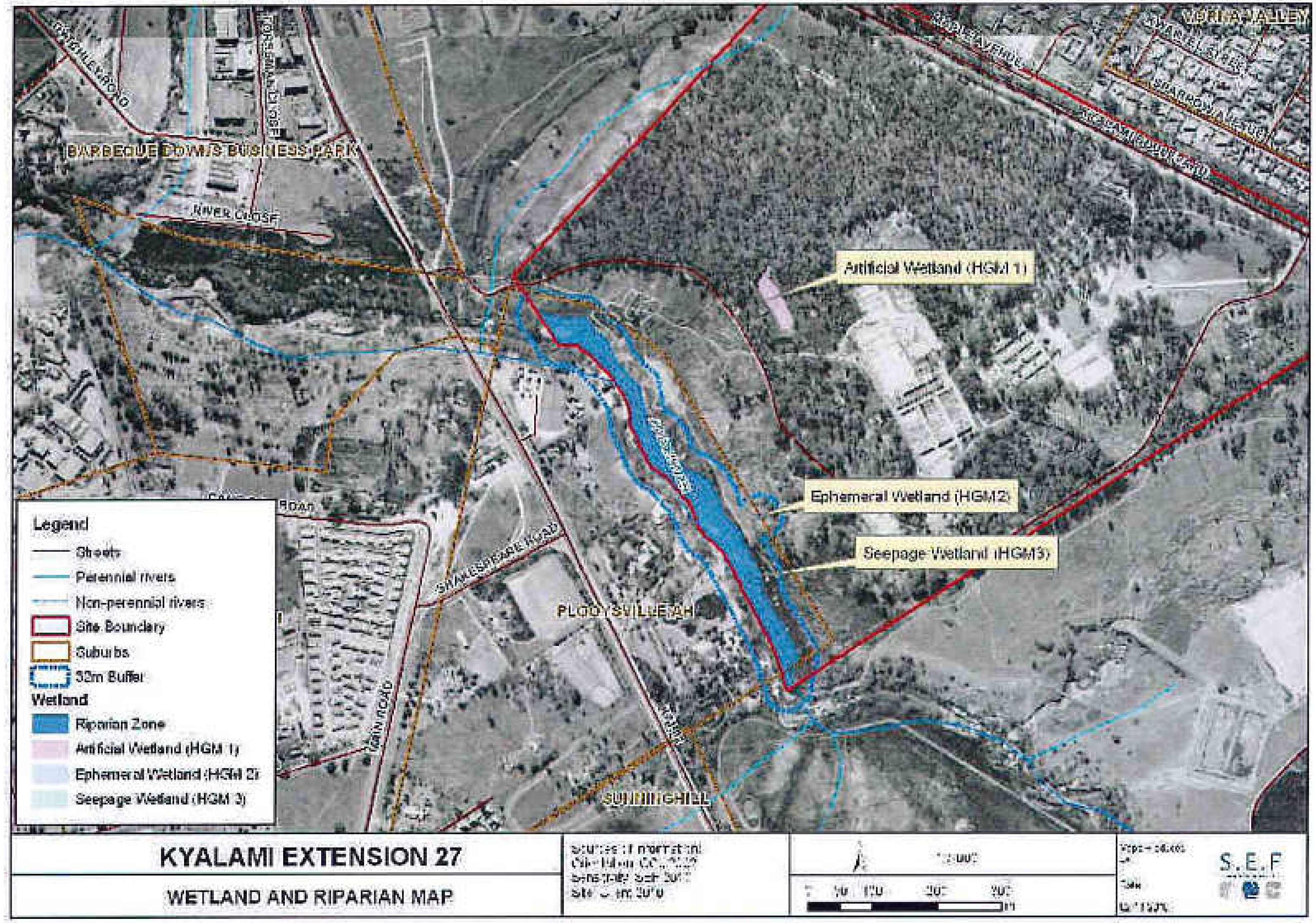


Figure 2: Verified Hydro-geomorphic units in the northern section of the study area

which create ephemeral wetland conditions, photograph 5. The dark organic soils within these depressions were formed due to the anaerobic conditions which persisted from time to time and slowed the breakdown of organic matter. The ephemeral wetland was classified as hydro-geomorphic unit 2.

Photograph 5: Ephemeral wetland on granite outcrop.

Small seepage wetlands dominated by *Phragmites* stands did occur on the riverbank of the Jukskei River, photo 4. These wetlands were delineated as part of the riparian vegetation within the riparian zone, except for one seep that was located on the boundary of the riparian zone. Soils were shallow and rocky and could therefore not be properly classified. The seepage wetland was classified as hydro-geomorphic unit 3.

An artificial wetland was delineated slightly west of the centre of the property within the *Eucalyptus* plantation. It consisted of an old dam wall and excavated area which have for some years collected sewerage effluent and surface water run-off, photograph 6. This man-made depression was classified as hydro-geomorphic unit 1.

Photograph 6: Artificial wetland close to the centre of study area.

2.5 *Identified riparian areas*

& others

According to Kotze et al, (2005), the National Water Act defines a riparian area as follows: "Riparian habitat includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas." Riparian areas perform a variety of functions that are of value to society, especially the protection and enhancement of water resources, and provision of habitat for plant and animal species. Some of these functions include:

- store water and help reduce floods;
- stabilize streambanks;
- improve water quality by trapping sediments and nutrients;
- maintain natural water temperature for aquatic species;
- provide shelter and food for birds and other animals;
- provide corridors and movement and migration of different species; and
- act as a buffer between aquatic ecosystems and adjacent land uses.

A large percentage of alluvial soils were sampled next to the Jukskei River despite the soil profile being anthropogenically disturbed in various areas. Sufficient vegetative indicators were also present to delineate the riparian area, including the indigenous species *Combretum erythrophyllum, Celtis africana, Searsia pyroides and Gymnosporia heterophylla*. In addition, some exotic species also occupied the riparian zone and included *Persicaria* species, *Rorippa nasturtium-aquaticum, Pennisetum clandestinum (Kikuyu Grass), Salix babylonica* and *Melia azedarach,* photograph 7.

Photograph 7: Riparian vegetation adjacent to the Jukskei River

3. FUNCTIONAL ASSESSMENT

Wetlands within the study area serves to improve habitat within and downstream of the study area through the provision of various ecosystem services (Table 2).

Table 2: Potential wetland services and functions in study area

Function	Aspect
Water balance	Streamflow regulation
	Flood attenuation
	Groundwater recharge
Water purification	Nitrogen removal
	Phosphate removal
	Toxicant removal
	Water quality
Sediment trapping	Particle assimilation
Harvesting of natural resources	Reeds, hunting, etc.
Livestock usage	Water for livestock
	Grazing for livestock
Crop farming	Irrigation

Hydro-geomorphic units are inherently associated with hydrological characteristics related to their form, structure and particularly because of their position in the landscape. This, together with the biotic and abiotic character (or biophysical environment) of wetlands in the study area, means that these wetlands are able to contribute better to some ecosystem services than to others (Kotze *et al.* 2005). Functional values are discussed according to grouped hydro-geomorphic types.

3.1 *Hillslope seepage wetlands not feeding a watercourse*

Figure 3 presents the wetland ecosystem services provided by Hillslope seepage wetlands not connected to a watercourse (HGM 3).

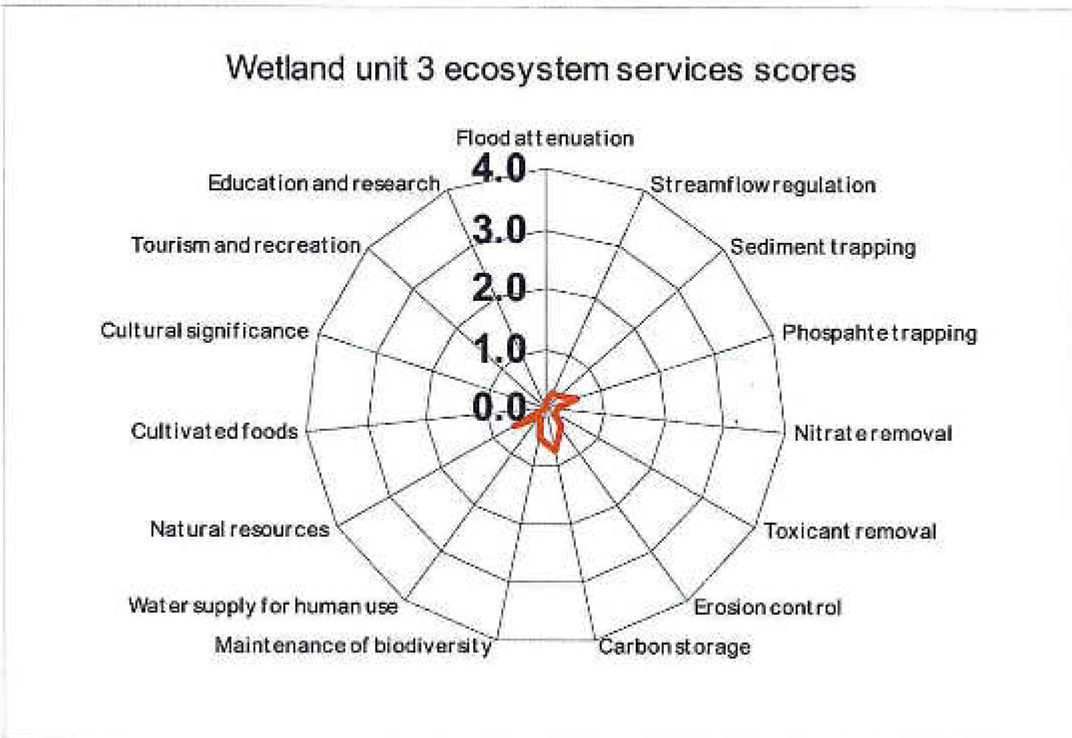


Figure 3: Wetland ecosystem services scores provided by hillslope seepage wetlands not connected to a watercourse within the study area

This wetland type closely resembles hillslope seepages that are connected to a watercourse in terms of sources of water and functioning. The key difference, however, is that these systems tend to have a lower degree of wetness which make little direct contribution to streamflow regulation as they are not directly connected to a watercourse. Some of these settings do however contribute via sub-surface water flow (Kotze *et al*, 2005). The seepage wetland within the study area achieved a very low score due to its relatively small size, however, when seen collectively with similar wetlands spread along the whole course of the river its functional contribution becomes significant especially in terms of erosion control, carbon storage and phosphate trapping.

3.2 *Depressions*

Wetland ecosystem services provided by the ephemeral wetland (HGM 2) are presented graphically in Figure 4.

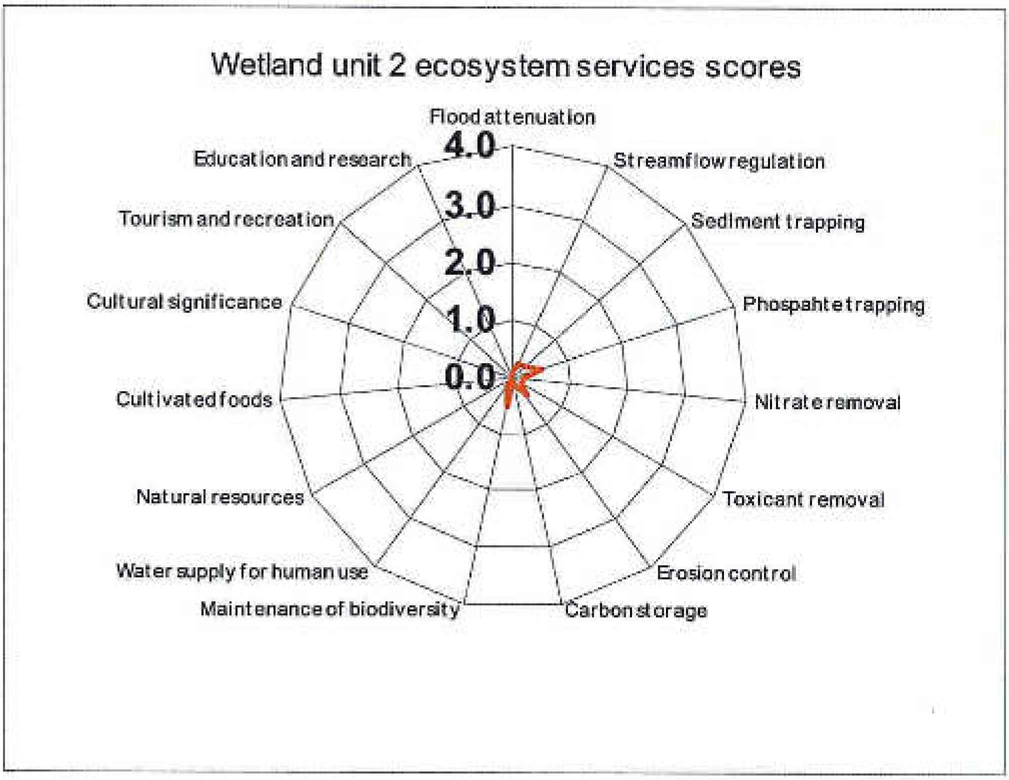


Figure 4: Wetland ecosystem services provided by ephemeral wetland within the study area

Hydro-geomorphic unit 2 consist of a depression which only receives water during rain events and are therefore classed as ephemeral. Depressions can receive both surface and groundwater flows, which accumulate in the depression owing to a generally impervious underlying layer which prevents the water draining away (Goudie and Thomas, 1985; Marshal and Harmse, 1992; Kotze *et al*, 2005). The relative contributions of these different water sources may vary considerably amongst different depressions. The ephemeral wetland in the study area's water contribution is most likely received from surface due to the impenetrable granite layer.

The opportunity for attenuating floods is limited by the position of depressions in the landscape, which is generally isolated from stream channels. However, they do capture runoff because of their inward draining nature, and thus they reduce the volume of surface water that would otherwise reach the stream system and contribute to stormflows. This inward draining nature, together with their generally impermeable underlying layer, however, also means that depressions are unlikely to play a significant role in streamflow regulation, although in the Highveld there appear to be some exceptions to this (Kotze *et al*, 2005). The small size of the ephemeral depression in the study area however makes its potential flood attenuation capabilities negligible.

According to Kotze *et al* (2005), temporary depressions allow for the precipitation of minerals, including phosphate minerals due to the concentrating effects of evaporation. Nitrogen cycling is likely to be important with some losses due to denitrification, and volatilization in the case of high pH's. Water quality in depressions is influenced by the pedology, geology, and local climate (Allan *et al.*, 1995). These factors in turn, also influence the response of these systems to nutrient inputs. In depressions that dry out completely at some stage or another (non-perennial pans), some of the accumulated salts and nutrients (such as organic nitrogen, and various phosphate and sulphate salts) can be transported out of system by wind and be deposited on the surrounding slopes. Those remaining may dissolve again when waters enter the system again as the depression fills after rainfall events.

Functional characteristics for hydro-geomorphic unit 1 would be similar to the above discussed hydro-geomorphic unit 2. Hydro-geomorphic unit 1 however is an artificial wetland and is situated in the landscape where it can not make a contribution to stream flow, significant biodiversity or help maintain connectivity in the landscape, its functionality is therefore greatly reduced.

4. WETLAND BUFFERS

A wetland buffer zone is an area of vegetation which begins from the boundary of a wetland's temporary zone (wetland edge) and extends outward (Water Notes 4, 2000). The purpose of a buffer zone is diverse and can include the continuation of hydrological, biological and socio-economical beneficiary processes. Well-designed buffers protect and maintain wetland functions by removing sediments and associated pollutants from surface water runoff, removing, detaining, or detoxifying nutrients and contaminants from upland sources, influencing the temperature and microclimate of a water body, and providing organic matter to the wetland. Buffers also maintain habitat for aquatic, semi-aquatic, and terrestrial wildlife, and can serve as corridors among local habitat patches, facilitating movement of wildlife through the landscape (Environmental Law Institute, 2008).

Wetland should be assessed on characteristics such as vegetation cover, slope and soil in order to determine the width or size of a buffer zone. Furthermore, the specific function of the buffer zone should be taken into consideration. For example, buffer zones suitable for sensitive Red Data flora or fauna in Gauteng range between 32m (for the greater flamingo) and 1000m (for the Giant Bullfrog) (GDACE, 2006).

Recent literature suggests that activities associated with developments should not have an adverse effect on a wetland or any naturally vegetated land area within 100m of a wetland by altering topography, soil structure, plant community composition, hydrologic regime and/or water quality in such a way as will result in any short-term or long-term adverse effect upon the wetland (Environmental Law Institute, 2008). Activities such as stormwater management should therefore be seen to take into consideration their effect on natural drainage systems by for example incorporating wetland-sensitive interventions such as detention or sedimentation basins, vegetated swales, impermeable paving and buffer strips (Environmental Law Institute, 2008).

Buffering around each HGM unit must not only focus on protecting sensitive habitat for biodiversity, but also take the regional hydrological processes into consideration. The recommended buffer zone for wetlands inside the urban edge is 32m from the edge of the temporary zone (GDACE, 2006) (Figure 2). A 32m buffer zone is therefore recommended for HGM 2 and 3. No buffer zone is recommended for HGM 1 as it is an artificial wetland with very little functionality.

Changes to recommended buffer zones to accommodate a proposed development layout should be accompanied by the following (SEF 2008[1]):

- Scientific support to justify a reduction in the GDACE (2006) buffer zone in terms of the rates of infiltration of water into the soil, surface water runoff rates, and other topographical or geohydrological parameters that may be relevant;
- Indicate on-site mitigation measures that will prevent wetland degradation or that will enhance wetland buffer functioning;
- Reference should be made to the GDACE Conservation Plan;
- Detailed analyses of the foraging, breeding and dispersal requirements of sensitive fauna and flora on the site;
- Detailed wetland sensitive stormwater management plans; and
- The proposed development layout should be indicated with the suggested as well as the reduced buffer zone.

When looking at buffer zones and buffer functionality it is of cardinal importance to take site specific conditions into consideration. According to Batchelor (2010), there are numerous examples where applying a 50m or even a 100m buffer zone (defined as a vegetated strip) did not afford the specific case studies wetlands the necessary protection and were subsequently lost. When considering wetland management and protection, it is fundamental to consider the management of the supporting hydrology. Non wetland areas are therefore as important to consider as the wetlands themselves, as for the most part they are the sources of water that emerge in the wetlands (Batchelor, 2010).

[1] Mr. Support Chavalala, Gauteng Department of Agriculture, Conservation and Environment. Support.Chavalala@gauteng.gov.za

According to DWAF, Section 21(c) and (i) Water use authorisation application process (Impeding or diverting the flow of water in a watercourse, and / or altering the bed, banks, course or characteristics of a watercourse):

- Wetlands and estuaries are extremely sensitive environments and as such, the section 21(c) and (i) water use GA does not apply to:
    - Any wetland or any water resource within a distance of 500 meters upstream or downstream from the boundary of any wetland.

Section 21(c) and (i) further states "*Even though an activity such as an alteration to the banks, or the building of a haul road across a watercourse (a section 21(i) use) may not directly affect flow as contemplated in section 21(c), any activities in the catchment, especially in the immediate vicinity of the watercourse, may affect runoff and lead to changes in flow*".

Thus, according to the above mentioned legislation, any development within 500m of a wetland or a watercourse is subject to a water use application

5. MANGEMENT RECOMMENDATIONS

A wetland sensitive approach is recommended for any development proposal for the study area. The protection of the riparian zone and identified hydrological sensitivities also complement the rocky outcrop sensitivities as identified within the vegetation report. An appropriate open space plan which serves as flood protection, wildlife corridor and wetland buffer should be designed and incorporated into the potential development layout.

Public open spaces should be carefully integrated with natural open spaces keeping the following principals in mind:

- Smaller, intervening patches of surviving habitat can also serve as "stepping stones" that link fragmented ecosystems by ensuring that certain ecological processes are maintained within and between groups of habitat fragments;
- Create ecological corridors that contribute to the conservation of biodiversity by:
    - Supporting connections between remaining natural habitat;
    - Supporting connections between large, intact areas of natural vegetation and adjacent open space systems to facilitate unrestricted dispersal and movement of biota;
    - Including a diverse array of natural habitats, including wetlands;
    - Ensuring that landscaping is done with indigenous plant species;
    - Ensuring that all barriers between properties are permeable to wildlife, e.g. Palisade fencing;

  - Ensuring that road curbs and other such infrastructure are wildlife compatible, e.g. easily crossed with road underpasses and or overpasses etc.
- Existing degradation should be mitigated / rehabilitated, including the removal of rubble and litter of any kind;
- A management plan must be compiled to provide landscaping guidelines that require that landscaping associated with the development include forage and host plants required by pollinators and other fauna;
- All stormwater management features should be constructed in a manner that will ensure the continued functioning of natural landscape, as any changes in surface water flow quality or quantity, will have significant impacts on the surrounding vegetation that in turn affects associated animal groups; and
- Road crossings over any drainage lines must be planned with the utmost care. Provision should be made for the continued undisrupted dispersal of fauna along any drainage lines.

Further general management measures which could potentially be employed on site according to Batchelor (2007) include:

- reducing the risk of erosion in the valley bottom and hillslope seepage wetlands; and
- an appropriate stormwater management system should be designed and implemented.

Batchelor (2007) further states that typical objectives of such a storm water management system should include but not be limited to the following:

- To reproduce as nearly as possible the hydrological conditions at point of discharge that existed prior to development.
- To provide moderate levels of removal for most urban pollutants.
- To be appropriate for the site given physical constraints.
- To have an acceptable future maintenance burden.
- To have a neutral to positive impact on the natural and human environment.

Pre development and post development at the smaller landscape level should direct runoff off the road surface into grass lined channels, stone filled infiltration ditches etc. rather than into an underground piped systems (Batchelor, 2007). The advantages associated with this approach are:

- that runoff is treated both by passing over the grass as well as filtration through the soil and rock packed trench
- the water percolating into the soils reduces the irrigation demand of roadside trees and shrubs
- The attenuation provided by the system reduces the requirement to provide alternative attenuation facilities; and

- Sediment transport into the water courses is obviated as the grass lined swales effectively trap sediment.

Maximising times to concentration by:

- Increasing flow path lengths;
- Decreasing road gradients as far as possible within the constraints of good design practice and site topography; and
- Retaining water on the road surface as long as possible.
- Providing a high density of low capacity detention ponds throughout the affected area.

A number of techniques have been developed to achieve the objectives outlined earlier. Some of the more widely known systems are:

- Detention ponds
- Infiltration trenches
- Porous pavements
- Grassed / vegetated swales
- Filter strips
- sedimentation basins
- Buffer strips

6 CONCLUSION

A total of 3 hydro-geomorphic units were delineated and classified within the study area with a combined surface area of less than one hectare. These included an artificial depression, a natural depression and a hillslope seepage wetland not feeding a watercourse. Further to the hydro geomorphic units delineated, a riparian zone along the Jukskei River was also delineated which represented an important component of the study area.

From a functional perspective, the riparian zone perform a variety of functions that are of value to society, especially the protection and enhancement of water resources, and provision of habitat for plant and animal species

A wetland sensitive approach is recommended for any development proposal for the study area. The protection of the riparian zone and identified hydrological sensitivities also complement the rocky outcrop sensitivities as identified within the vegetation report. An appropriate open space plan which serves as flood protection, wildlife corridor and wetland buffer should be designed and incorporated into the potential development layout.

According to DWAF, Section 21(c) and (i) Water use authorisation application process, any development within 500m of a wetland or a watercourse is subject to a water use application. Several other management recommendations are also made within the report.

7. GLOSSARY

Alien species	Plant taxa in a given area, whose presence there, is due to the intentional or accidental introduction as a result of human activity.
Biodiversity	Biodiversity is the variability among living organisms from all sources including inter alia terrestrial, marine and other aquatic ecosystems and ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.
Biome	A major biotic unit consisting of plant and animal communities having similarities in form and environmental conditions, but not including the abiotic portion of the environment.
Buffer zone	A collar of land that filters edge effects.
Conservation	The management of the biosphere so that it may yield the greatest sustainable benefit to present generation while maintaining its potential to meet the needs and aspirations of future generations. The wise use of natural resources to prevent loss of ecosystems function and integrity.
Critically Endangered	A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future.
Ecosystem	Organisms together with their abiotic environment, forming an interacting system, inhabiting an identifiable space.
Ecological Corridors	Corridors are roadways of natural habitat providing connectivity of various patches of native habitats along or through which faunal species may travel without any obstructions where other solutions are not feasible.
Edge effect	Inappropriate influences from surrounding activities, which physically degrade habitat, endanger resident biota and reduce the functional size of remnant fragments including, for example, the effects of invasive plant and animal species, physical damage and soil compaction caused through trampling and harvesting, abiotic habitat alterations and pollution.
Endangered	A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future.
Exotic species	Plant taxa in a given area, whose presence there, is due to the intentional or accidental introduction as a result of human activity
Fauna	The animal life of a region.

Flora	The plant life of a region.
Forb	A herbaceous plant other than grasses.
Habitat	Type of environment in which plants and animals live.
Indigenous	Any species of plant, shrub or tree that occurs naturally in South Africa.
Invasive species	Naturalised alien plants that have the ability to reproduce, often in large numbers. Aggressive invaders can spread and invade large areas.
Karoid	Dwarf xerophytic woody shrublets and succulents.
Outlier	An observation that is numerically distant from the rest of the data
Primary vegetation	Vegetation state before any disturbances such as cultivation, overgrazing or soil removal
Protected plant	According to the Transvaal Nature Conservation Ordinance of 1983 (No 12 of 1983), no one is allowed to sell, buy, transport, or remove this plant without a permit from the responsible authority.
Threatened	Species that have naturally small populations, and species which have been reduced to small (often unsustainable) population by man's activities.
Red data	A list of species, fauna and flora that require environmental protection. Based on the IUCN definitions.
Species diversity	A measure of the number and relative abundance of species.
Species richness	The number of species in an area or habitat.
Vulnerable	A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future.

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Appendix A

Methodology

The report incorporated a desktop study, as well as field surveys, with a site visit conducted on 13 October 2010.. Additional data sources that were incorporated into the investigation for further reliability included:

- Google Earth images;
- 1:50 000 cadastral maps; and
- ortho-rectified aerial photographs.

Identified wetland areas were marked digitally using GIS (changes in vegetation composition within wetlands as compared to surrounding non-wetland vegetation show up as a different hue on the orthophotos, thus allowing the identification of wetland areas). These were converted to digital image backdrops and delineation lines and boundaries were imposed accordingly after the field surveys.

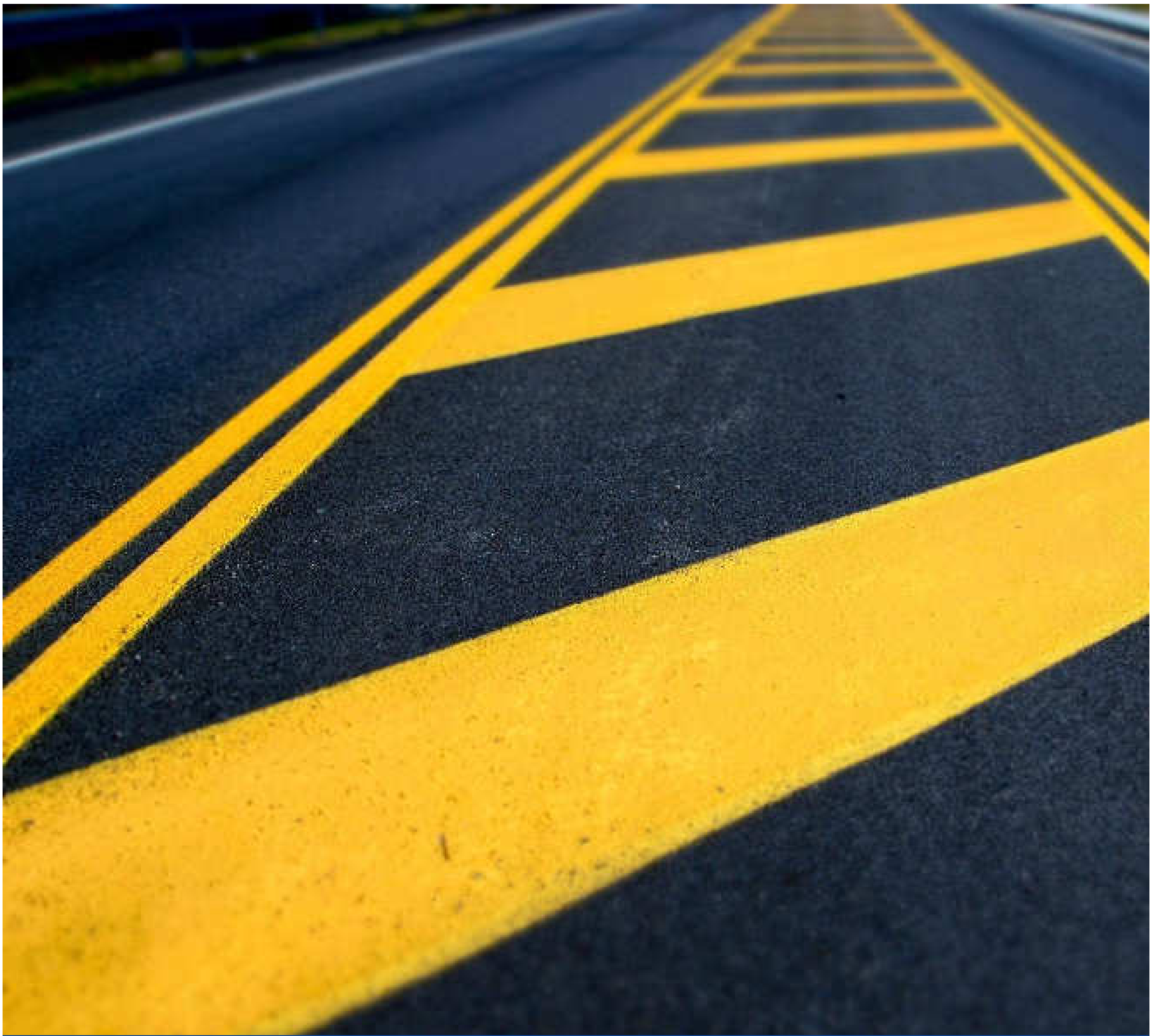
The wetland delineation methodology used was the same as the one set out by the Department of Water affairs and Forestry (DWAF, 2005) document *"A Practical field procedure for the identification and delineation of wetlands and riparian areas"*.

The Department of Water affairs and Forestry (DWAF) wetland delineation guide makes use of indirect indicators of prolonged saturation by water, namely wetland plants (hydrophytes) and (hydromorphic) soils. The presence of these two indicators is indicative of an area that has sufficient saturation to classify the area as a wetland. Hydrophytes were recorded during the site visit and hydromorphic soils in the top 0.5 m of the profile were identified by taking cored soil samples with a bucket soil auger and Dutch clay auger (photographs of the soils were taken). Each auger point was marked with a handheld Global Positioning System (GPS) device. All cored samples were analysed for signs of wetness that indicate wetland associated conditions.. Areas denuded of primary vegetation often corresponded to areas that have been tilled, making vegetation and soil profiles poor wetland indicators.

The methodology *"Wet-EcoServices"* (Kotze *et al*, 2005) was adapted and used to assess the different benefit values of the wetland units. An adapted level two assessment, including a desktop study and a field assessment were preformed to determine the wetland functional benefits between the different hydro-geomorphological types within the study area. Other documents and guidelines used are referenced accordingly. During the field survey, all possible wetlands and drainage lines identified from maps and aerial photos were visited on foot. Where feasible, cross sections were taken to determine the state and boundaries of the wetlands.

Following the field survey, the data was submitted to a GIS program for compilation of the map sets. Subsequently the field survey and desktop survey data were combined within a single project report.

ANNEXURE E7:
FEASIBILITY STUDY



FEASIBILITY & IMPACT STUDY: CENTURY MUSHROOM FARM FILLING STATION

Kyalami X27, City of Johannesburg, Gauteng Province

2015/03/11

Confidentiality: Confidential

Quality Management

Issue/revision	Issue 1	Revision 1	Revision 2	Revision 3
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Date	March 2015			
Prepared by	Eduard Horak			
Signature	Digitally signed by Horak, Eduard Date: 2015.04.01 13:10:22 +02'00'			
Checked by	Pieter Jooste			
Signature				
Authorised by	Eddie Krause Pr Tech Eng			
Signature				
Project number	17260			
Report number				
File reference				

Feasibility & Impact Study: Century Mushroom Farm Filling Station

Kyalami X27, City of Johannesburg, Gauteng Province

2015/03/11

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Table of Contents

1 Summary

A new filling station is proposed for development along Allandale Road in Kyalami Extension 27. The site is positioned to cater for westbound traffic on Allandale Road (gps coordinates: 26°00'14.68" S 28°05'24.32" E). The impact of the proposed trading on existing competitor stations was considered. The study site will not likely cause a significant loss of fuel sales at existing filling stations. A traffic count was conducted on 24 February 2015 and was used to calculate the average monthly fuel sales for a modern, benchmark filling station. The study site will likely sell ± 650’000 litres of fuel per month upon maturity.

2 Project Background

2.1 Introduction

2.1.1.1 *WSP Group Africa (Pty) Ltd.* (WSP) conducted a study to investigate a site for filling station development. An investigation was launched into the possibility of opening and operating a filling station along Allandale Road westbound in Kyalami Extension 27, Gauteng Province. The evaluation will be for a modern filling station; with a canopy covered forecourt; four pumps selling petrol and diesel fuels with a modern ± 200 m² convenience store on a site that has enough space to accommodate all such developments.

2.1.1.2 The purpose of the study is to determine if the proposed site is feasible for operating a modern, benchmark filling station. The feasibility study considers the development viability by assessing the impact on competitor stations and the projected volume of fuel that will be sold.

2.2 Study Area

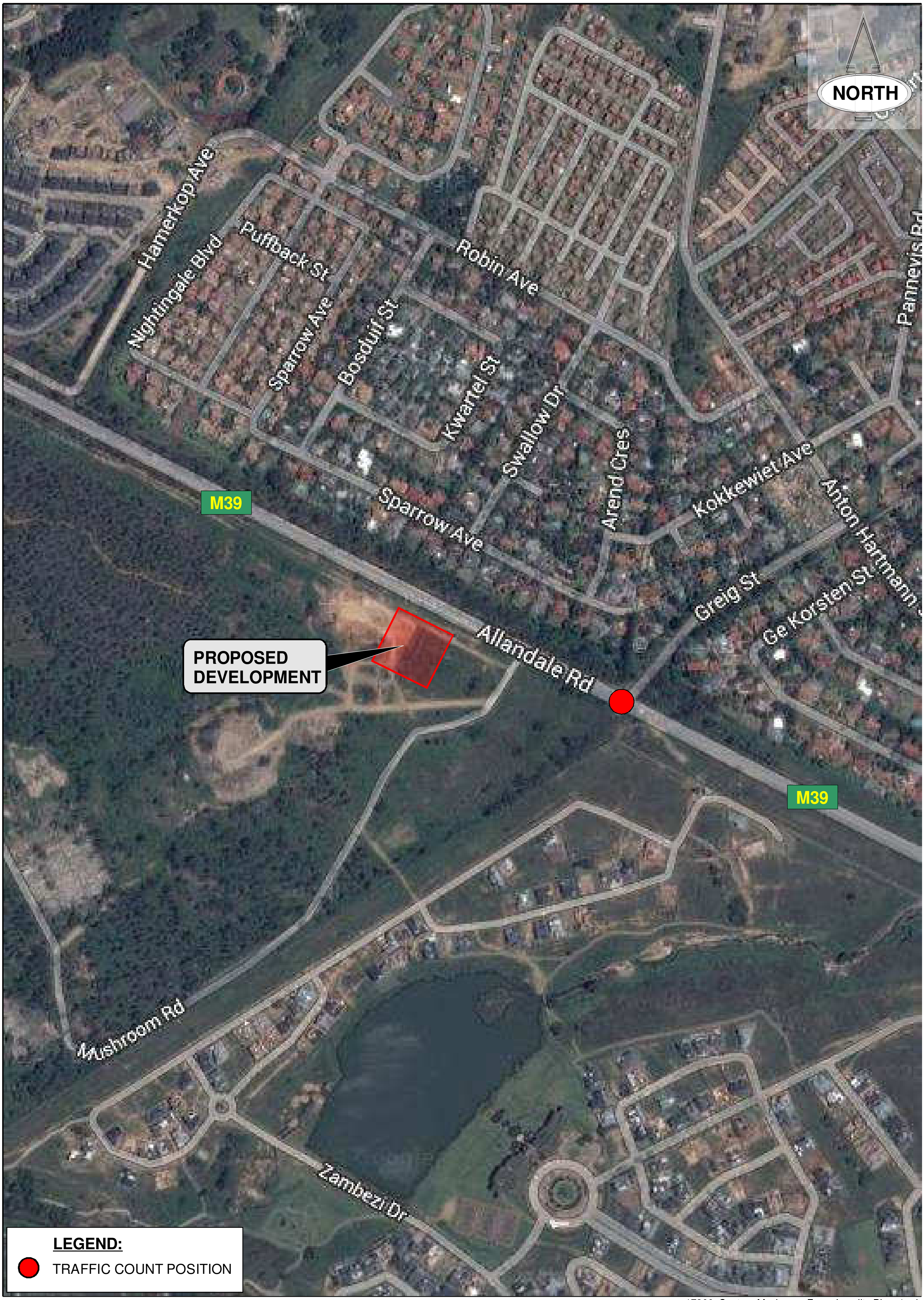
2.2.1.1 The study site is located near the intersection of Greig Street and Allandale Road. The study site's location is indicated in **Figure 1** and a photograph of the site is shown in **Photo 1**. The proposed filling station is currently located on a property and associated development referred to as Mushroom Farm (also previously known as Centro@Kyalami). A combined development is proposed for construction at the study site and is located south of Allandale Road; in-between the alignment of the future road K73 and Greig Street; and extends south and west to the Jukskei River. The proposed filling station's adjacent developments include commercial, office, residential retail shopping centre and other land uses. The size of the adjacent development is approximately 700'000 m² of Gross Leasable Area (GLA).

2.2.1.2 A traffic study for the Kyalami X27 development was conducted previously by Arup and WSP submitted a memorandum for a partial access on Allandale Road. The proposed partial access is located between the intersection of Greig Street and Allandale Road and the future K73 (i.e. west of the filling station site). Considering the likely approval and construction of a partial access immediately west of the filling station site, an estimated 1'800 veh/day will pass the proposed filling station directly in future years.

2.2.1.3 The study area is located in a rapidly developing area of land between Johannesburg and Midrand (i.e. Waterfall). Future roads will be constructed and existing intersections will receive capacity upgrades.

2.3 Traffic Growth

2.3.1.1 Precise traffic growth patterns were not analysed and calculated in depth for this report. Typical traffic growth rates are recommended by the Committee of Transport Officials (COTO) **[1]**. For the study site a growth rate of 6.0% per annum was adopted.



17260_Century Mushroom Farm_Locality Plan_1.cdr

WSP

Project:	Figure:	No.
CENTURY MUSHROOM FARM	**LOCALITY PLAN**	**1**

PROPOSED SITE LOCATION

EASTBOUND VIEW ALONG ALLANDALE ROAD; STUDY SITE WILL CATER FOR WESTBOUND TRAFFIC

WSP Group Africa (Pty) Ltd.
PRETORIA EAST

PROJECT NO.	PROJECT NAME	FIGURE DESCRIPTION	PHOTO NO.
17260	CENTURY MUSHROOM FARM FILLING STATION	PROPOSED SITE	1

2.4 Future Roads

2.4.1.1 WSP authored a memorandum for the proposed partial access on Allandale Road, immediately west of the filling station's location. There are other future roads that will be constructed (i.e. the K73) and capacity upgrades are proposed at the intersection of Greig Street and Allandale Road. It is expected that no future road changes will pose a detriment to the trading of the proposed filling station.

2.5 Evaluation of Study Site

2.5.1.1 The study site was investigated in February 2015. A qualitative assessment from a traffic engineering viewpoint was made of the study site's trading potential. The overall impression of the study site is that it has very good trading potential. The trading potential for the site is rated according to the following scale:

Poor	Average	Moderate	Good	Very Good

2.5.1.2 **Visibility**: The study site has Good visibility. Visibility can be enhanced with appropriate branded signage. The oncoming traffic will be able to see the site clearly once developed.

2.5.1.3 **Location**: The study site is located on a busy transient/arterial route. The location's trading potential is considered Very Good.

2.5.1.4 **Access**: The study site will be accessed by the following positive traffic flow: westbound on Allandale Road. A left-in-left-out access is proposed. The access is considered Good.

2.5.1.5 **Trading Market**: The trading market is considered Very Good for the study site. The study site is positioned mainly to intercept traffic from the Allandale Road arterial catchment market and it will serve the local developing market. The westbound volume of traffic on Allandale Road is > 13'000 vehicles per day.

2.5.1.6 **Competitor Stations**: There are no existing filling stations serving Allandale Road west of the N1. The trading potential against existing competitor stations is considered Very Good for the study site. No other existing competitor station provides a modern, benchmark offering to passing road users.

3 Impact on Existing Sites

3.1 Competitor Sites

3.1.1.1 To determine the impact on surrounding sites in a suburban/urban environment it is typical to look at all stations sharing the same catchment markets and the impact on adjacent catchment markets. This guideline is used by various departments, major fuel companies and agencies. The impact investigation considered the catchment markets the study site would serve and the impact on existing stations located within those catchment markets. The closest existing stations in adjacent catchment markets were also considered in the impact investigation. Two (2) existing sites were considered for this study. **Figure 2** illustrates the competitor sites in relation to the different markets within the critical area of influence.

3.2 Catchment Markets

3.2.1.1 Physical man-made barriers (such as freeways, railway lines, airports) or natural barriers (such as mountains, rivers and dams) create different markets (catchment areas for a site). The type of commuters (local vs. transient) is also considered for the catchment market. The study site is positioned to cater for the Atlas Road westbound arterial market. The following catchment markets were considered for the study site:

- A: The arterial/transient catchment market of Allandale Road; westbound between the N1 and R55;
- B: The future local catchment market of Mushroom Farm/Kyalami X27, south of Allandale Road;
- C: The local market of Barbeque Downs Business Park and Kyalami Glen;
- D: The local market of Waterfall;
- E: The local market of Willaway;
- F: The R55 arterial/transient market.

3.3 Impact on Existing Sites

3.3.1.1 To assess the impact of the proposed filling station on other filling stations, the shared traffic streams were considered. The amount of traffic shared between the study site and existing sites depend on the distance between the sites; number of lanes; road alignment; number of intersections between sites; and surrounding developments (e.g. shopping malls or motor showrooms that generate traffic). Shared traffic only gives an indication of the daily traffic movement patterns and no inference can be made on loss of fuel sales at existing stations.

3.3.1.2 Little knowledge is available on how drivers make their decision at which filling station to fill up, but it is influenced by the same factors determining the turn-in percentage (interception rate). Other regulating agencies, such as the Department of Energy, consider passing road users' access to petroleum products at existing filling stations and not all the factors influencing the interception rate.

These factors will determine the moving market factor (i.e. when the study site gains fuel from other existing stations).

3.3.1.3 Research[1] indicates several factors that influence the moving market between competing filling stations. From experience, WSP has observed that the convenience store at a facility plays a significant role in attracting passing road users. Different petrol brands play a very small role in consumer motivations. The price of the convenience store goods plays a limited role in re-patronage. Aesthetic factors impact on re-patronage and total customer experience (i.e. the interception rate factors discussed previously) lead people to become more frequent patrons of a filling station.

3.3.1.4 In short, it is the station that delivers the best overall experience and service to customers that outperforms competitors. The following impact on existing station(s) is considered for this study:

3.3.2 Engen Kyalami

3.3.2.1 This station is located along the R55 northbound at the intersection of Dytchley Road, approximately located at the following coordinates: 26°00'10.02" S 28°04'33.11" E. The station is located 1.4 km (i.e. 2.1 km measured by road) west of the study site. This station will likely not share a significant portion of traffic with the study site and it also serves its own, dedicated local market in Barbeque Downs. The facility offers six fuel pumps; all pumps have six-nozzle dispensers. An average fill of 24 litres per vehicle was observed. The station is not clearly visible from the R55 and the alignment of the access road makes the site less desirable to access. A branded convenience store is available; the service and offering are of good quality. A photograph of this station is shown in **Annexure A**.

3.3.3 Total Campbells

3.3.3.1 This recently rebranded Total station is located in the suburbs northeast of the study site. The Total station is located 1.5 km (i.e. 2.7 km measured by road) northeast of the study site and can be accessed from Harry Galaun Drive and Jamie Uys Street. The forecourt offers four fuel pumps with eight-nozzle dispensers. A separate, remote diesel pump is also available at the site. The facilities' amenities include a branded convenience store, ATM and car wash. An average fill of 23 litres per vehicle was observed. This station is a modern, benchmark competitor and will not likely be affected by a new filling station trading at the study site location. There is likely no significant amount of shared traffic between the study site and the Total station. A photograph of this station is shown in **Annexure A**.

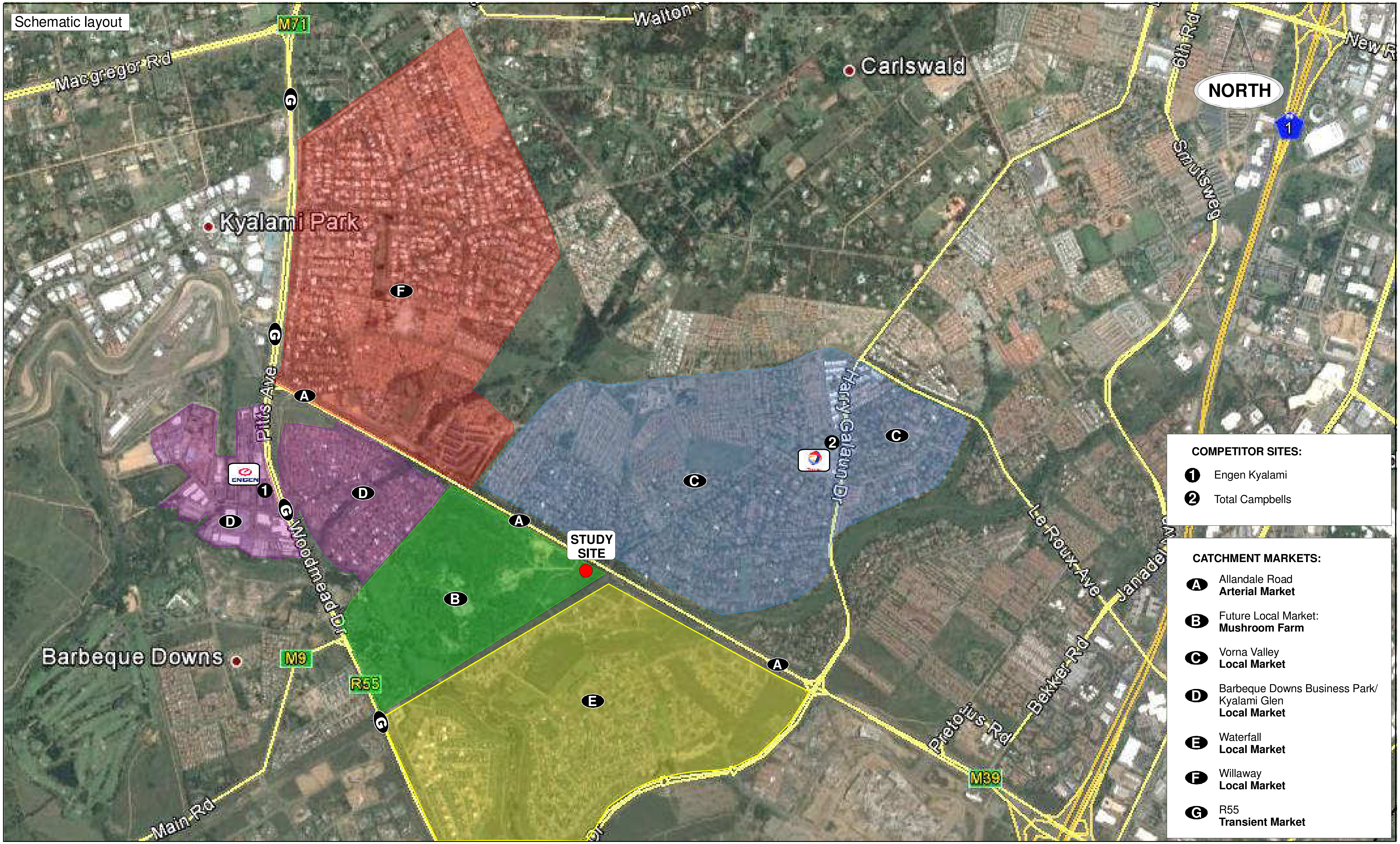
3.3.4 Other Filling Stations

3.3.4.1 There are numerous other filling stations located within a 5 km radius. None of these stations share a significant portion of traffic with the study site. The study site does not compete with an existing station in an already served catchment market.

[1] M.M. Molefe. 2006. *Consumer Motivations in Forecourt Convenience Retail in South Africa*. University of Pretoria

3.4 Conclusions on Competitor Stations

3.4.1.1 There are two competitor stations that were investigated for the impact of a new station at the study site location. The study site will not likely cause a significant loss of fuel sales for the Engen and Total stations.



17260_Century Maushroom Farm_Competitor Sites_Figure 2.cdr

WSP

Project:	Figure Description:	No.
CENTURY MUSHROOM FARM	COMPETITOR SITES	2

4 Estimated Sales of Proposed Site

4.1 Fuel Sales Volume Forecast Background

4.1.1.1 The following empiric formula is used by the fuel industry to calculate the expected average litres of fuel to be sold in a month:

$$L = ADT \times \bar{F} \times p \times d$$

Litres per month (*L*)	=	[Vehicles per day passing the site (*ADT*)] x
		[Average fill per vehicle ($\bar{F}$)] x
		[Percentage vehicles of pass-by traffic turning into the site (*p*)] x
		[Average full normal trading days in a month (*d*)]

Each of the factors used in the calculations for fuel sales are discussed in this chapter.

4.2 Traffic Demand

4.2.1.1 Traffic counts were used to estimate the traffic demand and traffic volume for the study site. WSP conducted a traffic count on Tuesday 24 February 2015 that was classified according to 3 vehicle classes (i.e. light-, heavy-, and minibus taxi traffic). Details of the traffic count are attached to this report as **Annexure B**.

4.2.1.2 The Average Daily Traffic (ADT) exposed to the site is approximately ± 26'700 vehicles per day. The traffic volumes are split in the following manner:

- ± 11'100 vehicles per day travelling eastbound along Allandale Road;
- ± 13'000 vehicles per day travelling westbound, directly past the site, along Allandale Road; and
- ± 1'800 vehicles per day of future local traffic with the adjacent partial access on Allandale Road.

4.3 Average Fill

4.3.1.1 The average fill per vehicle, facilities provided at the various sites, and estimated current monthly sales were surveyed at relevant sites within the study area. The average fill expected from the subject site was consequently estimated, given the location and expected increase in amount and quality of facilities.

4.3.1.2 The average fills were surveyed and were adopted from experience with similar existing stations trading in a typical urban arterial market. The majority of road users passing the site are considered to be transient/arterial traffic with a large portion of local commuters. An average fill for competitor stations was calculated at 23.5 litres per fill.

4.3.1.3 For the study site an average fill of **24 litres per vehicle** was adopted for all fuel sales.

4.4 Interception Rates

4.4.1.1 The turn-in percentage (i.e. interception rate) of a passing road user is determined by the following factors:

- Convenience (clean and aesthetically pleasing facility; easily accessible);
- Visibility (passing road users have adequate time to decide whether to turn into facility or not);
- Volume of passing traffic (as detailed in traffic count);
- Type of traffic (transient, commuter, residential, etc.)
- Competitor filling stations and their service to the public;
- Service offering at study site (e.g. branded convenience store, ATM, car wash, fast food, etc.);
- Good accesses (proper deceleration and acceleration lanes);
- Location of site (homebound or work-bound traffic);
- Site layout (is stand large enough to have a facility with proper circulation).

4.4.1.2 The expected interception rates for the study site are summarised in **Table 1**. The study site is only accessible for the westbound flow on Allandale Road.

Table 1: Interception Rates

ROAD AND DIRECTION	ADOPTED INTERCEPTION RATE
Allandale Road Eastbound	-
Allandale Road Westbound	4.00%
Future Local Traffic	10.00%

4.5 Full Trading Days in a Month

4.5.1.1 The definition of full normal trading days in a month is the number of typical weekday sales in a month. A typical weekday is a Tuesday, Wednesday or a Thursday during a week with no school holidays or public holidays. If there was no variation in the traffic there would have been 30.5 (365/12) full normal trading days in a month. If, for example, the weekend traffic demand is lower than during the week, the full normal trading days in a month become less.

4.5.1.2 It is thus wrong to assume that a default value of 30.5 days should be used due to the fact that a 24 hour facility will be operated for each day of the month. Traffic patterns have an impact on the number of trading days per month. The analysis assumed **29 trading days** per month for all traffic.

4.6 Expected Monthly Sales

4.6.1.1 The estimated fuel sales are calculated in **Table 2**. A general guideline is used when estimating fuel sales for future years. Upon the first two years of operation a filling station's fuel sales reach a high percentage of their full potential, but only during the third year the full (100%) potential is usually reached.

Table 2: Summary of Fuel Sales

MUSHROOM FARM FILLING STATION

MONTHLY SALES POTENTIAL	ALL FUEL SALES				
MOVEMENT	ALLANDALE ROAD				
	NB	SB	EB	WB	FUTURE TRAFFIC
Traffic Flow (Veh/day)			11 120	13 007	1 800
Average Fill (Litres/Veh)			24.0	24.0	24.0
Trading Days (Days/Month)			29	29	29
Interception Rate (%)			-	4.00%	10.00%
SUB-TOTAL	-	-	-	362 115	125 280
SALES POTENTIAL	487 395				
TOTAL ESTIMATED CURRENT MONTHLY SALES POTENTIAL					487 395

ANNUAL FORECAST - MONTHLY SALES POTENTIAL						
PERIOD		POTENTIAL GROWTH		ESTIMATED LITRES		TOTAL
YEAR		Percentage of Potential	Growth Rate	PETROL	DIESEL	LITRES PER MONTH
1	2016	85%	6.00%	439 143	52 697	491 840
2	2017	95%	6.00%	520 255	62 431	582 686
3	2018	100%	6.00%	580 495	69 659	650 155

4.6.1.2 The estimated fuel sales for the study site can allow for the development of a feasible filling station. WSP has previously consulted with filling station developers and considered several development cases for the minimum fuel sales threshold at a new filling station expressed as litres of fuel sold per month. **Table 3** provides a summary of the typical costs associated with a new, modern filling station and the monthly fuel sales that are required for feasibility. Note that these costs do not reflect actual costs applicable to the study site and are only stated as information.

Table 3: Typical Costs of a New Filling Station

COST ITEM	CONSTITUENT COST	COST
1. ZONED PROPERTY		R 4 750 000.00
1.1 Rights, EIA, licences, etc.	R 1 000 000.00	
1.2 Land Cost	R 3 000 000.00	
1.3 Developer Profit	R 500 000.00	
1.4 Bulk Service Contribution	R 250 000.00	
2. CIVIL ENGINEERING CONTRACT		R 3 000 000.00
2.1 Access	R 1 650 000.00	
2.2 Internal Roads	R 1 000 000.00	
2.3 Services	R 350 000.00	
3. BUILDER'S CONTRACT		R 7 700 000.00
3.1 Building	R 2 500 000.00	
3.2 Canopy	R 600 000.00	
3.3 Pump & Tank	R 2 100 000.00	
3.4 Signage	R 700 000.00	
3.5 Shopfitting	R 500 000.00	
3.6 Computer System	R 200 000.00	
3.7 Professional Fees	R 1 100 000.00	
SUB-TOTAL		R 15 450 000.00
AVG MONTHLY FUEL SALES FEASIBILITY THRESHOLD:		400'000 lpm

5 Other Traffic Engineering Considerations

5.1 Impact on Traffic Flow Past the Site (Road Safety)

5.1.1.1 The Johannesburg Roads Agency and GAUTRANS are the applicable authorities for the study site. The road authorities have identified the possible negative impact a filling station can have on the traffic flow past a site. Therefore, a design manual was compiled after proper research was conducted and input from various experienced traffic engineers was obtained to ensure the road safety is not negatively affected when establishing a filling station site **[2]**.

5.1.1.2 The proposed site can comply with the minimum standards of the relevant design document (i.e. BB2 guideline).

5.1.1.3 The site is large enough to accommodate the required minimum distances as recommended by guidelines. Sight distance, which is a key factor in determining traffic safety at any intersection or road, is good at the proposed site.

5.1.1.4 The impact of the proposed site on the traffic flow is considered for two different phases of the station's construction and operation.

5.1.2 During the Construction Phase

5.1.2.1 During the construction phase specialised heavy vehicles could affect and/or disrupt the background traffic flows. During this phase issues of possible increased traffic congestion, temporary impediments on the existing roadway and influence on adjacent developments must be considered.

5.1.3 During the Operational Phase

5.1.3.1 During the operational phase the existing traffic flow patterns on the roadways adjacent to the proposed site are expected to vary and change over time. Filling stations are developments that intercept trips from the background traffic as opposed to other developments that generate additional trips. The interception of traffic could cause minor disruptions if not considered thoroughly. The following issues should be considered to minimise the possible negative impacts the proposed filling station might have on the passing traffic volumes:

- The detail design of the proposed filling station should adhere to the prescribed specifications (and subsequent approval) of the applicable road authorities;
- Care should be taken pertaining to the placing of signage in the proximity of access points to the proposed filling station;
- Issues pertaining to damages and poor condition of the roads in close proximity of the site should be reported to the applicable authority and custodian of the respective roads; and
- Appropriate signage and traffic measures should be implemented at the site to ensure safe and convenient access for passing traffic volumes.

5.1.3.2 It is concluded that the impact on the existing traffic past the site will not be negatively affected by the proposed filling station's operations.

5.2 Delivery Vehicle Path

5.2.1.1 Similar to road safety, the paths of the delivery vehicle are also evaluated by the road authority. The geometric standards adopted in the design manuals allow for the delivery vehicle entering and exiting the sites safely. Typically, the entrance lane width should be at least 5 m to accommodate a Single Unit + Trailer Heavy Vehicle. For light vehicles only the required width would be 3.5m.

5.2.1.2 It is concluded that the proposed filling station will be able to accommodate the delivery vehicle.

6 Conclusions

6.1 Fuel Sales and Impact Conclusion

6.1.1.1 The study site will not share a significant portion of traffic with any existing competitor station.

6.1.1.2 The study site is positioned to be a modern, benchmark station that is encountered on Allandale Road approximately 2.9 km west of its interchange with the N1.

6.1.1.3 The expected fuel sales are summarised in **Table 2**. The estimated fuel sales volume for the proposed filling station's third year of operation is ± 650'000 litres per month.

6.2 General Conclusions

6.2.1.1 The study site has very good trading potential.

6.2.1.2 The study site can be considered feasible based on the typical filling station development costs summarised in **Table 3**.

6.2.1.3 The study site has the approval from a traffic engineering point of view.

7 References

[1]	TMH 17 Volume 1, South African Trip Data Manual, Version 1.0, Committee of Transport Officials (COTO), September 2012.
[2]	Guidelines for Access to Filling Stations (BB2), Gauteng Provincial Government, Department of Public Transport, Roads and Works, November 2003.

Annexures

A. Supplementary Photos

B. Traffic Count Report

STUDY SITE INTERSECTION

GREIG STREET & ALLANDALE ROAD

WSP Group Africa (Pty) Ltd.
PRETORIA EAST

PROJECT NO.	PROJECT NAME	FIGURE DESCRIPTION	PHOTO NO.
17260	CENTURY MUSHROOM FARM FILLING STATION	SITE LOCATION	2

ENGEN KYALAMI BARBEQUE DOWNS

26°00'10.02" S 28°04'33.11" E

WSP Group Africa (Pty) Ltd.
PRETORIA EAST

PROJECT NO.	PROJECT NAME	FIGURE DESCRIPTION	PHOTO NO.
17260	CENTURY MUSHROOM FARM FILLING STATION	COMPETITOR SITE	3

TOTAL CAMPBELLS

25°59'56.73" S 28°06'13.74" E

WSP Group Africa (Pty) Ltd.
PRETORIA EAST

PROJECT NO.	PROJECT NAME	FIGURE DESCRIPTION	PHOTO NO.
17260	CENTURY MUSHROOM FARM FILLING STATION	COMPETITOR SITE	4

TRAFFIC COUNT

ONE DAY CLASSIFIED

1 INTERSECTION COUNT

CENTURY MUSHROOM FARM

PROPOSED NEW FILLING STATION

VORNA VALLEY - MIDRAND - ALLANDALE ROAD

CENTURY PROPERTY DEVELOPERS

PREPARED FOR CLIENT :

COUNT DATE	Tuesday 24 February 2015
DATE APPROVED	February 2015
WSP PROJECT ENGINEER	**EDUARD HORAK**
PROJECT TECHNICIAN	**LYNETTE VAN ZYL**
PROJECT NUMBER	17260

UNITED BY OUR DIFFERENCE

WSP SA Civil and Structural Engineers (Pty) Ltd.

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WSP Offices Worldwide
www.wspgroup.co.za
Registered No. 1970008603/07

TRAFFIC COUNT

PROJECT INFORMATION

PROJECT DETAILS

WSP PROJECT NAME	**CENTURY MUSHROOM FARM**
PROJECT TYPE	**PROPOSED NEW FILLING STATION**
SITE LOCATION	**VORNA VALLEY - MIDRAND - ALLANDALE ROAD**

TRAFFIC COUNT INFORMATION	**INTERSECTION COUNTED :**
INTERSECTION	ALLANDALE ROAD - GREIG STREET
TYPE OF SURVEY	**13 HOURS**
COUNT DATE	**Tuesday 24 February 2015**

PROJECT TEAM

WSP PROJECT ENGINEER	**EDUARD HORAK**
E-MAIL ADDRESS	eduard.horak@wspgroup.co.za
DATE APPROVED	February 2015
SIGNATURE	Digitally signed by Horak, Eduard Date: 2015.02.26 15:06:51 +02'00'
PROJECT TECHNICIAN	**LYNETTE VAN ZYL**
PROJECT NUMBER	**17260**
DATA COUNT REFERENCE	TSS-BERTW

CLIENT DETAILS

CLIENT COMPANY NAME	**CENTURY PROPERTY DEVELOPERS**
CLIENT CONTACT PERSON	**Harm Schreurs**
E-MAIL ADDRESS	harm@century.co.za

Table of Contents

TABLE OF CONTENTS

BACKGROUND 1

PROJECT NAME	CENTURY MUSHROOM FARM
SITE LOCATION	VORNA VALLEY - MIDRAND - ALLANDALE ROAD
COUNT DATE	Tuesday 24 February 2015
TYPE OF SURVEY	13 HOURS

SURVEY BACKGROUND & FIELD OBSERVATIONS

SURVEY BACKGROUND & FIELD OBSERVATIONS

SURVEY BACKGROUND

& FIELD OBSERVATIONS

1.1 INTRODUCTION & BACKGROUND

WSP SA Civil & Structural Engineers were appointed by CENTURY PROPERTY DEVELOPERS
to do a **Traffic Count** at :

VORNA VALLEY - MIDRAND - ALLANDALE ROAD

INTERSECTION COUNTED :

1 ALLANDALE ROAD - GREIG STREET

1.2 WEATHER CONDITIONS

The following weather conditions were recorded:

AM CONDITIONS:

- ✓ Mild
- ✓ Sunny
- ✓ No Rain
- ✓ No Wind

PM CONDITIONS:

- ✓ Hot
- ✓ Sunny
- ✓ No Rain
- ✓ Mild Wind

1.3 FIELD OBSERVATIONS

The following conditions and incidents were recorded:

AM OBSERVATIONS:

- ✓ Relatively Good Conditions
- ✓ No Incidents
- ✓ No Obstructions

PM OBSERVATIONS:

- ✓ Relatively Good Conditions
- ✓ No Incidents
- ✓ No Obstructions

SPECIAL NOTE :

1.4 GENERAL

This **Traffic Count** was subjected to the conditions as stipulated above and these conditions and incidents were taken into account.

SITE LOCATION 2

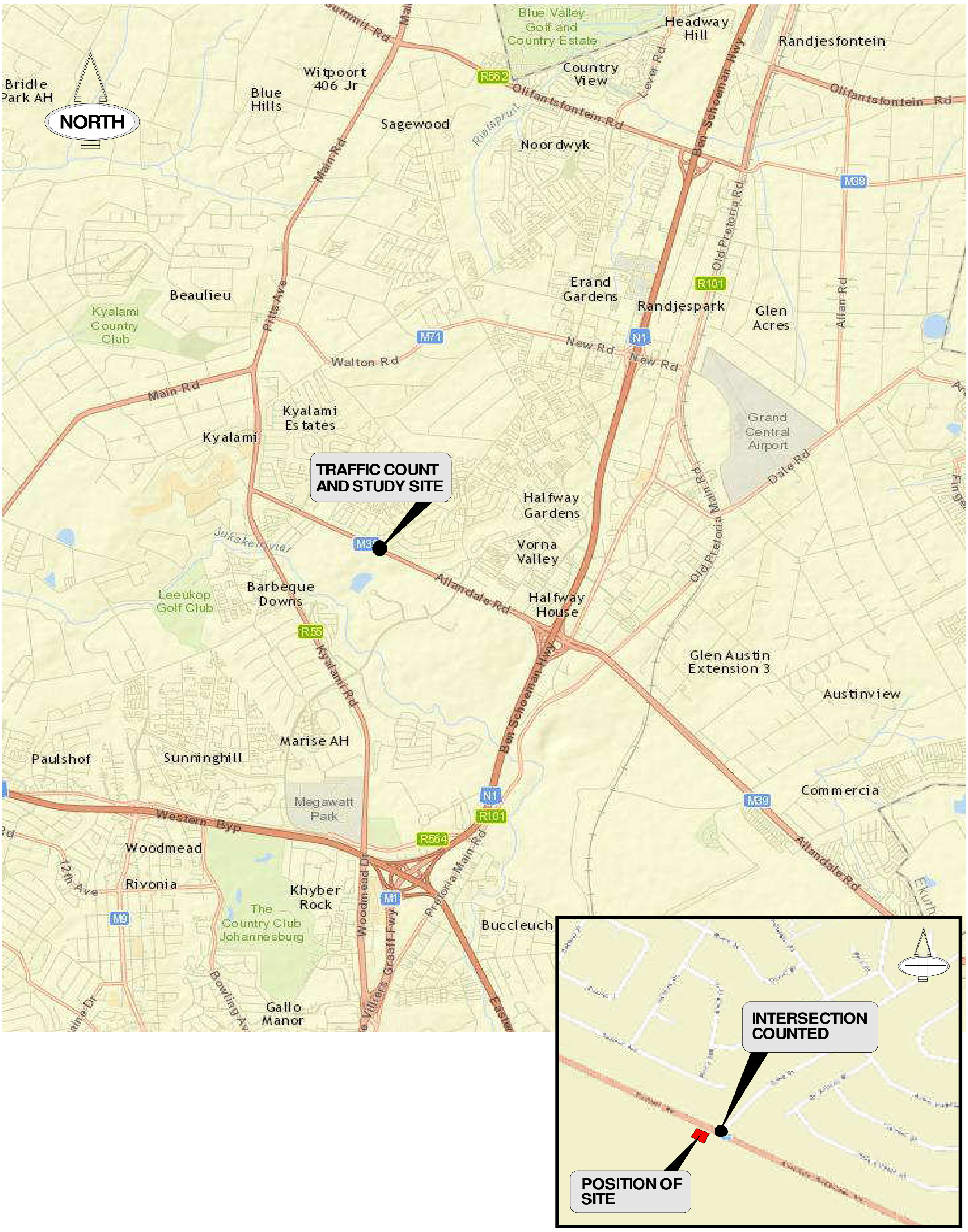
PROJECT NAME	CENTURY MUSHROOM FARM
SITE LOCATION	VORNA VALLEY - MIDRAND - ALLANDALE ROAD
COUNT DATE	Tuesday 24 February 2015
TYPE OF SURVEY	13 HOURS

LOCALITY PLAN

LOCALITY PLAN

FIGURE 1

SITE LOCATION



SITE LOCATION	FIGURE	NUMBER
VORNA VALLEY - MIDRAND - ALLANDALE ROAD	LOCALITY PLAN	1
PROJECT	**CHECKED BY**	**PROJECT**
CENTURY MUSHROOM FARM	EDUARD HORAK	17260

WSP SA Civil & Structural Engineers (Pty) Ltd.

PRETORIA EAST

WSP

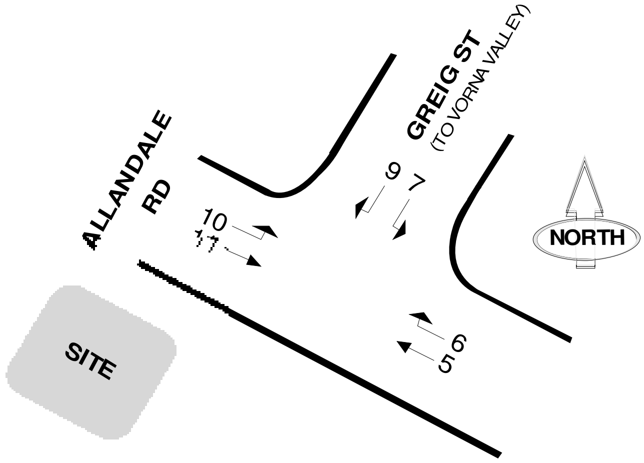
TRAFFIC COUNT 3

PROJECT NAME	CENTURY MUSHROOM FARM
INTERSECTION	ALLANDALE ROAD - GREIG STREET
COUNT DATE	Tuesday 24 February 2015
TYPE OF SURVEY	13 HOURS

INTERSECTION COUNT

INTERSECTION ALLANDALE ROAD - GREIG STREET

TRAFFIC MOVEMENT



WSP SA Civil & Structural Engineers (Pty) Ltd.

PRETORIA EAST

INTERSECTION	FIGURE	NUMBER
ALLANDALE ROAD - GREIG STREET	TRAFFIC MOVEMENT	2
PROJECT	CHECKED BY	PROJECT
CENTURY MUSHROOM FARM	EDUARD HORAK	17260

TRAFFIC COUNT	CENTURY MUSHROOM FARM
INTERSECTION	ALLANDALE ROAD - GREIG STREET
TYPE OF SURVEY	13 HOURS
COUNT DATE	Tuesday 24 February 2015

WSP

Project No. 17260

SUMMARY OF ALL VEHICLES

TIME		NORTHBOUND			WESTBOUND			SOUTHBOUND			EASTBOUND			
START	END					5	6	7		9	10	11		TOTAL
06:00	06:15					114	1	32		28	7	106		288
06:15	06:30					170	5	61		69	11	210		526
06:30	06:45					182	3	80		100	14	214		593
06:45	07:00					224	12	88		110	24	207		665
07:00	07:15					216	9	46		133	25	194		623
07:15	07:30					220	8	28		84	16	194		550
07:30	07:45					220	5	21		98	20	155		519
07:45	08:00					224	2	34		70	13	141		484
08:00	08:15					183	9	41		80	29	236		578
08:15	08:30					140	11	31		54	17	178		431
08:30	08:45					139	12	30		30	18	248		477
08:45	09:00					120	7	22		32	18	195		394
09:00	09:15					158	3	17		25	13	160		376
09:15	09:30					146	5	21		23	18	137		350
09:30	09:45					142	5	18		19	14	134		332
09:45	10:00					137	6	17		17	14	133		324
10:00	10:15					136	7	17		13	18	134		325
10:15	10:30					132	6	14		12	17	132		313
10:30	10:45					126	6	13		7	20	133		305
10:45	11:00					167	10	8		9	13	142		349
11:00	11:15					177	13	8		16	20	145		379
11:15	11:30					128	7	5		5	17	127		289
11:30	11:45					127	11	7		8	10	101		264
11:45	12:00					157	14	9		13	16	148		357
12:00	12:15					152	8	6		23	15	120		324
12:15	12:30					158	10	6		11	17	119		321
12:30	12:45					183	9	11		16	17	120		356
12:45	13:00					184	14	8		17	33	149		405
13:00	13:15					145	12	8		16	14	132		327
13:15	13:30					183	16	10		15	15	107		346
13:30	13:45					216	14	14		23	24	148		439
13:45	14:00					132	8	8		11	15	112		286
14:00	14:15					205	13	12		12	34	130		406
14:15	14:30					173	21	12		14	15	110		345
14:30	14:45					170	24	11		16	20	113		354
14:45	15:00					173	25	11		16	25	113		363
15:00	15:15					185	27	11		18	33	114		388
15:15	15:30					174	18	5		10	28	168		403
15:30	15:45					181	17	8		23	31	145		405
15:45	16:00					210	25	5		11	43	129		423
16:00	16:15					229	39	4		16	53	143		484
16:15	16:30					247	15	5		15	48	196		526
16:30	16:45					270	59	15		24	76	190		634
16:45	17:00					223	62	16		24	74	183		582
17:00	17:15					248	70	9		21	64	177		589
17:15	17:30					224	91	9		14	83	164		585
17:30	17:45					213	74	9		21	74	181		572
17:45	18:00					242	90	11		15	93	153		604
18:00	18:15					190	95	6		16	77	117		501
18:15	18:30					172	89	15		22	41	102		441
18:30	18:45					167	83	13		18	31	95		407
18:45	19:00					174	83	11		18	36	102		424
TOTAL						9 308	1 288	937		1 531	1 531	7 736		22 331
EST. 24 HR						11 170	1 546	1 124		1 837	1 837	9 283		26 797

TRAFFIC COUNT	CENTURY MUSHROOM FARM
INTERSECTION	ALLANDALE ROAD - GREIG STREET
TYPE OF SURVEY	13 HOURS
COUNT DATE	Tuesday 24 February 2015

WSP

Project No. 17260

TRAFFIC MOVEMENT : LIGHT VEHICLES

TIME		NORTHBOUND			WESTBOUND			SOUTHBOUND			EASTBOUND			
START	END					5	6	7		9	10	11		TOTAL
06:00	06:15					99	1	32		25	7	102		266
06:15	06:30					151	5	61		67	11	186		481
06:30	06:45					163	3	80		97	14	194		551
06:45	07:00					195	12	88		106	24	194		619
07:00	07:15					192	9	46		132	25	175		579
07:15	07:30					200	7	28		84	16	183		518
07:30	07:45					201	4	21		98	20	147		491
07:45	08:00					205	1	34		68	13	135		456
08:00	08:15					167	8	41		77	27	222		542
08:15	08:30					119	8	31		53	17	166		394
08:30	08:45					124	11	30		30	18	236		449
08:45	09:00					108	7	22		32	18	176		363
09:00	09:15					141	3	16		25	13	147		345
09:15	09:30					135	5	20		23	14	126		323
09:30	09:45					133	5	18		19	12	124		311
09:45	10:00					128	6	16		15	14	123		302
10:00	10:15					125	7	17		13	16	121		299
10:15	10:30					122	6	13		11	17	119		288
10:30	10:45					117	6	13		7	18	118		279
10:45	11:00					146	9	7		8	13	126		309
11:00	11:15					166	13	8		15	16	131		349
11:15	11:30					116	6	4		5	13	118		262
11:30	11:45					121	11	5		7	10	97		251
11:45	12:00					144	14	9		13	14	139		333
12:00	12:15					132	7	6		21	15	111		292
12:15	12:30					151	9	6		10	17	112		305
12:30	12:45					168	9	11		16	17	108		329
12:45	13:00					173	14	8		17	31	145		388
13:00	13:15					129	12	8		16	14	122		301
13:15	13:30					171	16	8		15	15	98		323
13:30	13:45					199	13	13		22	24	138		409
13:45	14:00					120	8	8		11	15	92		254
14:00	14:15					184	13	11		12	34	116		370
14:15	14:30					165	21	12		13	15	99		325
14:30	14:45					166	23	11		14	18	100		332
14:45	15:00					167	25	10		15	25	101		343
15:00	15:15					168	27	9		16	32	104		356
15:15	15:30					162	16	5		10	28	143		364
15:30	15:45					163	17	7		22	27	136		372
15:45	16:00					197	24	5		9	41	118		394
16:00	16:15					218	39	4		13	52	133		459
16:15	16:30					232	15	5		15	47	182		496
16:30	16:45					253	59	14		22	76	170		594
16:45	17:00					211	62	15		23	73	166		550
17:00	17:15					234	70	9		21	64	155		553
17:15	17:30					213	90	7		14	83	152		559
17:30	17:45					198	74	8		19	74	169		542
17:45	18:00					219	90	11		15	93	140		568
18:00	18:15					183	95	6		15	76	111		486
18:15	18:30					166	89	15		22	41	92		425
18:30	18:45					164	83	12		17	31	89		396
18:45	19:00					169	83	11		18	36	93		410
TOTAL						8 593	1 270	915		1 483	1 494	7 100		20 855
EST. 24 HR						10 312	1 524	1 098		1 780	1 793	8 520		25 026

TRAFFIC COUNT	CENTURY MUSHROOM FARM
INTERSECTION	ALLANDALE ROAD - GREIG STREET
TYPE OF SURVEY	13 HOURS
COUNT DATE	Tuesday 24 February 2015

WSP

Project No. 17260

TRAFFIC MOVEMENT : TAXIS

TIME		NORTHBOUND			WESTBOUND			SOUTHBOUND			EASTBOUND			
START	END					5	6	7		9	10	11		TOTAL
06:00	06:15					14	0	0		3	0	4		**21**
06:15	06:30					17	0	0		2	0	18		**37**
06:30	06:45					16	0	0		3	0	17		**36**
06:45	07:00					21	0	0		4	0	10		**35**
07:00	07:15					18	0	0		1	0	15		**34**
07:15	07:30					15	0	0		0	0	9		**24**
07:30	07:45					13	0	0		0	0	6		**19**
07:45	08:00					14	0	0		2	0	5		**21**
08:00	08:15					11	0	0		0	1	9		**21**
08:15	08:30					4	0	0		0	0	9		**13**
08:30	08:45					4	0	0		0	0	1		**5**
08:45	09:00					1	0	0		0	0	6		**7**
09:00	09:15					1	0	0		0	0	1		**2**
09:15	09:30					1	0	0		0	2	2		**5**
09:30	09:45					0	0	0		0	1	1		**2**
09:45	10:00					0	0	0		1	0	0		**1**
10:00	10:15					1	0	0		0	1	1		**3**
10:15	10:30					1	0	0		1	0	0		**2**
10:30	10:45					0	0	0		0	1	1		**2**
10:45	11:00					1	0	0		0	0	0		**1**
11:00	11:15					0	0	0		0	2	3		**5**
11:15	11:30					1	0	0		0	2	0		**3**
11:30	11:45					1	0	0		0	0	0		**1**
11:45	12:00					1	0	0		0	1	1		**3**
12:00	12:15					2	0	0		2	0	2		**6**
12:15	12:30					3	0	0		0	0	0		**3**
12:30	12:45					2	0	0		0	0	0		**2**
12:45	13:00					3	0	0		0	1	1		**5**
13:00	13:15					2	0	0		0	0	1		**3**
13:15	13:30					2	0	0		0	0	0		**2**
13:30	13:45					5	0	0		1	0	1		**7**
13:45	14:00					2	0	0		0	0	0		**2**
14:00	14:15					5	0	0		0	0	2		**7**
14:15	14:30					2	0	0		1	0	1		**4**
14:30	14:45					4	0	0		1	1	4		**10**
14:45	15:00					6	0	0		1	0	2		**9**
15:00	15:15					8	0	0		1	1	2		**12**
15:15	15:30					5	0	0		0	0	2		**7**
15:30	15:45					10	0	0		1	4	3		**18**
15:45	16:00					8	0	0		2	2	6		**18**
16:00	16:15					4	0	0		1	1	7		**13**
16:15	16:30					8	0	0		0	0	5		**13**
16:30	16:45					4	0	0		0	0	12		**16**
16:45	17:00					1	0	0		1	1	11		**14**
17:00	17:15					5	0	0		0	0	14		**19**
17:15	17:30					7	0	0		0	0	8		**15**
17:30	17:45					13	0	0		2	0	9		**24**
17:45	18:00					17	0	0		0	0	11		**28**
18:00	18:15					4	0	0		1	1	5		**11**
18:15	18:30					3	0	0		0	0	8		**11**
18:30	18:45					2	0	0		1	0	5		**8**
18:45	19:00					2	0	0		0	0	7		**9**
TOTAL						**295**	**0**	**0**		**33**	**23**	**248**		**599**
EST. 24 HR						**354**	**0**	**0**		**40**	**28**	**298**		**719**

TRAFFIC COUNT	CENTURY MUSHROOM FARM
INTERSECTION	ALLANDALE ROAD - GREIG STREET
TYPE OF SURVEY	13 HOURS
COUNT DATE	Tuesday 24 February 2015

WSP

Project No. 17260

TRAFFIC MOVEMENT : HEAVY VEHICLES

TIME		NORTHBOUND			WESTBOUND			SOUTHBOUND			EASTBOUND			
START	END					5	6	7		9	10	11		TOTAL
06:00	06:15					1	0	0		0	0	0		1
06:15	06:30					2	0	0		0	0	6		8
06:30	06:45					3	0	0		0	0	3		6
06:45	07:00					8	0	0		0	0	3		11
07:00	07:15					6	0	0		0	0	4		10
07:15	07:30					5	1	0		0	0	2		8
07:30	07:45					6	1	0		0	0	2		9
07:45	08:00					5	1	0		0	0	1		7
08:00	08:15					5	1	0		3	1	5		15
08:15	08:30					17	3	0		1	0	3		24
08:30	08:45					11	1	0		0	0	11		23
08:45	09:00					11	0	0		0	0	13		24
09:00	09:15					16	0	1		0	0	12		29
09:15	09:30					10	0	1		0	2	9		22
09:30	09:45					9	0	0		0	1	9		19
09:45	10:00					9	0	1		1	0	10		21
10:00	10:15					10	0	0		0	1	12		23
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12:45	13:00					8	0	0		0	1	3		12
13:00	13:15					14	0	0		0	0	9		23
13:15	13:30					10	0	2		0	0	9		21
13:30	13:45					12	1	1		0	0	9		23
13:45	14:00					10	0	0		0	0	20		30
14:00	14:15					16	0	1		0	0	12		29
14:15	14:30					6	0	0		0	0	10		16
14:30	14:45					0	1	0		1	1	9		12
14:45	15:00					0	0	1		0	0	10		11
15:00	15:15					9	0	2		1	0	8		20
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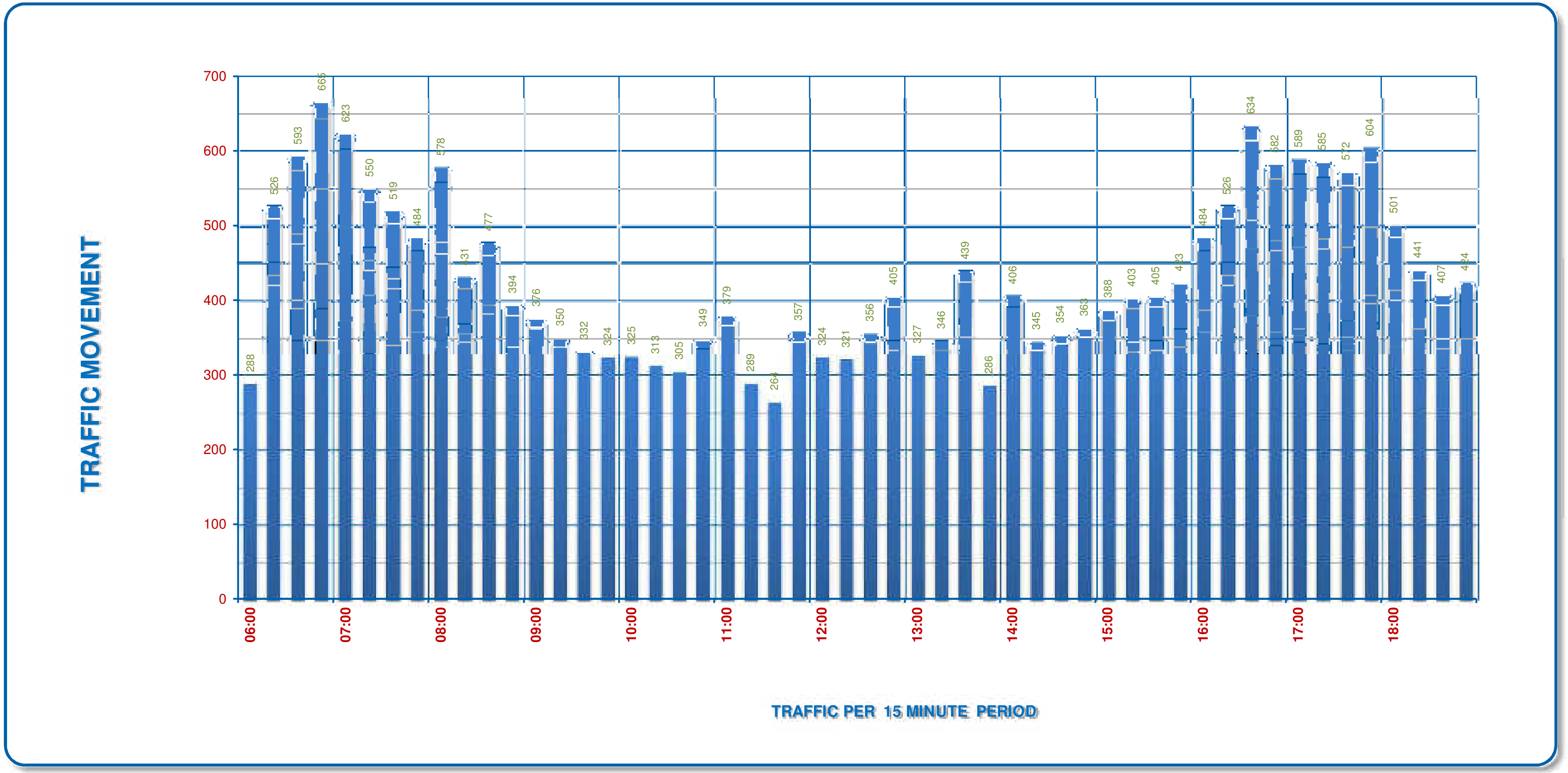
18:00	18:15					3	0	0		0	0	1		4
18:15	18:30					3	0	0		0	0	2		5
18:30	18:45					1	0	1		0	0	1		3
18:45	19:00					3	0	0		0	0	2		5
TOTAL						420	18	22		15	14	388		877
EST. 24 HR						504	22	26		18	17	466		1 052

TRAFFIC COUNT	CENTURY MUSHROOM FARM	TYPE OF SURVEY	13 HOURS	PROJECT NUMBER
INTERSECTION	ALLANDALE ROAD - GREIG STREET	COUNT DATE	Tuesday 24 February 2015	17260

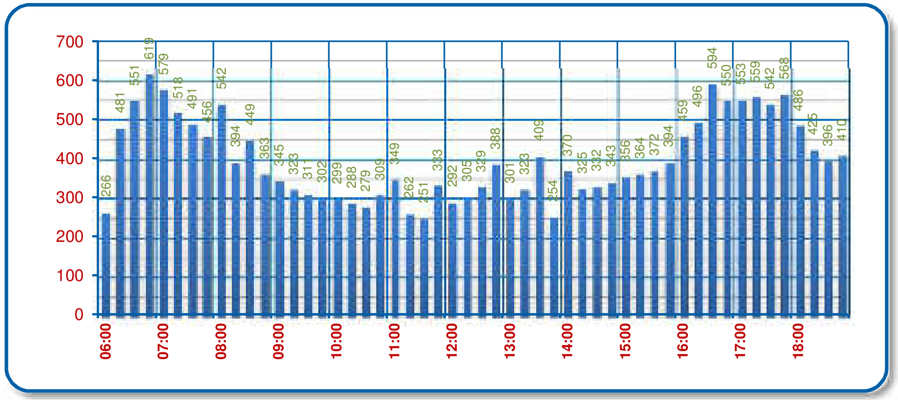
SUMMARY OF ALL VEHICLES



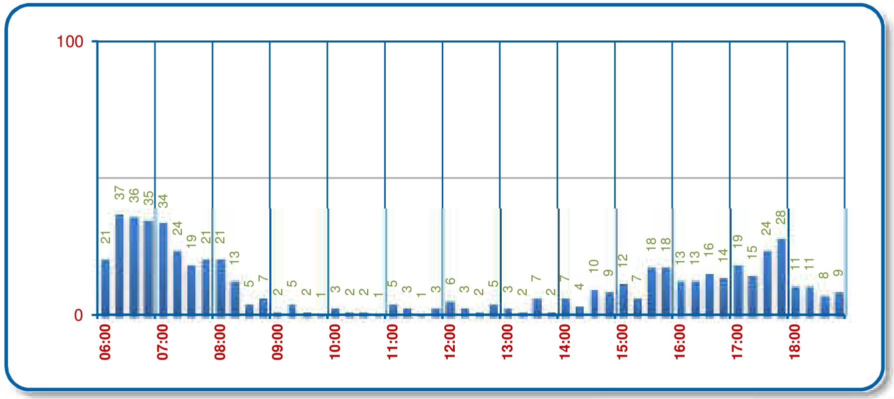
TRAFFIC COUNT	CENTURY MUSHROOM FARM	TYPE OF SURVEY	13 HOURS	PROJECT No.
INTERSECTION	ALLANDALE ROAD - GREIG STREET	COUNT DATE	Tuesday 24 February 2015	17260

SUMMARISED BREAKDOWN OF ALL VEHICLES

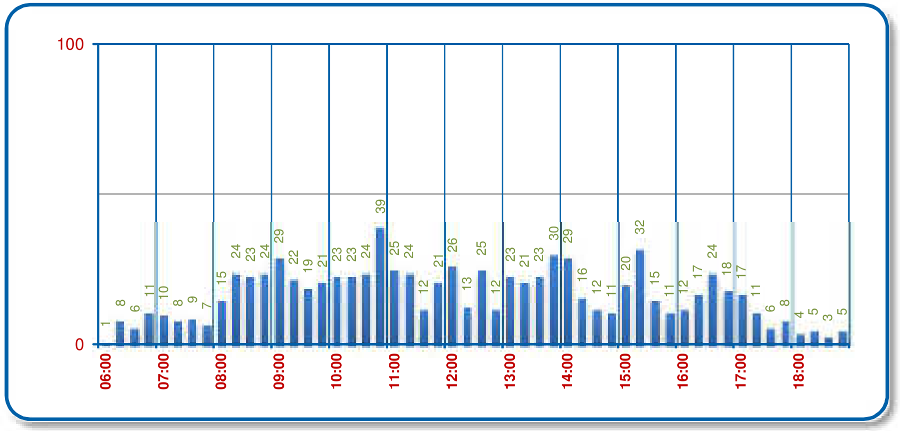
LIGHT VEHICLES



TAXIS



HEAVY VEHICLES



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UNITED BY OUR DIFFERENCE

ANNEXURE F:

CORRESPONDENCE WITH GOVERNMENT DEPARTMENTS

ANNEXURE F1:

GDARD ACKNOWLEDGEMENT LETTER – APRIL 2015

agriculture and
rural development
Department: Agriculture and Rural Development
GAUTENG PROVINCE

Ground floor, Diamond Building, 11 Diagonal Street, Johannesburg
P O Box 8769, Johannesburg, 2000

Telephone: (011) 240 2500
Fax: (011) 240 2700
Website: http://www.gdard.gpg.gov.za

Reference:	Gaut: 002/14-15/0280
Enquiries:	Justine Chan
Telephone:	(011) 240 3048
Email:	Justine.Chan@gauteng.gov.za

Bokamoso Landscape Architects and Environmental Consultants

Email/Fax: lizelleg@mweb.co.za

Dear Sir / Madam

Application for Environmental Authorisation: Proposed Mushroom Farm filling station

The Department acknowledges having received the application form for environmental authorisation of the above-mentioned project on 05/03/2015.

The application has been assigned the reference number Gaut: 002/14-15/0280. Kindly quote this reference number in any future correspondence in respect of the application.

Please circulate the draft report to any state department that administers a law relating to a matter affecting the environment to comment.

You are required to submit two (2) copies (full colour CDs-PDF) of the Draft Basic Assessment Report as well as proof of submission to state departments referred to above.

In order to determine whether a biodiversity assessment is required and, if so, which specialist studies are required, please send a shapefile (WGS84 datum; geographic co-ordinate system) of the application site to our biodiversity information service (GDACE_BiodiversityInfo@gauteng.gov.za), the e-mail clearly indicating the project reference number. Where biodiversity assessment is required; please ensure that it is conducted consistent with the *GDACE Requirements for Biodiversity Assessments*. A copy of this document can be obtained by e-mailing GDACE_BiodiversityInfo@gauteng.gov.za

In terms of Regulation 67(1) (2) of the NEMA EIA Regulations 2010, this application will lapse should you fail to submit the requested information within 6 months of the date of signature of this letter, except in the case where the Department has received and accepted written explanation for failure to submit such information.

Please draw the applicant's attention to the fact that the activity may not commence prior to an environmental authorisation being granted by the Department.

Yours faithfully

P.P.

Boniswa Belot
Deputy Director: Strategic Administration Support
Date: 08/04/2015

CC:	Century Property Developments (Pty) Ltd	Att: Email/Fax:	H Schreurs harm@century.co.za

ANNEXURE F2:

GDARD EXTENSION – MAY 2015

agriculture and
rural development
Department: Agriculture and Rural Development
GAUTENG PROVINCE

11 Diagonal Street, Diamond Building, Newtown, Johannesburg
P O Box 8769, Johannesburg, 2000

Telephone: (011) 240-2500
Fax: (011) 240-2700
Website: http://www.gdard.gpg.gov.za

Reference:	Gaut: 002/14-15/0280
Enquiries:	Faith Mlambo
Telephone:	011 240-3053
Email:	faith.mlambo@gauteng.gov.za

Bokamoso Landscape Architects and Environmental Consultants

Email/Fax: lizelleg@mweb.co.za

Dear Sir/ Madam

Request for extension of time to submit Draft Basic Assessment Report: Proposed Mushroom Farm filling station

The Department acknowledges having received your request for extension of time to submit Draft BA for the abovementioned project on 15/04/2015.

Your request for extension of time to submit Draft BA has been granted. Thus, you have until 15/10/2015 to submit the Draft BA.

Please draw the applicant's attention to the fact that the activity may not commence prior to an environmental authorisation being granted by the Department.

Yours faithfully

Pp

Boniswa Belot
Deputy Director: Strategic Administration Support
Date: 21/05/2015
CC: Century Property Developments (Pty) Ltd

Att: H Schreurs
Email/Fax: harm@century.co.za

ANNEXURE G:

ENVIRONMENTAL
MANAGEMENT PROGRAM

1 Project Outline

1.1 Background

Bokamoso Landscape Architects and Environmental Consultants CC was appointed by the ***Century Property Developments (Pty) Ltd*** to compile an Environmental Management Plan for the proposed Mushroom Farm Filling Station situated on a Portion of the Remainder of Portion 2 of the Farm Bothasfontein 408 JR, City of Johannesburg, Gauteng Province. The Report has been prepared to comply with Section 34 of the National Environmental Management Act (NEMA), 1998 (Act 107 of 1998).

1.2 Project description

The proposed development of the Mushroom Farm Filling Station will entail a Filling Station, consisting of a canopy covered forecourt, Pumps (8 x 2 hose and 1 x 3 hose), four Islands, five underground tanks, two with a 46,000 liter capacity (diesel and super) and three with 23,000 liter capacity (leaded, unleaded, and diesel), a convenience store of approximately 200m² and a place of refreshment, parking bays, oil separator, installation of water and sewage services, and concrete containment structures.

The proposed development site is located on and east of the M39 (Allandale Road) with the R55 (Woodmead Drive) running past the western property boundary, within the City of Johannesburg Metropolitan Municipality. The site is situated 3.5km west-south-west of Midrand and 5km north-east of Bryanston on what is currently known as the Tongaat Mushroom Farm due to Mushrooms having been farmed there in the past.

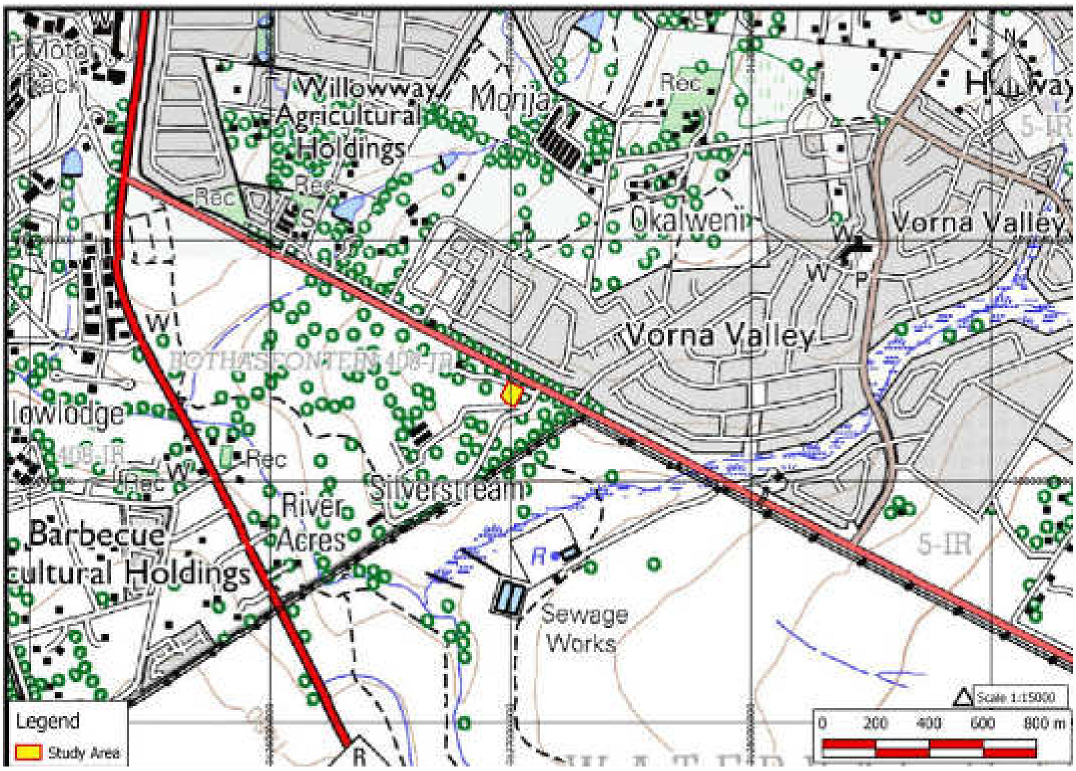


Figure 1: Locality map

Figure 2: Aerial map

The total surface area to be impacted by the proposed development is approximately **1000m².**

The study area falls within the area of jurisdiction of the City of Johannesburg Metropolitan Municipality in **Gauteng Province**.

1.3 Receiving Environment

Geology:

- The Geotechnical study conducted concluded that the site comprises of two Zones; Zone 1 – Residual Granite, and Zone 2 – Rock outcrops.
- The site was found to be favourable for the proposed development provided that the following is considered:
  - Moderate collapsible potential of foundations sub-grades;
  - Potential differential settlement of sub-grade interfaces; and
  - Potential corrosive conditions on steel pipes and fittings.

Hydrology:

- The proposed development site is not affected by 1:50 and 1:100 flood line of a watercourse.
- Cleared and impermeable surfaces will result in an increase in surface run-off volume and velocity.

Wetlands:

- The proposed filling station occurs within 500m of a wetland and therefore a Section 21 (c) and (i) water use license is required for the proposed development.

Fauna and flora:

- The study area consists mainly of vacant land with a high occurrence of Eucalyptus trees.

- No protected flora or fauna species are known to occur within the proposed development footprint.
- The proposed development occurs within an area classified as Ecological Support Area.

Agricultural:

- The development site has low agricultural potential and is currently vacant.

Cultural /Historical:

- No features of cultural or historical significance were found during a Heritage Impact Assessment conducted for the development.

Noise:

- Due to the proposed location of the filling station being in a built-up residential area there is a possibility of noise pollution during construction activities, however construction activities shall be limited to daytime hours from Monday to Saturday only.

Air Pollution

- It is not foreseen that dust pollution will be a concern due to limited areas to be cleared for construction purposes; however mitigation measures shall be implemented.

Traffic:

- Due to the urban setting of the project, interruption of traffic flow along Allandale Road during peak hours is of concern. Construction vehicles should not use local roads during peak traffic hours.
- The proposed filling station occurs on a proposed K-road and a Traffic Impact Assessment was conducted.

Erosion and loss of topsoil:

- Topsoil removed prior to construction commencing must be stockpiled in designated areas and protected from washing away during flood events, or being damaged by heavy mobile plant.
- Topsoil must be returned to areas where it was removed from upon completion of construction activities for the purpose of rehabilitation.

Waste:

- Waste should be temporarily stored in a designated already disturbed area, away from natural and artificial drainage lines.
- Waste to be disposed of at a registered landfill site at regular intervals.
- Hydrocarbons removed from the oil separator during operational phase should be recycled if possible or disposed of as hazardous waste at a registered class H site.

Service provision:

- The filling station will require the installation of Municipal services such as sewerage, water, and electricity.
- The filling station will provide a service to local residents and commuters in the form of fuel.

2 <u>EMP Objectives and context</u>

Objectives

The objectives of this plan are to:

- Identify the possible environmental impacts of the proposed activity;
- Develop measures to minimise, mitigate and manage these impacts;
- Meet the requirements of the Authorisation of GDARD and requirements of other Authorities; and
- Monitor the project.

EMP context

This EMP fits into the overall planning process of the project by carrying out the conditions of consent set out by the Gauteng Department of Agriculture and Rural Development. In addition, all mitigation measures recommended in the Basic Assessment report are included in the EMP.

This EMP addresses the following three phases of the development:

- Planning phase
- Pre-construction;
- Construction phase;
- Decommissioning and rehabilitation phase; and
- Operational phase.

3 Monitoring

In order for the EMP to be successfully implemented all the role players involved must have a clear understanding of their roles and responsibilities in the project.

These role players may include the Authorities (A), other Authorities (OA), Developer/proponent (D), Environmental Control Officer (ECO), Project Manager (PM), Contractors (C), Environmental Assessment Practitioner (EAP) and Environmental Site Officer (ESO). Landowners interested and affected parties and the relevant environmental and project specialist's area also important role players.

3.1 Roles and responsibilities

Developer (D)

The developer is ultimately accountable for ensuring compliance with the EMP and conditions contained in the Authorisation. The developer must appoint an independent Environmental Control Officer (ECO), for the duration of the pre-construction and construction phases, to ensure compliance with the requirements of this EMP. The developer must ensure that the ECO is integrated as part of the project team. The responsibility of compliance will be carried across to the individual property owners as soon as transfer of the erven has taken place. It will be ensured that a copy of this document accompanies the purchase agreements for the erven.

Project Manager (PM)

The project Manager is responsible for the coordination of various activities and ensures compliance with this EMP through delegation of the EMP to the contractors and monitoring of performance as per the Environmental Control Officer's monthly reports.

Environmental Control Officer (ECO)

An independent Environmental Control Officer (ECO) shall be appointed, for the duration of the pre-construction and construction phase of the services and bulk infrastructure, by the developer to ensure compliance with the requirements of this EMP. Thereafter the individual property owners will be responsible for the further appointment of the ECO.

- The Environmental Control Officer shall ensure that the contractor is aware of all the specifications pertaining to the project;
- Any damage to the environment must be repaired as soon as possible after consultation between the Environmental Control Officer, Consulting Engineer and Contractor;
- The Environmental Control Officer shall ensure that the developer staff and/or contractor are adhering to all stipulations of the EMP;

- The Environmental Control Officer shall be responsible for monitoring the EMP throughout the project by means of site visits and meetings. This should be documented as part of the site meeting minutes;
- The Environmental Control Officer shall be responsible for the environmental training program;
- The Environmental Control Officer shall ensure that all clean up and rehabilitation or any remedial action required, are completed prior to transfer of properties;
- A post construction environmental audit is to be conducted to ensure that all conditions in the EMP have been adhered to.

Contractor (C):

The contractors shall be responsible for ensuring that all activities on site are undertaken in accordance with the environmental provisions detailed in this document and that sub-contractor and labourers are duly informed of their roles and responsibilities in this regard.

The contractor will be required, where specified to provide Method Statements setting out in detail how the management actions contained in the EMP will be implemented.

The contractors will be responsible for the cost of rehabilitation of any environmental damage that may result from non-compliance with the environmental regulations.

Environmental Site Officer (ESO):

The ESO is appointed by the developer and then finally the owners of the individual properties as his/her environmental representative to monitor, review, and verify compliance with the EMP by the contractor. The ESO is not an independent appointment but must be a member of the contractor's management team. The ESO must ensure that he/she is involved at all phases of the construction (from site clearance to rehabilitation).

Authority (A):

The authorities are the relevant environmental department that has issued the Environmental Authorisation. The authorities are responsible for ensuring that the monitoring of the EMP and other authorization documentation is carried out by means of reviewing audit reports submitted by the ECO and conducting regular site visits.

Other Authorities (OA):

Other authorities are those that may be involved in the approval process of the EMP.

Environmental Assessment Practitioner (EAP):

According to section 1 of NEMA the definition of an environmental assessment practitioner 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 through regulations".

3.2 Lines of Communication

The Environmental Control Officer in writing should immediately report any breach of the EMP to the Project Manager. The Project Manager should then be responsible for rectifying the problem on-site after discussion with the contractor. Should this require additional cost, then the developer should be notified immediately before any additional steps are taken.

3.3 Reporting Procedures to the Developer

Any pollution incidents must be reported to the Environmental Control Officer immediately (within 12 hours). The Environmental Control Officer shall report to the Developer on a regular basis (site meetings).

3.4 Site Instruction Entries

The site instruction book entries will be used for the recording of general site instructions as they relate to the works on site. There should be issuing of stop work order for the purposes of immediately halting any activities of the contractor that may pose environmental risk.

3.5 ESA/ESO (Environmental Site Officer) Diary Entries

Each of these books must be available in duplicate, with copies for the Engineer and Environmental Site Officer. These books should be available to the authorities for inspection or on request. All spills are to be recorded in the ESA/Environmental Site Officer's dairy.

3.6 Methods Statements

Methods statements from the contractor will be required for specific sensitive actions on request of the authorities or ESA/ESO (Environmental Site Officer). All method statements will form part of the EMP documentation and are subject to all terms and conditions contained within the EMP document. For each instance wherein it is requested that the contractor submit a method statement to the satisfaction of ESA/ESO, the format should clearly indicate the following:

- What – a brief description of the work to be undertaken
- How- a detailed description of the process of work, methods and materials

- Where- a description / sketch map of the locality of work; and
- When- the sequencing of actions with due commencement dates and completion date estimate.

The contractor must submit the method statement before any particular construction activity is due to start. Work may not commence until the method statement has been approved by the ESA/ESO.

3.7 Record Keeping

All records related to the implementation of this management plan (e.g. site instruction book, ESA/ESO dairy, methods statements etc.) must be kept together in an office where it is safe and can be retrieved easily. These records should be kept for two years at any time be available for scrutiny by any relevant authorities.

4. Applicable legislation

4.1 National Environmental Management Act (Act 107 of 1998)

The NEMA is primarily an enabling Act in that it provides for the development of environmental implementation plans and environmental management plans. The principles listed in the act serve as a general framework within which environmental management and implementation plans must be formulated.

The principles in essence state that environmental management must place people and their needs at the forefront of its concern and that development must be socially, environmentally and economically sustainable.

Notice **No. R 983, R 984 and R 985** of the Amended Regulations list the activities that indicate the process to be followed. The activities listed in Notice No. R 983 requires that a Basic Assessment process be followed and the Activities listed in terms of Notice No. R 984 requires that the Scoping and EIA process be followed.

Notice No. 985 has been introduced to make provision for Activities in certain geographical and sensitive areas.

Impact on proposed Development:

Significant – Due to the proposed development triggering listed activities under NEMA EIA Regulations an environmental management plan has to be compiled and submitted together with the Basic Assessment Report.

The application for the proposed filling station consist only of activities listed under Notice No. R 983, therefore a Basic Assessment Report will be submitted for authorization from GDARD.

4.2 The National Water Act, 1998 (Act No: 36 of 1998)

The purpose of this Act is to ensure that the nation's water resources are protected, used, developed, conserved, managed and controlled in ways that take into account, amongst other factors, the following:

- Meeting the basic human needs of present and future generations;
- Promoting equitable access to water;
- Promoting the efficient, sustainable and beneficial use of water in the public interest;
- Reducing and preventing pollution and degradation of water resources;
- Facilitating social and economic development; and
- Providing for the growing demand for water use.

Impact on proposed Development:

Significant - The proposed development site is not affected by 1:50 and 1:100 flood lines, it does however occur **within 500m radius from the boundary of a wetland** and therefore the General Authorisation for Section 21 c and i water use does not apply, and the development requires a Section 21 WULA for Activities (c) and (i)

4.3 National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004)

The purpose of the Act is "To reform the law regulating air quality in order to protect the environment by providing reasonable measures for the prevention of pollution and ecological degradation and for securing ecologically sustainable development while promoting justifiable economic and social development; to provide for national norms and standards regulating air quality monitoring, management and control by all spheres of government; for specific air quality measures; and for matters incidental thereto."

Impact on proposed development:

Not significant - During the construction phase of the proposed development, generation of dust and noise can become a significant factor to residence living adjacent to the planned development site. However if the development is well planned and the mitigating measures are successfully implemented the proposed development's contribution to air and noise pollution can become less significant.

4.4 National Environmental Management Waste Act, 2008 (Act No. 59 of 2008)

The Act provides for regulating waste management in order to protect health and the environment by providing reasonable measures for the prevention of pollution and ecological degradation and for securing ecologically sustainable development.

Impact on proposed development:

Not significant – No listed waste activities will take place on site and therefore a waste license will not be required. Construction and operational general waste will have to be removed to a registered landfill site.

4.5 National Environmental Management Act: Biodiversity Act, 2004 (Act No. 10 of 2004)

The purpose of the Biodiversity Act is to provide for the management of South Africa's biodiversity within the Framework of the NEMA and the protection of species and ecosystems that warrant National protection. As part of the implementation strategy, the National Spatial Biodiversity Assessment was developed.

Impact on proposed development:

Not significant - No Red or Orange listed plant species are known to occur on the proposed development site according to the Gauteng Conservation Plan Version 3.3. The site does not fall within a Critical Biodiversity Area.

4.6 National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003)

The purpose of this Act is to provide for the protection, conservation, and management of ecologically viable areas representative of South Africa's biological biodiversity and its natural landscapes.

Impact on proposed development:

Significant – The proposed development site does not form part of a protected area or occur near a protected area, the site does however occur within and Ecological Support Area.

4.7 National Heritage Resources Act, 1999 (Act No. 25 of 1999)

The National Heritage Resources Act legislates the necessity and heritage impact assessment in areas earmarked for development, which exceed 0.5 ha. The Act makes provision for the potential destruction to existing sites, pending the archaeologists' recommendations through permitting procedures. Permits are administered by the South African Heritage Resources Agency (SAHRA).

Impact on proposed development:

Not significant – Considering the proposed development is bigger than 0.5ha a HIA is required. The Phase 1 Heritage Survey conducted revealed no heritage resources on the development footprint of the proposed development.
The development can thus proceed, however if any resources are unearthed during construction, construction activities must cease until such time as a heritage specialist investigated the find.

4.8 The Deeds Registries Act, 47 of 1937

The Act was created to consolidate and amend the laws in force in the Republic relating to the Registration of deeds. The act caters for the registration of servitudes.

Impact on proposed development:

Significant – Considering the proposed development entails the installation of Municipal services, the developer has to allow for municipal services servitudes.

4.9 Occupational Health & Safety Act, 85 of 1993

The Act was created to provide for the health and safety of persons at work and for the health and safety of persons in connection with the use of plant and machinery; the protection of persons other than persons at work against hazards to health and safety arising out of or in connection with the activities of persons at work; to establish an advisory council for occupational health and safety; and to provide for matters connected therewith.

Implications for the proposed development:

Significant – Considering the proposed development will occur within an urban environment next to a Metropolitan road running through a residential area, the Act not only applies to the persons who will be responsible for construction, but also to the safety of members of the public.

4.10 Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983)

This Act provides for control over the utilization of the natural agricultural resources of the Republic in order to promote the conservation of the soil, the water sources, the vegetation and the combating of weeds and invader plants; and for matters connected therewith.

Impact on proposed development:

Not Significant – The proposed development site does not fall within any of the Agricultural Hubs of Gauteng and does not fall within an area with high agricultural potential. According to GAPA 3 the site has low agricultural potential. No Agricultural Potential Study was therefore conducted.

4.11 Petroleum Products Act

In terms of the Petroleum Products Act, 1977 (PPA) as amended in 2006, and which is administered by the national Department of Energy, one cannot apply for a site and/or retail license before you have both land use rights and an environmental authorisation.

In terms of the Petroleum Products Act, energy authorities must ensure that the number of filling stations is appropriate to local sales volumes and does not exceed the optimal number for an area.

Impact on proposed development:

Significant – Environmental Authorization as well as land use rights are required prior to applying for filling station with the Department of Energy.

4.12 Gauteng Transport Infrastructure Amendment Act

The aim of this Amendment Act is to amend the Gauteng Transport Infrastructure Act, 2001 so as to amend and insert certain definitions; to provide for the necessary land use rights with respect to stations and for the necessary powers of the MEC to enter into contracts for road and rail projects; to amend the procedure in relation to route determination; to make a second environmental investigation at the stage of preliminary design of a road or railway line unnecessary where the competent environmental authority decides that the environmental investigation at the stage of route determination is adequate; and to provide for incidental matters.

Impact on proposed development:

Significant – The proposed development site is bounded by the future provincial road K58 (Allandale Road) and therefore the act applies and requires involvement of the Gauteng Department of Roads & Transport.

4.13 GDARD Agricultural Hub Policy

GDARD identified 7 Agricultural Hubs in Gauteng province. These hubs are earmarked for agricultural activities and there are policies and guidelines that should be taken into consideration when one plans to develop in these hubs areas. Urban development is usually not supported in these hubs.

Impact on proposed development:

Not significant - The application site does not fall within any of the Gauteng Agricultural Hubs and available GAPA data regarding Agricultural Potential within the Gauteng Province indicate that the study area has low Agricultural Potential.

4.14 GDARD Draft Ridges Policy

According to the GDARD Draft Ridges Policy no development should take place on slopes steeper than 8.8%.

Impact on proposed development:

Not significant - No ridges occur on, or in the direct vicinity of the study site. The development site has a level topography.

4.15 Gauteng conservation plan (C-Plan) Version 3.3

Gauteng Nature Conservation (hereafter Conservation), a component of the Gauteng Department of Agriculture and Rural Development (GDARD) produced the Gauteng Conservation Plan Version 3 (C-Plan 3) in December 2010. The conservation plan was edited on three occasions since then: C-Plan 3.1 was released in July 2011 after it became apparent that some areas were not desirable in Critical Biodiversity Areas (CBAs hereafter). Not all areas were addressed in the first round of editing, so this was done during September 2011 resulting in C-Plan Version 3.2. It was soon released however, that some CBAs became separated by the removal of undesirable areas causing some attributes not to be completely reflective of that CBAs any longer. C-Plan 3.3 became available in October 2011 after this issue was addressed.

The main purposes of C-Plan 3.3 are:

- to serve as the primary decision support tool for the biodiversity component of the Environmental Impact Assessment (EIA) process;
- to inform protected area expansion and biodiversity stewardship programmes in the province;
- To serve as a basis for development of Bioregional Plans in municipalities within the province.

Impact on proposed development:

Significant – The proposed development occur within an area classified as Ecological Support Area in terms ofthe Gauteng Conservation Plan.

4.16 Gauteng Urban Edge

The Gauteng urban edge is delineated on a yearly basis denoting areas earmarked for development.

Impact on proposed development:

Not significant - The proposed development site falls within the Gauteng Urban Edge. The proposed development is regarded as being in line with the Urban Edge Policy.

4.17 Gauteng Draft Red data policy

The main purpose of the draft Red Data Policy is to protect red data fauna and flora species in Gauteng Province. This policy requires that red data species are conserved.

Impact on proposed development:

Not significant – No Red or Orange listed plant species are known to occur on the proposed development site according to the Gauteng Conservation Plan Version 3.3. The site does not fall within a Critical Biodiversity Area.

4.18 Gauteng Noise Control Regulations, 1999

The regulation controls noise pollution. According to the acceptable noise levels in a residential area situated within an urban area is 55dBA and the maximum acceptable noise levels in a rural area is 45dBA.

Impact on proposed development:

Significant - If well planned and if mitigation measures are successfully implemented, the proposed filling station development will not contribute to significant noise generation in the area. The noise impacts will mainly be during the construction phase and is therefore only short term.

4.19 City of Johannesburg IDP (2012-2016)

The Johannesburg IDP is a short-long-term planning tool which provides space for the development of the municipality in an integrated and coordinated manner. The policy envisions a city that is resilient, sustainable, and liveable. This is to be achieved through various developmental strategies including the Spatial Development Frameworks. The spatial development strategies supported by the proposed development are:

- Supporting an efficient movement system; and
- Initiating and implementing corridor development.

Impact on proposed development:

Significant - From the above, the proposed development is in line with the development principles of the spatial development for the City of Johannesburg.

4.20 City of Johannesburg Metropolitan Municipality's Growth Management Strategy (GMS)

The GMS prescribes where, and under what conditions, growth can be accommodated. The future growth of the City must ensure that population and economic growth is supported by complimentary services and infrastructure whilst also meeting spatial and socio-economic objectives. The two key objectives of the strategy are to:

a) Determine priority areas for short-medium term investment and allocation of future development rights.
b) Re-direct the respective capital investment programmes of the City's service providers to address the short-term hotspots and strategic priority areas.

The GMS sets high, medium, and low priority areas across the City and describes specific interventions. The list below provides a summary of the other seven Development Strategies of the sub-region:

- Supporting an efficient movement system;
- Ensuring strong viable nodes;
- Supporting sustainable environmental management;
- Initiating and implementing corridor development;
- Managing urban growth and delineating and urban development boundary;
- Increased densification of strategic locations; and
- Facilitating sustainable housing environments in appropriate locations.

Impact on proposed development:

Significant – The proposed development of a filling station supports the objectives of the City of Johannesburg GMS.

5. Mitigation Measures and Responsibility per project phase

Environmental Attribute	Environmental concern	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable legislation reference
Planning Phase							
Legal compliance	**Legal non-compliance**	Financial provision for legal compliance	Developer to put aside **sufficient funding** to ensure **monitoring requirements** stipulated in this plan can be met.	Financial provision for environmental management including rehabilitation, conducting specialist studies, conducting search and rescue, implementing monitoring plans, appointing ECO etc.	Developer	Once off	4.1-4.20
Land use	**Township establishment**	Township established	Developer to obtain approval for land use	Land use approved	Developer	Once off	4.18 and 4.19
Design and planning	**EMP adherence**	To make the EMP enforceable under the general conditions of the contract	The **EMP** document must be included as part of the tender documentation for all contractor appointments.	The EMP is included as part of the tender documentation	Applicant Contractor	Prior to publishing tender	4.1-4.20
	Filling station design	To ensure stability of structures	The **detail design** of the proposed filling station infrastructure should be approved by DWA as part of the WULA due to proximity to wetland.	Written approval by DWA	Engineer	Before construction activities commence	4.2
Fauna and Flora	**Damage to protected fauna and flora**	To prevent negative impact on protected fauna and flora	Conduct ecological assessment of proposed filling station location due to occurring within Ecological Support Area.	Ecological Assessment to be conducted prior to construction commencing	Developer/EAP	Once-off	4.1, 4.5 and 4.6
		To prevent the destruction of protected fauna and flora discovered during construction	If Ecological Assessment establishes that protected fauna or flora occurs within the proposed development footprint, then construction workers should be **made aware** of procedures to follow if any **protected species** are discovered during any phase of the construction. Procedures as stipulated at the end of the EMP should be followed, if protected species are discovered during construction phase.	Construction personnel undergo protected species awareness training	ECO/Project Manager	Before construction activities commence and as and when required	4.1, 4.5 and 4.6

Environmental Attribute	Environmental concern	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable legislation reference
			Planning Phase				
			If applicable, Sensitive areas are to be fenced off in assistance with the ECO, prior to construction commencing and will serve as a **no-go areas**.	Sensitive areas and indigenous flora protected	ECO/Project Manager	Before construction activities commence	4.1, 4.5 and 4.6
		To prevent and reduce the negative impact on fauna species residing on the site	No fauna species may be disturbed, trapped, hunted, or killed during the construction phase. No indigenous flora may be removed. **Conservation** orientated **clauses** should be built into contracts for construction personnel, complete with penalty clauses for non-compliance.	Conservation orientated clause occurs in contracts with contractors.	Developer/ Project Manager	Before construction activities commence	4.1, 4.5 and 4.6
		To prevent the invasion of the area with alien invaders	**Alien invaders must be eradicated** before, during and after construction activities. A **clause** to this effect should be built into contracts for construction personnel, complete with penalty clauses for non-compliance.	Alien plant eradication clause occurs in contracts with contractors.	Developer/ Project Manager	Before construction activities commence	4.1, 4.5 and 4.6
Geology and Soils	**Erosion and Siltation**	To prevent the unnecessary loss of soil through poor management	**Suitable locations** should be selected on site to place the topsoil as well as spoil **stockpiles** as to avoid release of materials. All stockpiles must be appropriately positioned and managed in line with good engineering principles.	Areas for stockpiles are marked out at suitable locations.	Contractor/ ECO	Before construction activities commence	4.1, 4.2 and 4.10
			Provision of **earth bunds** or sand bags in areas where a large amount of exposed soils exist is required.	Earth bunds constructed to protect exposed soils during construction.	Contractor	Before or as soon as construction activities commence	4.1, 4.2 and 4.10
			The construction works shall be properly **planned** to **minimise soil excavation during 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	4.1, 4.2 and 4.10
			Make construction workers **aware of sediment controls** and the importance prior to work commencing.	Contractors have knowledge of purpose of sediment control	ECO/ Site supervisor	Before or as soon as construction activities	4.1, 4.2 and 4.10

Environmental Attribute	Environmental concern	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable legislation reference
Planning Phase							
						commence	
			Suitable locations should be selected on site to place the topsoil and subsoil **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	4.1, 4.2 and 4.10
	Collapse of structures	Structural integrity	Recommendations made in geotechnical study pertaining to collapsible potential, differential settlement and corrosive conditions must be adhered to during construction phase.	Geotech recommendations included in design	Developer	Before construction activities commence	4.1, 4.2 and 4.10
Ecological integrity	**Ecological damage**	Avoid erosion and disturbance to indigenous vegetation	**Designated access point and routes** shall be determined for the construction vehicles and designated areas for storage of equipment. Clearly mark the site access point and routes on site to be used by construction vehicles. Provide an access map to all contractors whom in turn must provide copies to the construction workers. Instruct all drivers to use access point and determined route.	Access to must be clearly marked prior to construction commencing	Contractor	Before construction activities commence	4.1, 4.2 and 4.10
Aesthetics	**Waste generation**	To control the temporary storage of waste	**Temporary waste storage locations** on site shall be determined. These storage points shall be accessible by waste removal trucks and these points should not be located in sensitive areas, 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. Waste storage requirements must be submitted to the Contractor prior to construction. This must be monitored.	Waste storage locations marked out and suitable bins are provided for waste at these locations.	Contractor/ ESO	Before construction activities commence	4.1, 4.2, and 4.4
	Noise generation	To minimise the noise impact associated with	Construction activities may only take place during "**normal working hours**" which are from "sunrise to sunset",	Contractors working hours must be stipulated in the	Developer/ Project Manager	Before construction activities	4.1 and 4.3

Environmental Attribute	Environmental concern	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable legislation reference
Planning Phase							
		the proposed construction activities	Monday through Saturday. Non-working hours and days must be highlighted in the project document i.e. Sundays, public holidays etc.	contract.		commence	
Cultural heritage	**Loss of or damage to cultural Resources**	Preserve cultural historic sites and finds	Inform **Provincial Heritage Resources Authority** of planned construction activities in terms of section 38 of the National Heritage Resources Act.	Comment/ Approval received from Province	Developer/EAP	Once-off	4.1 and 4.7
			Conduct **Heritage Impact Assessment** due to development area exceeding 0.5ha.	HIA conducted	Developer/EAP	Prior to construction commencing	4.1 and 4.7
Land	**Servitudes required**	Servitudes claimed	**Claim servitudes** for the proposed filling station, if required.	Servitude allowed and registered	Developer/EAP	Once-off	4.1 and 4.8
Hydrology	**Impacting wetland functionality**	No negative impact on wetland	The proposed development occurs within 500m from a wetland. A section 21 c and i Water Use License is required prior to construction commencing. Conditions associated with this WUL as well as IWQQMMP must be adhered to during construction.	WULA submitted to DWA	Developer	Before construction activities commence	4.2
	Increased storm water run-off volumes and velocity	No scouring or erosion resulting in siltation of storm water infrastructure or wetland.	Due to the clearing of vegetation the volume of storm water run-off will increase as well as velocity. The area to be cleared is however small ($1000m^2$). Proper storm water infrastructure will have to be constructed and maintained in accordance with a Storm water management plan.	Storm water management plan compiled	Developer	Before construction activities commence	4.2
Social	**Impact on future planned K- roads**	Conduct TIS	Developer to inform local municipality, JRA, and Gauteng Department of Roads and Transport of planned construction of filling station next to planned K route.	Authorities informed	Developer	Before construction activities commence	4.12
			TIS to be carried out for development.	TIS Report available	Developer	Before construction activities commence	4.12
Socio-	**DoE approval**	DoE approval for	Environmental Authorization as well as	DoE approval for	Developer	Before	4.11

Environmental Attribute	Environmental concern	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable legislation reference
Planning Phase							
economic	**not granted**	fillings station development	land use rights are required prior to applying for filling station with the Department of Energy. Approval required from DoE for establishment of filling station in proposed location.	fillings station development received		construction activities commence	

Environmental Attribute	Environmental concern	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable legislation reference
Construction Phase							
Legal compliance	**Environmental destruction**	Sufficient funds available for environmental management	Developer to release funds required for environmental management	Environmental management implemented during construction phase in accordance with EMP and other requirements e.g. WULA.	Developer	Once off	4.1-4.20
		Compliance with RoD/license/permit conditions	Developer to appoint necessary specialist to ensure compliance with RoD, licenses and permits.	Authorisation requirements met.	Developer	Throughout construction phase	4.1-4.20
Fauna and Flora	**Loss of protected Vegetation, and topsoil**	To minimize damage to/loss of protected vegetation, and retain quality of topsoil	If any protected species were identified as being present within the proposed development footprint during the Ecological Assessment conducted, the following must be conducted: 1. Apply for Biodiversity permit from GDARD for removal and relocation of protected species. 2. Appoint Ecologist to remove protected plants and keep it safe for rehabilitation purposes.	Protected species rescued from development footprint	Contractor/ESO/ ECO	Once off	4.1, 4.5 and 4.6
			Construction site to be **established** under supervision of ECO/ESO.	Minimal vegetation removed/ damaged during site establishment	Contractor/ ECO	Before any construction activity commences	4.1, 4.5 and 4.6
Fauna and Flora	**Damage to flora and fauna**	To protect the existing fauna and flora	**All exotic invaders and weeds must be eradicated**. Snaring and hunting of fauna by construction workers on or adjacent to the study area are strictly prohibited and offenders shall be prosecuted. Removal of protected fauna from the study area or adjacent areas shall not be allowed. If any protected species are discovered during construction, procedures as stipulated at the end of	Alien vegetation removed No measurable signs of habitat destruction	Contractor/ ESO	Continuous	4.1, 4.5 and 4.6 and 4.10

Environmental Attribute	Environmental concern	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable legislation reference
Construction Phase							
			the EMP should be followed.				
			Any areas that have been **fenced off** in assistance with the ECO will be **No-Go areas** during and after construction.	Minimal damage to indigenous vegetation	Contractor/ ESO	Continuous	4.1, 4.5 and 4.6 and 4.10
	Spread of invasive and alien vegetation	Spread of weed	Ensure that materials used for mulching and fertilisers are certified weed free. Collect certifications where available. **Control weed growth** that appears during construction	Weed growth controlled	Contractor/ ESO	Continuous	4.1, 4.5 and 4.6 and 4.10
Geology and soils	**Loss of Vegetation, and topsoil**	Strip topsoil to depth of 150mm	Areas where construction is to take place is to be **stripped of topsoil** to a depth of at least **150mm**.	Vegetation only removed in designated areas. Topsoil stripped to 150mm.	Contractor/ ECO	Before any construction activity commences	4.1, 4.2 and 4.10
	Loss of topsoil	To prevent the loss of topsoil To prevent soil and materials being tracked onto the road.	**Stockpiling of topsoil will only be done in designated areas** where it will not interfere with the natural drainage paths of the environment and must not be higher than 1, 5 m. In order to minimise erosion of topsoil and siltation and disturbance to existing vegetation, it is recommended that stockpiling be done in already disturbed/exposed areas. Remove vegetation only in areas designated during the planning stage and for the purpose of construction within the 3m wide servitude.	No loss of topsoil. Excavated materials correctly stockpiled < 1.5m high. No visible signs of erosion of topsoil.	Contractor/ ESO	Before construction commences in a designated area.	4.1, 4.2 and 4.10
Hydrology	**Pollution of ground and surface water**	Prevent the pollution of the ground- and surface water	**Chemical toilets** may not be placed within the aquatic buffer zone or within 100m from a watercourse. At least one chemical toilet must be available for every 15 persons at each construction area. The contractor shall keep the toilets in a clean, neat, and hygienic condition. Toilets provided by the contractor must be easily accessible and a maximum	Toilets are located away from drainage lines. Workforce use toilets provided. Chemical toilets are clean and maintained.	Contractor/ ESO	Before construction activities commence	4.1 and 4.2

Environmental Attribute	Environmental concern	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable legislation reference
Construction Phase							
			of 50 m from the working area to ensure they are utilized. The contractor (who must use reputable toilet-servicing company) shall be responsible for the cleaning, maintenance and servicing of the toilets. The contractor (using reputable toilet-servicing company) shall ensure that all toilets are cleaned and emptied before the builders' or other public holidays. No person is allowed to use any other area than chemical toilets. No French drain systems may be installed. No chemical or waste water must be allowed to contaminate the run-off on site. The chemical toilets may not be placed in close proximity of adjacent developments to prevent odours.				
		Prevent pollution of ground and surface water by hydrocarbons from mobile plant	**Drip trays** should be provided for all mobile plant on site for the construction period, while parked; All mobile plant should be equipped with a **hydrocarbon spills kit** to facilitate cleaning up any spills as a result of a breakdown; An impermeable plastic sheet must be placed underneath the mobile plant to be worked on to prevent ingress of hydrocarbons into soil or water; Any spillages on the impermeable sheet must be cleaned with a spills kit prior to removing the sheet. No leaking vehicle shall be allowed on site. The mechanic/the mechanic of the appointed contractor must supply	No signs of hydrocarbon spillages on site. The contractor must prove vehicles have been serviced and do not have any leaks.	Contractor/ ESO	Continuous	4.1 and 4.2

Environmental Attribute	Environmental concern	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable legislation reference
Construction Phase							
			the environmental officer with a letter of confirmation that the vehicles and equipment are leak proof.				
Hydrology	**Impacting wetland functionality**	No negative impact on wetland	Conditions associated with this WUL as well as IWQQMMP must be adhered to during construction.	WUL issued and conditions complied with	Contractor/ ESO	During construction	4.1, 4.2, 4.5, and 4.6
Hydrology	**Pollution of ground and surface water**	To minimize pollution of surface and groundwater resources due to spilling of hazardous materials.	**Hydrocarbons 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 substance stored) for potential spills or leaks. All spilled hazardous substances must be contained in impermeable containers for removal to a licensed hazardous waste site. No bins containing organic solvents such as paint and thinners shall be cleaned on site. All spillages must be cleaned up with spills orb product and contaminated soil removed as hazardous waste. Hazardous waste must be disposed of by a registered contractor at an appropriately registered disposal site.	No pollution of the environment by hazardous substances visible on site	Contractor/ ESO	Continuous	4.1 and 4.2
		To minimize pollution of surface and groundwater resources by cement	The **mixing of concrete** shall only be done at specifically selected sites outside the aquatic buffer zone, on mortar boards or similar structures to prevent run-off into surrounding drainage lines, streams, and natural vegetation.	No evidence of cement contaminated soil on the construction site	Contractor/ ESO	Continuous	4.1 and 4.2
		To minimize pollution of surface and Groundwater resources due to effluent	**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	Continuous	4.1 and 4.2

Environmental Attribute	Environmental concern	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable legislation reference
Construction Phase							
Aesthetic	**Waste generation - Visual impact and air pollution**	To minimise the visual impact of the proposed activity	**Waste storage locations 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	Continuous	4.1, 4.3 and 4.4
	Waste generation	To prevent unhygienic usage on the site and pollution of the natural assets	Weather proof **waste bins** must be provided and emptied regularly. The contractor shall provide labourers to clean up the contractor's camp and construction site on a daily basis. **Waste storage points** should be accessible by waste removal trucks and these points should be located in already disturbed areas/areas not 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: • Skips for the containment and disposal of waste that could cause soil and water pollution, i.e. paint, lubricants, etc.; • Small lightweight waste items should be contained in skips with lids to prevent wind littering; and • Bunded areas for containment and holding of dry building waste. No solid waste may be disposed of on the site. No waste materials shall at any stage be disposed of in the open veldt, adjacent properties or in sensitive areas. The storage of solid waste on the site, until such time as it may be disposed	No waste bins overflowing No litter visible on the site	Contractor/ ESO	Continuous	4.1, 4.3 and 4.4

Environmental Attribute	Environmental concern	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable legislation reference
Construction Phase							
			of, must be in a manner acceptable to the local authority and the Department of Water Affairs (DWA). Cover any waste that is likely to wash away or contaminate storm water.				
	Waste generation	**Recycle material where possible and correctly dispose of unusable wastes**	**Waste shall be separated** into recyclable and non-recyclable waste, and shall be separated as follows: • General waste: • Building rubble; and • Reusable /recyclable material. Recyclable waste shall preferably be deposited in separate bins. All solid must be removed to a permitted waste disposal site on a weekly basis. Keep records of waste generated, reused, recycled, and disposed for future reference. Provide information to ECO.	Sufficient containers available on site No visible signs of pollution	Contractor/ ESO	Continuous	4.1, 4.3 and 4.4
Ecological integrity	**Increased fire risk to site and surrounding areas**	**To decrease fire risk**	**No open fires** are allowed on site. Smoking is only allowed in designated areas (signposted) and cigarette buds may not be disposed of in the open veldt. 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, at the site camp and with each supervisor.	No signs of burnt veldt. Fire beaters present in vehicles and on site. Emergency numbers displayed.	Contractor/ ESO	Continuous	4.1, 4.5 and 4.10
Geology and soils	**Stability of structures**	To ensure the stability of structures to be constructed	The precautionary measures and foundation design from the involved geotechnical engineers must be implemented during construction of structures.	No signs of collapse of structures	Contractor/ Engineer	Continuous	4.1
	Erosion and	To prevent erosion	**Mark out the areas to be excavated**	No erosion scars	Contractor	Continuous	4.1, 4.2, 4.5,

Environmental Attribute	Environmental concern	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable legislation reference
Construction Phase							
	siltation	, siltation & water pollution	prior to excavation commencing. Unnecessary clearing of flora resulting in exposed soil prone to erosive conditions should be avoided. Provision of earth bunds or sand bags in areas where large amounts of exposed soils exist is required. Construction work must be properly programmed to minimize soil excavation in the rainy season. All stockpiles must be managed in accordance with good engineering principles. It must be positioned appropriately and be protected from run-off. Existing access roads only, may be used to gain access to site and travel on site. 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. 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. All embankments must be adequately compacted and planted with grass to stop any excessive soils erosion and scouring of the landscape. Cover stockpiles and surround downhill sides with a sediment fence to stop materials washing away.	All damaged areas successfully rehabilitated Earth bunds present Drainage channels established Cut-off drains excavated Stockpiles covered and sediment fence erected around stockpiles Stockpiles suitably covered and sediment fence erected	ESO		4.6 and 4.10
	Compaction of	To prevent the	Construction vehicles should only use	No evidence of	Contractor	Continuous	4.1, 4.2, 4.5,

Environmental Attribute	Environmental concern	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable legislation reference
Construction Phase							
	soil	compaction of valuable soils due to traffic and equipment	the **designated routes** as determined in the pre-construction phase. Topsoil stripped should be 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. **All compacted areas should be ripped** prior to them being rehabilitated by the contractor.	driving over stockpiled topsoil.	ESO		4.6 and 4.10
	Contamination of soil	Prevent contamination of soil	There should not be any unnecessary vehicle maintenance on site and if a vehicle needs to be serviced it should be sent to a registered/certified vehicle garage. Should the **soil** be **contaminated** by the leaking of fuel the following should apply: The contaminated soil should be removed to a depth of 200 mm and disposed of as hazardous waste. Thereafter the area should be treated with an organic solvent.	No vehicle maintenance occurring on site. No signs of soil pollution	Contractor ESO	Continuous	4.1, 4.2, 4.5, 4.6 and 4.10
Social and Aesthetic	**Noise impact**	To maintain noise levels below “disturbing” as defined in the national and provincial Noise Regulations	Construction activates shall only take place during **working hours**” which are between sunrise to sunset, Monday through Saturday.	No complaints from surrounding residents and I & APs	Contractor/ ESO	Continuous	4.1 and 4.3
	Dust impact	Minimise dust from the site	Dust pollution could occur during the construction works, especially during the dry months. Regular and effective **dust suppression** 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	No visible signs of dust pollution No complaints from surrounding residents and I & APs	Contractor/ ESO	Continuous	4.1 and 4.3

Environmental Attribute	Environmental concern	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable legislation reference
Construction Phase							
			nearby roads. If necessary, construction areas and access roads should be watered in the mornings and afternoons.				
	Safety and security	To ensure the safety and security of the public	**Signage** indicating the operations of heavy vehicles on access roads and on the construction site is to be erected. Construction personnel **may not stay over on site**. The following actions would assist in management of safety along the road: • Adequate road traffic signs; • 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 prevent injury. **No fires are permitted on site.**	Traffic signs are visible No signs of sleeping quarters on site Barrier tape erected around excavations No detrimental fire hazards	Contractor/ ESO	Continuous	4.9
	Influx of people from other areas	Prevent the influx of people from other areas	It is recommended that (where possible) only people from the **local communities** in and around the area are **employed** on the construction site.	People from local community employed	Contractor	Continuous	4.9
Social	**Interruption of Allandale Road traffic flow**	Limited interruption of Allandale Road traffic flow due to construction of filling station adjacent to it.	Limited duration of interruption of normal traffic flow by sticking to project plan.	No complaints from I&APs	Developer	During construction	4.12
Cultural heritage	**Loss of or damage to cultural Resources**	Preserve cultural historic sites and finds	If any features are discovered during construction activities, the correct "procedures for an Environmental incident" (at the end of this EMP) must be followed.	No destruction of or damage to graves archaeological sites	Contractor/ ESO/ ECO	Continuous	4.1 and 4.7
Hazardous waste	**Contamination of land**	No contamination of land by	Hydrocarbons trapped in oil trap are to be removed at a frequency in	No hydrocarbon pollution	Contractor/ ESO/	Continuous	4.1 and 4.4

Environmental Attribute	Environmental concern	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable legislation reference
Construction Phase							
		hydrocarbons	accordance with OEM of the trap installed and are to be stored in 210l drums for recycling or disposal at a registered landfill site.		ECO		

Environmental Attribute	Environmental concern	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable legislation reference
Decommissioning/Rehabilitation Phase							
Legal compliance	**Environmental rehabilitation**	Sufficient funds available for rehabilitation	Developer to release funds required for environmental rehabilitation	Rehabilitation affected in accordance with Environmental authorisation conditions e.g. RoD and WULA.	Developer	During Decommissioning Phase	4.1-4.20
Geology and soils	**Loss of soil**	Ensure rehabilitation of disturbed areas	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. The soil shall be levelled before seeding Hydro-seed the soil with grass species indigenous to the development area. Watering shall take place at least once per day for the first 14 days until germination of seeds have taken place. Thereafter watering should take place at least for 20 minutes every 4 days until grass have hardened off.	Grass have re-established	Contractor/ ESO	Prior to decom-missioning	4.1, and 4.10
Fauna and Flora	**Destruction of protected vegetation**	Rescued flora returned to development footprint or similar habitat	Protected flora rescued prior to construction phase to be returned to development footprint or nearest location with similar habitat.	Returning rescued flora.	Contractor/ ESO	During rehabilitation	4.1, 4.5 and 4.6
	Spread of invasive and alien vegetation	To prevent the spread and occurrence of alien invaders	Prior to concluding decommissioning activities the contractor should eradicate all invaders visible on the construction site.	No alien and invasive species visible	Contractor ESO and ECO	At end of construction phase	4.1, 4.5 and 4.6 and 4.10
	Incomplete rehabilitation	To protect the existing indigenous flora and fauna	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	Site rehabilitated	Contractor ESO and ECO	Until ECO satisfied	4.1, 4.5 and 4.6

Environmental Attribute	Environmental concern	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable legislation reference
Decommissioning/Rehabilitation Phase							
			of the necessary vegetation. Rehabilitation works should be monitored until 80% of vegetation has been established.				
Aesthetic	**Dumping of builder's rubble on neighbouring properties.**	All waste removed from construction site	All waste temporarily stored on the construction site during the operational phase has to be removed from the site during the decommissioning phase and prior to the project being regarded as closed.	No pollution of the environment	Contractor Site supervisor ECO	At end of construction phase	4.1 and 4.4
Legal compliance	**Compliance with RoD and EMP**	ECO to conduct final site inspection and audit	ECO to conduct last inspection on site and sign off that the EMP has been complied with or identify breaches. Submit to DEA for approval.	EMP compliance	ECO	At end of construction phase	4.1-4.20
	Structural integrity	Structures comply with design	Verify structures comply with design specifications.	Structural integrity	Eskom	At end of construction phase	4.1
Hydrology & morphology	**Impacting wetland functionality and groundwater**	Wetland not negatively impacted	Decommissioning activities within 500m from a wetland poses potential for water pollution.	No pollution of wetland	Contractor/ ESO	At end of construction phase	4.1 and 4.2
			Conditions associated with this WUL as well as IWQQMMP must be adhered to during decommissioning phase.	WUL conditions and IWQQMMP implemented	Contractor/ ESO	During and at the end of construction phase	4.1 and 4.2
Social	**Allandale Road not returned to former condition**	Return Allandale Road to former condition following construction of filling station across it.	JRA and or Gauteng Department of Roads to sign off on road upgrades affected following construction of filling station adjacent to Allandale Road.	JRA and GDR satisfied with road upgrades.	Developer	Following construction	4.12
	Heavy vehicle traffic increase could disrupt the surrounding landowners' daily routines.	Traffic not disrupted	Heavy vehicles responsible for collecting waste or rehabilitation during the decommissioning phase must be instructed to only use the main roads during off-peak hours.	Traffic not disrupted during decommissioning	Contractor Site supervisor	At end of construction phase	4.12
	Restrictions of	Continued access	To minimize the impacts on local	Continued access to	Contractor	At end of	4.12

Environmental Attribute	Environmental concern	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable legislation reference
Decommissioning/Rehabilitation Phase							
	access to surrounding properties and the construction area during decommissioning and closure phases.	to adjacent properties	traffic, vehicles associated with decommissioning should avoid using the local road network during peak traffic times. These vehicles should use only specific roads and strictly keep within the speed limits and abide to all traffic laws. No speeding or reckless driving should be allowed. Access to the site for decommissioning vehicles should be planned to minimize the impact on the surrounding network; and Warning signs should be erected on the roads that these vehicles will use, at big crossings/ access roads and on the site if needed.	adjacent properties during decommissioning	Site supervisor	construction phase	
	Damage to roads.	No road damage	Provisions made for temporary access to and from the construction site along local roads should be removed. Any damage to the local road curbs at access points to construction site caused by construction activities should be repaired.	No road damage evident following rehabilitation	Contractor Site supervisor	At end of construction phase	4.12
	Access to adjacent properties not restored	Access to adjacent properties restored	Existing accesses to properties should be restored to former state prior to construction having commenced, in order to prevent complaints.	Access to adjacent properties restored	Contractor Site supervisor	At end of construction phase	4.12

Environmental Attribute	Environmental concern	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable legislation reference
Operational Phase							
Hydrology & morphology	**Impacting wetland functionality and groundwater**	Wetland not negatively impacted	Monitoring and reporting conditions associated with this WUL as well as IWQQMMP must be adhered to during operational phase.	WUL conditions and IWQQMMP implemented	Contractor/ ESO	During and at the end of construction phase	4.1 and 4.2

6. Procedures for environmental incidents

6.1 Leakages & spills

- Identify source of problem.
- Stop goods leaking, 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).
- Environmental Control Officer to follow Incident Management Plan.

6.2 Failure of erosion/sediment control devices

- Prevent further escape of sediment.
- 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.
- ECO to follow Incident Management plan.
- Monitor for effectiveness until re-establishment.

6.3 Bank/slope failure

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

6.4 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.
- Recommence work when cleared by ECO.

6.5 Discovery of archaeological or heritage items

- Stop work.
- Do not further disturb the area.
- Notify ECO.
- ECO to arrange appraisal of specimen.
- If confirmed significant, ECO to liaise with National, Cultural and History Museum.
  P.O. Box 28088
  SUNNYSIDE
  0132
  Contact Mr. J. van Schalkwyk

or Mr. Naude	▪ Recommence work when cleared by ECO.

7 EMP review

1. Changes will be affected to this draft EMP in accordance with GDARD comments.
2. The Contractor's Site Supervisor is responsible for ensuring that site workers comply with procedures, and for informing the site workers of any changes that may have been implemented by GDARD before starting any construction work.
3. If the contractor cannot comply with any of the mitigation measures as described in ***Section 5.,*** they should inform the ECO with reasons within 7 working days from receipt of the EMP.

ANNEXURE H:
BOKAMOSO PROFILE

Bokamoso

Landscape Architects & Environmental consultants

P.O.BOX 11375
Maroelana
0161

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

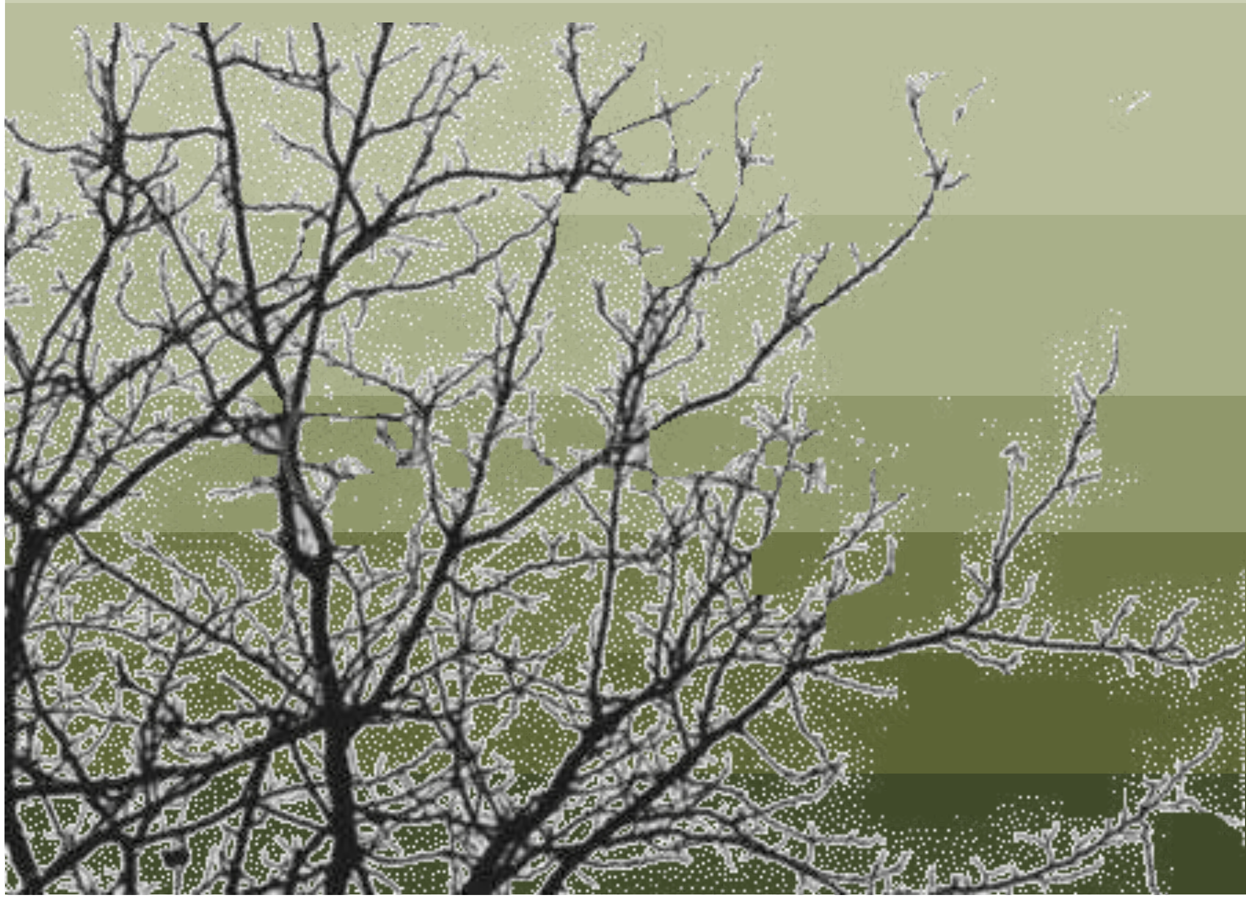
E-mail: lizelleg@mweb.co.za
Website: www.bokamoso.biz

Bokamoso

Table of Contents

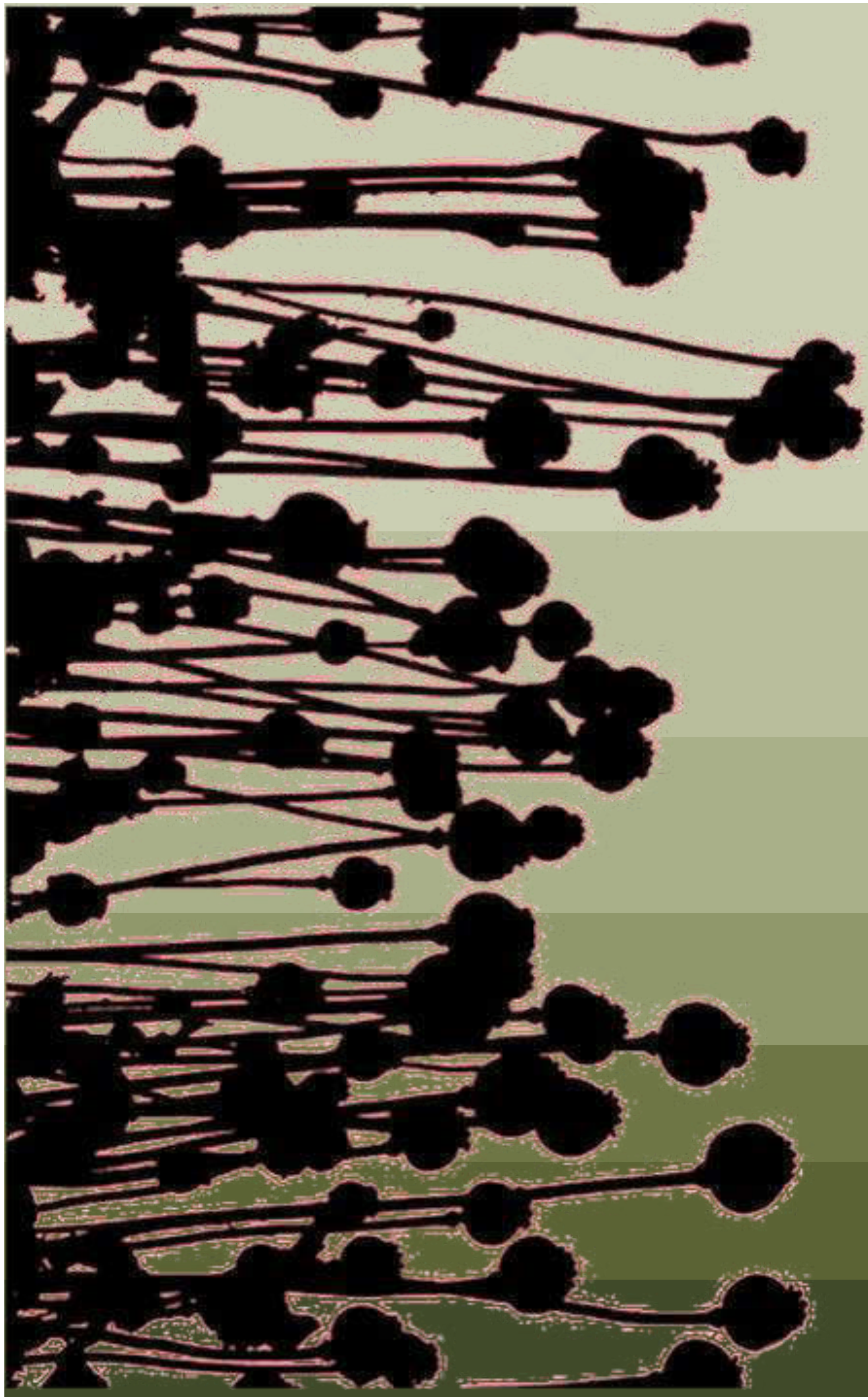
Bokamoso specialises in the fields of Landscape Architecture and all aspects of Environmental Management and Planning. Bokamoso was founded in 1992 and has shown growth by continually meeting the needs of our clients. Our area of expertise stretches throughout the whole of South Africa. Our projects 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

011 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

02 Vision, Mission & Values

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

031 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 supplied GAUTRANS/former PWV Consortium with Environmental input and reports regarding road network plans, road determinations, preliminary and detailed designs for the past 12 years.

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)
More than 3 years working experience in the Environmental field
Specialises in ECO works, Basic Assessments, EIA's, and Flora Reports
Compilation of various Environmental Reports

Dashentha Naidoo

BA Honours Degree in Environmental Management (UNISA) - CUM LAUDE
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
Specialises in Water Use License & Compilation of various Env. Reports

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, Rehabilitation Plans and Compilation Basic Assessment Reports
Compilation of Tender documents

Bokamoso

Anton Nel	**B-Tech Landscape Technology (TUT)** **N Dip Landscape Technology (TUT)** **Hazardous Waste Management Short Course** 2 years experience in ECO. Specialises in Basic Assessment Reports.
Juanita de Beer	**Diploma Events Management and Marketing (Damelin)** Specializes in Public relations and Public Participation Processes (3 years experience)
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** **Specialises in compiling various environmental reports**
A.E. van Wyk	**BSc. Environmental Sciences (Zoology and Geography)** **Specialises in compiling various environmental reports**

Bokamoso

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

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 License Application

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

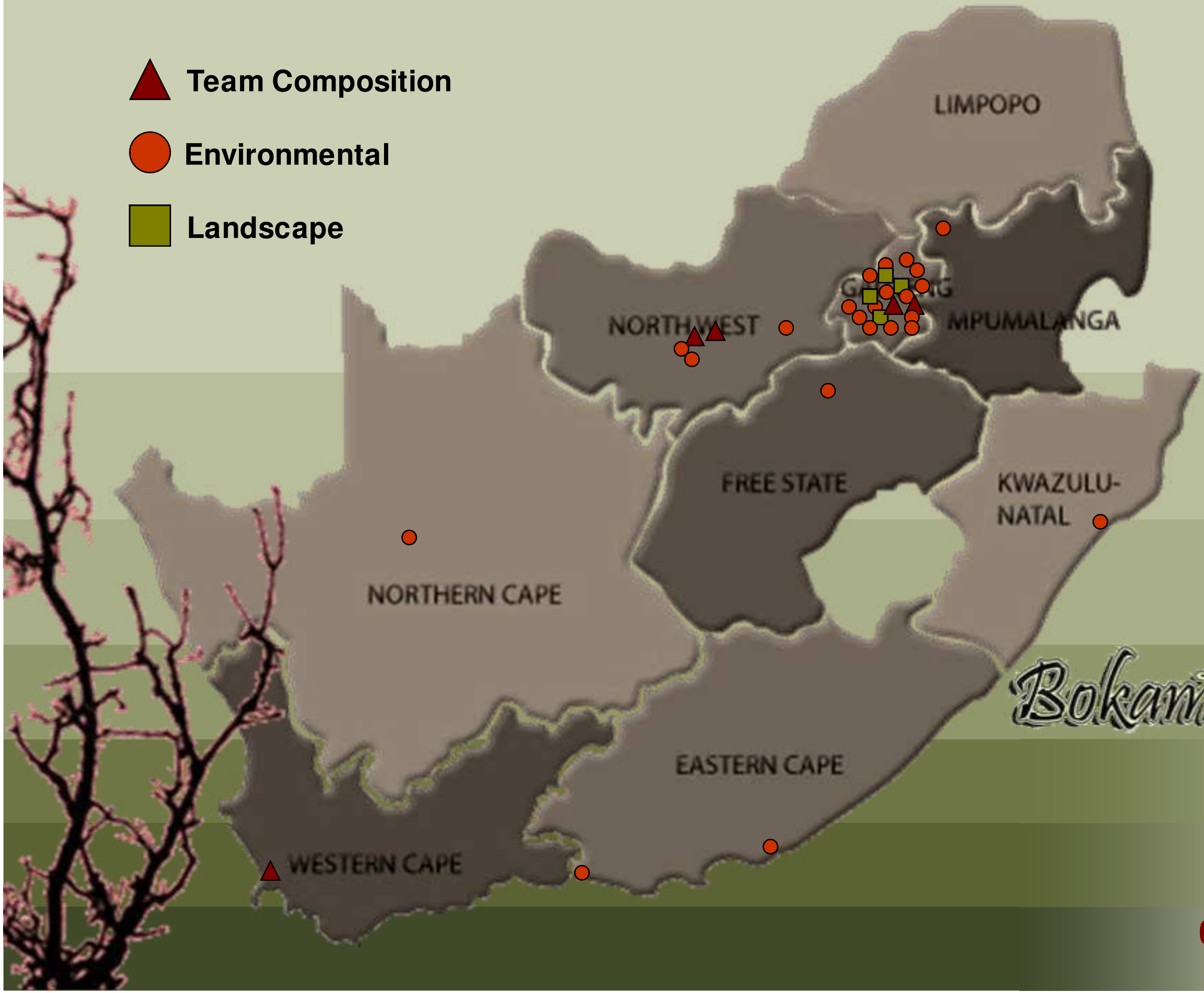
03 Landscape Contracting

Implementation of Plans for:

- Office Parks
- Commercial/ Retail / Recreational Development
- Residential Complexes
- Private Residential Gardens
- Implementation of irrigation systems

04 Services

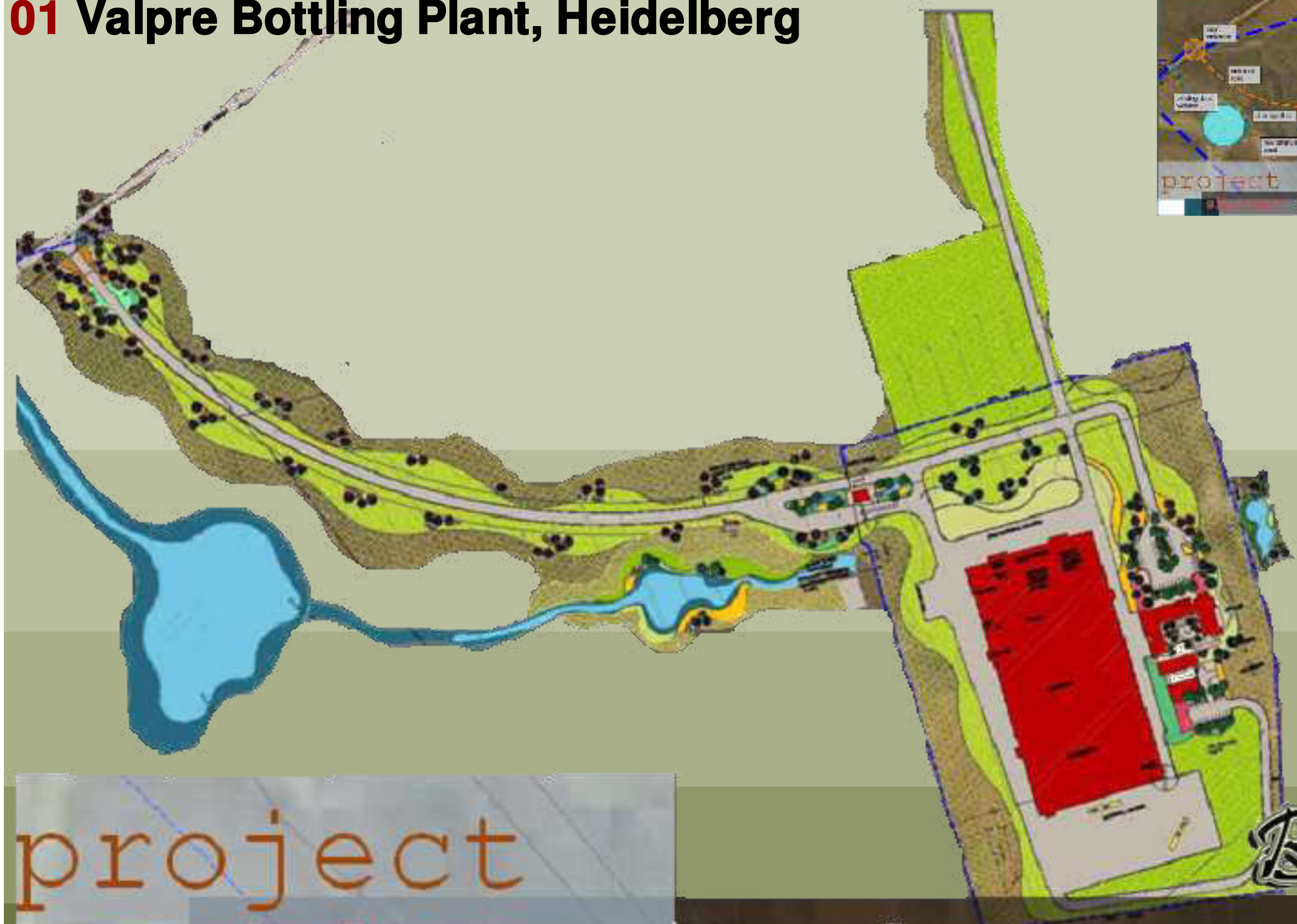
042 Contracting Services



04 Services

043 Orientation

01 Valpre Bottling Plant, Heidelberg



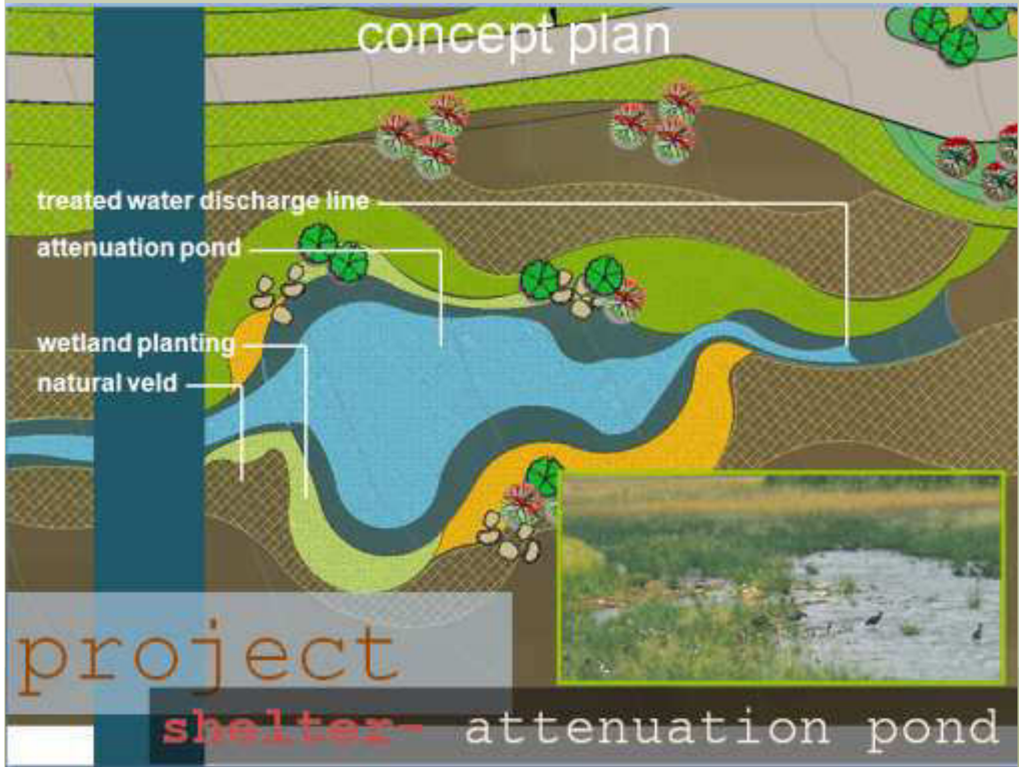
project

shelter- site plan

05 Landscape Projects– Current

051 Commercial

01 Valpre Bottling Plant, Heidelberg

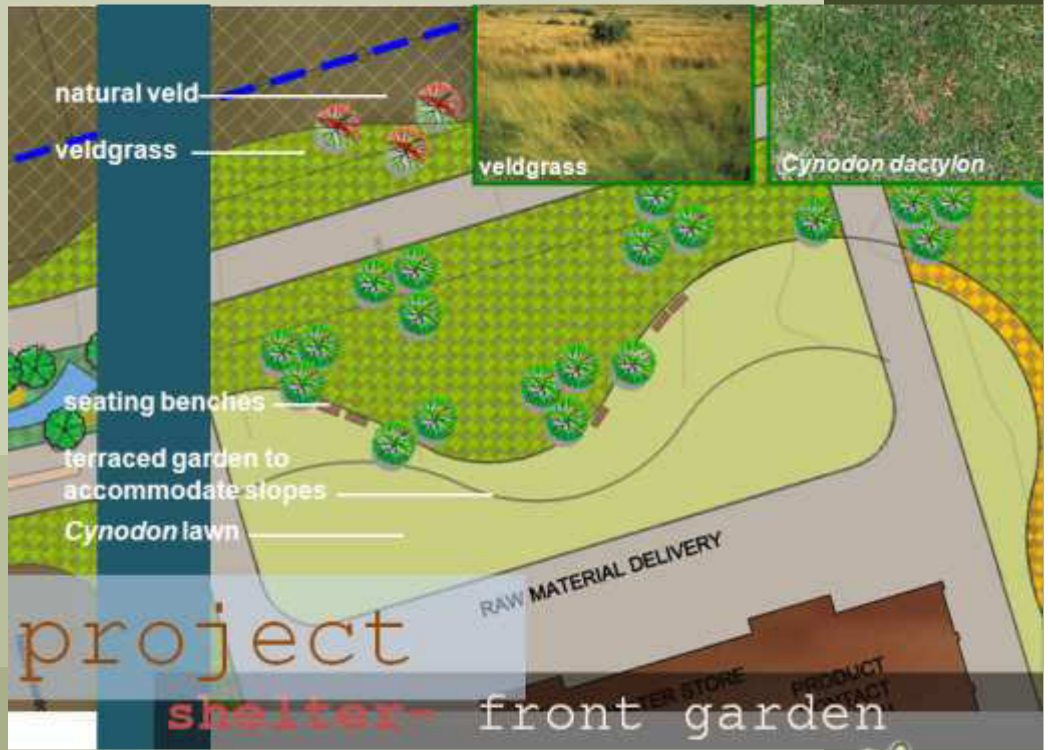


Bokamoso

05 Landscape Projects– Current

051 Commercial

01 Valpre Bottling Plant, Heidelberg



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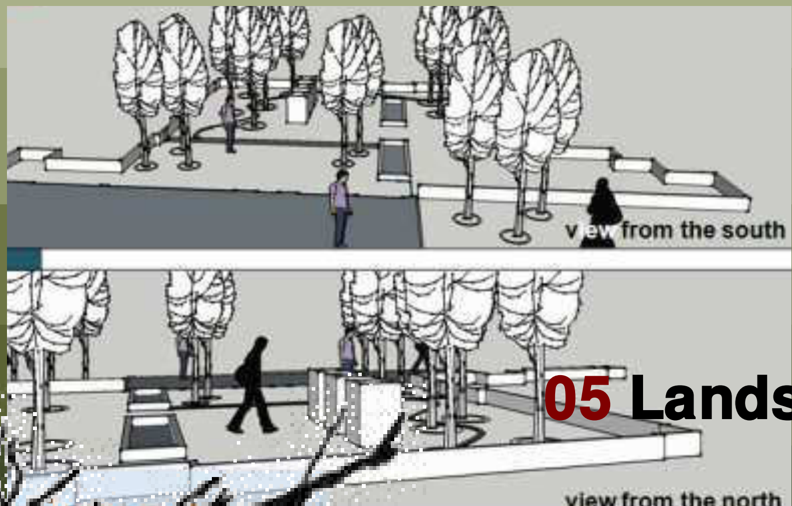
05 Landscape Projects– Current

051 Commercial

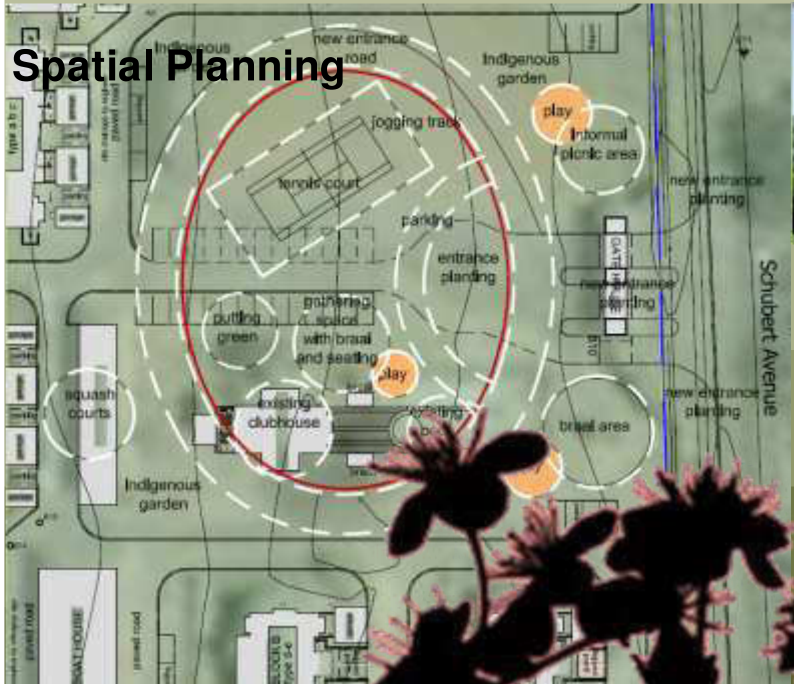
01 Valpre Bottling Plant, Heidelberg



05 Landscape Projects– Current

051 Commercial

02 Melodie Waters, Hartebeespoortdam



Spatial Planning

Indigenous Planting

Streetscape

Bokamoso

05 Landscape Projects – Current

052 Commercial/Recreational

02 Melodie waters, Hartebeestpoortdam

Rehabilitation

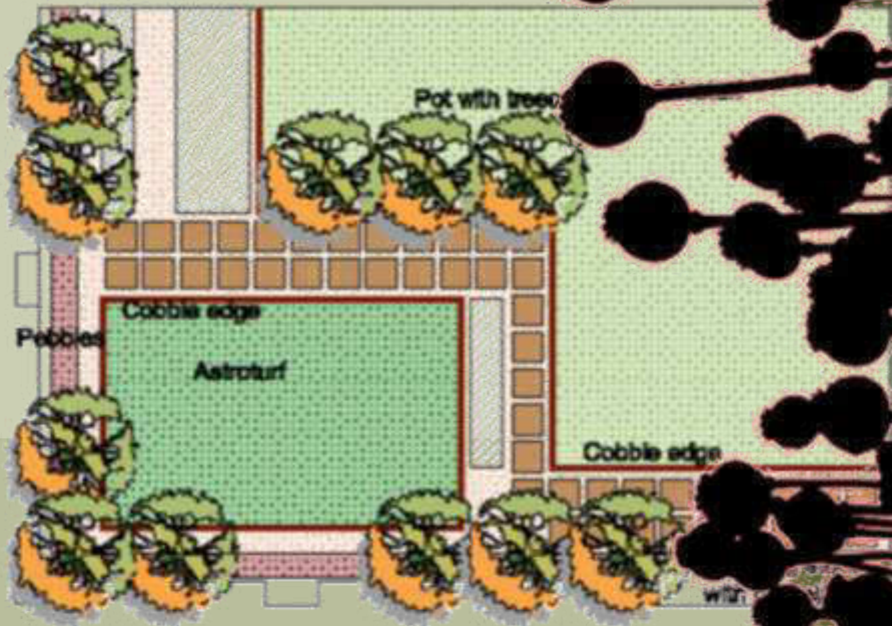
Area Layout

Bokamoso

05 Landscape Projects– Current

052 Commercial/Recreational

03 Grain Building, Pretoria

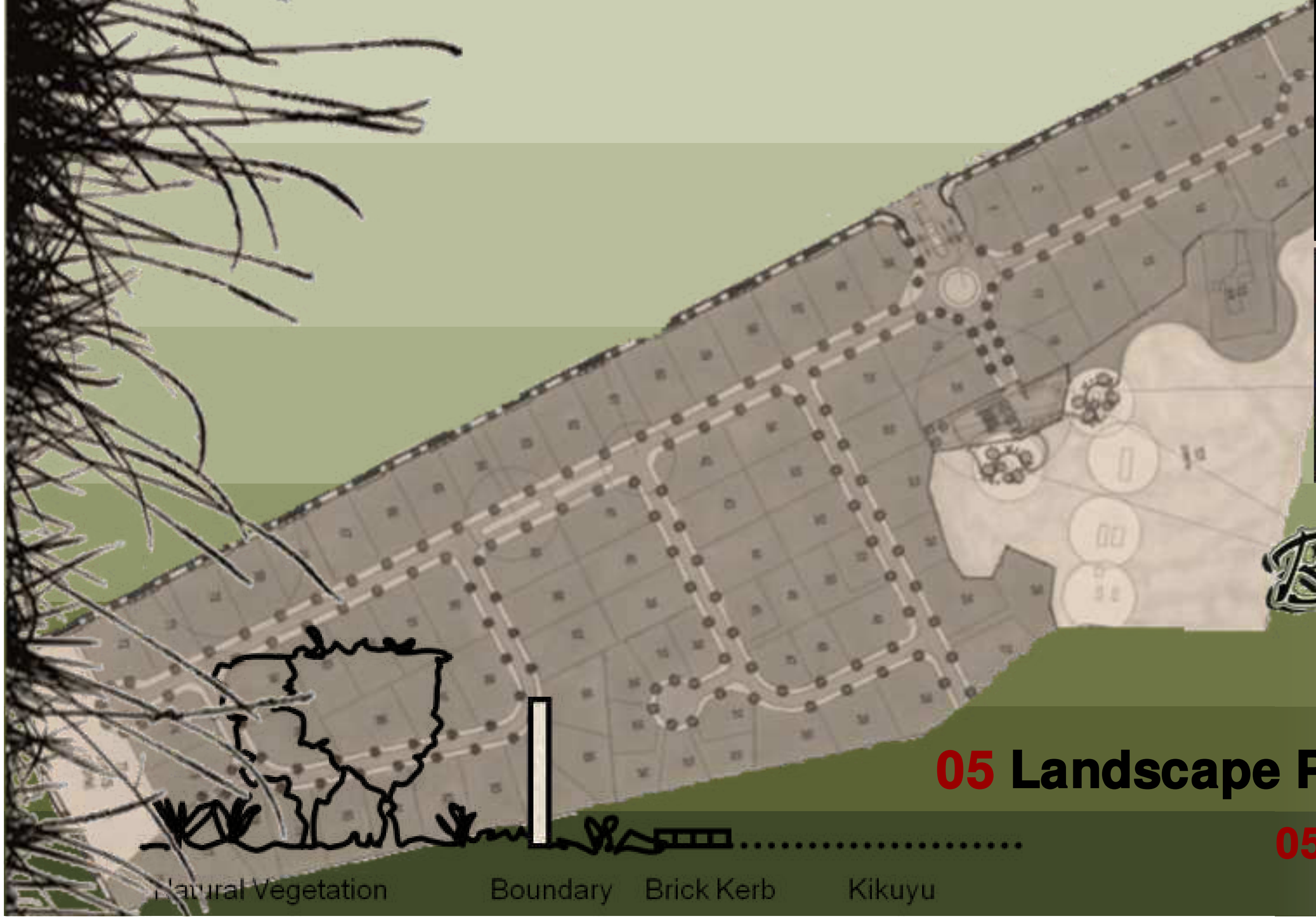


05 Landscape Projects– Completed

053 Offices

04 Ismail Dawson offices, Pretoria

05 Celtic Manor, Pretoria



05 Landscape Projects - Completed

054 Complex Development

06 The Wilds, Pretoria

07 The Wilds, Pretoria

08 The Wilds, Pretoria

05 Landscape Projects – Completed

055 Residential

09 The Wilds, Pretoria

010 The Wilds, Pretoria

Bokamoso

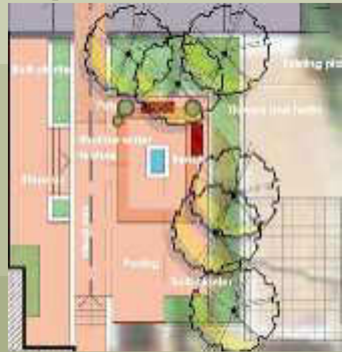
05 Landscape Projects – Completed

055 Residential

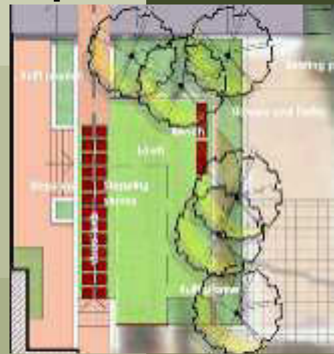
011 Governor of Reserve Bank's Residence, Pretoria

Plant Palette

Option 1



Option 2



05 Landscape Projects – Conceptual

055 Residential

012 House Ismail, Pretoria







Front Garden

Back Garden



05 Landscape Projects - Conceptual

055 Residential

013 Forest Garden, Pretoria

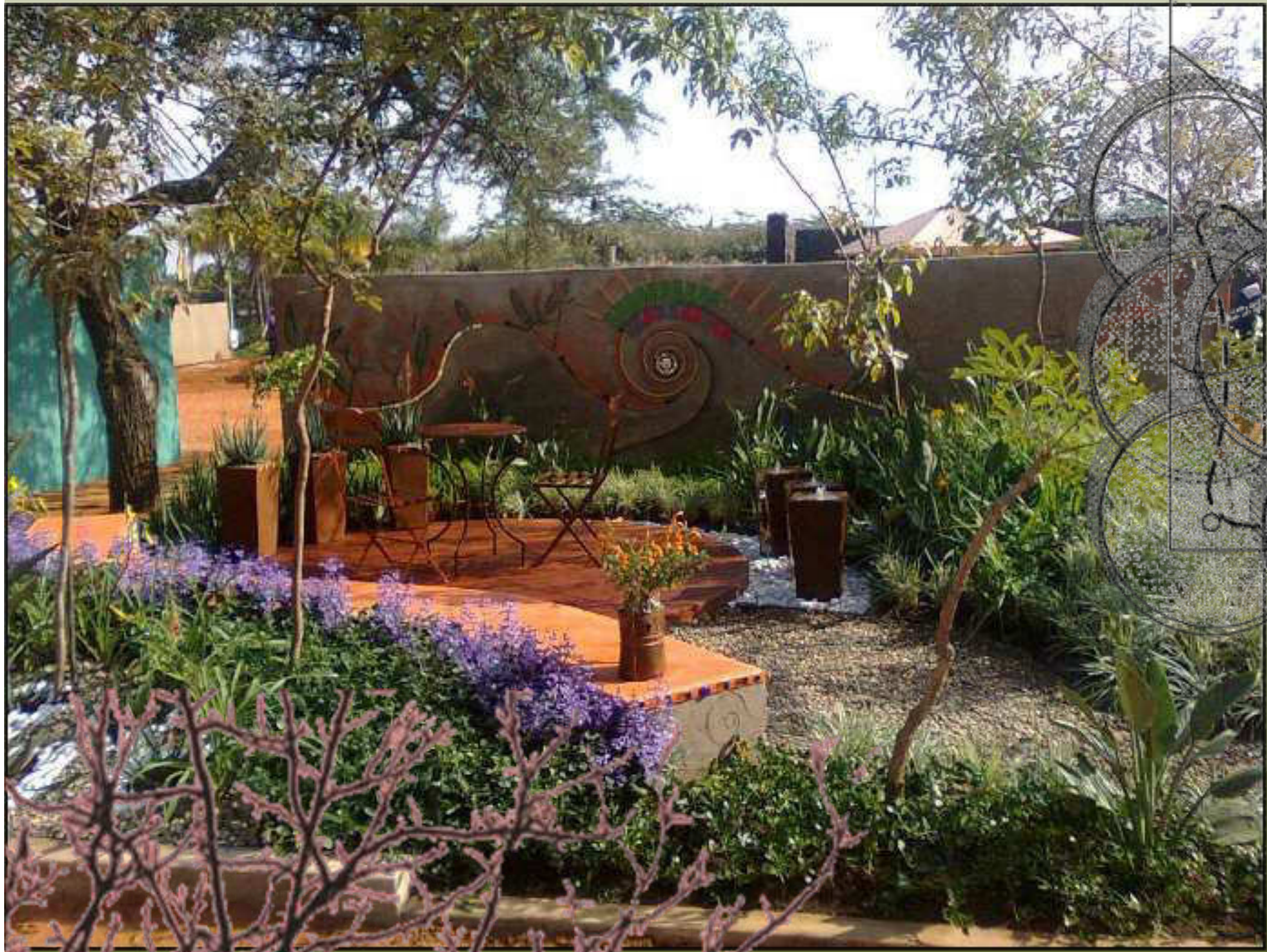
015 Forest Garden, Pretoria

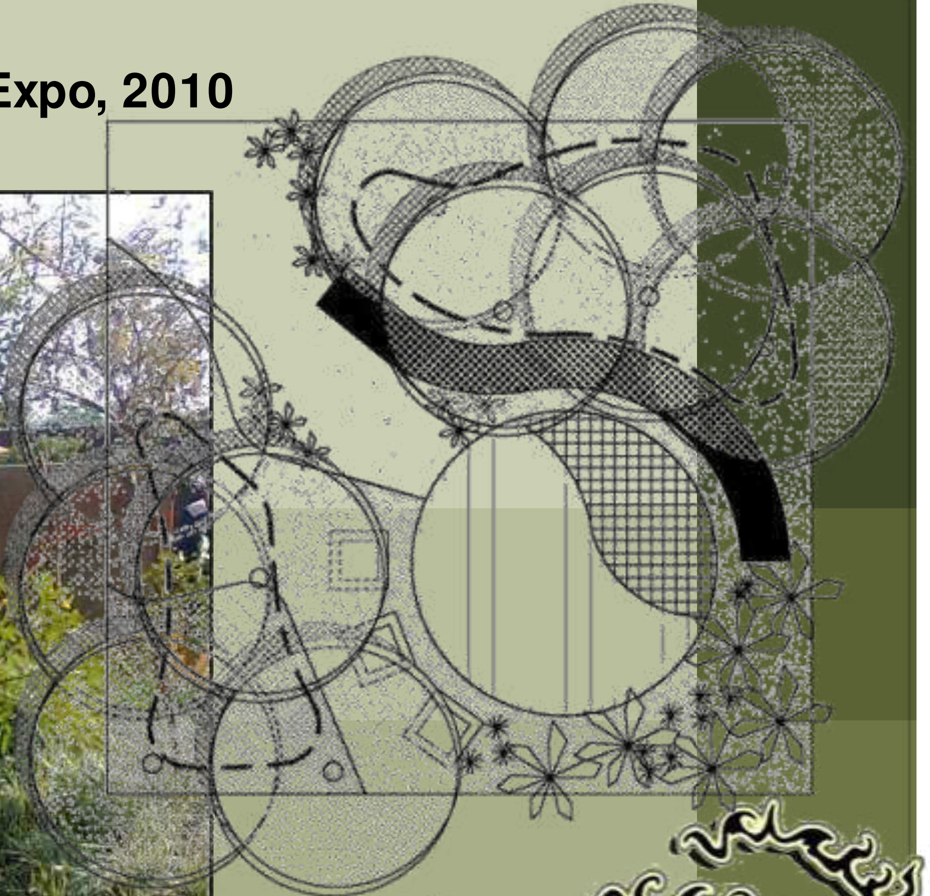
05 Landscape Projects - Completed

055 Residential

01 Safari Garden Expo

Received a Silver Certificate at the Safari Garden Expo, 2010



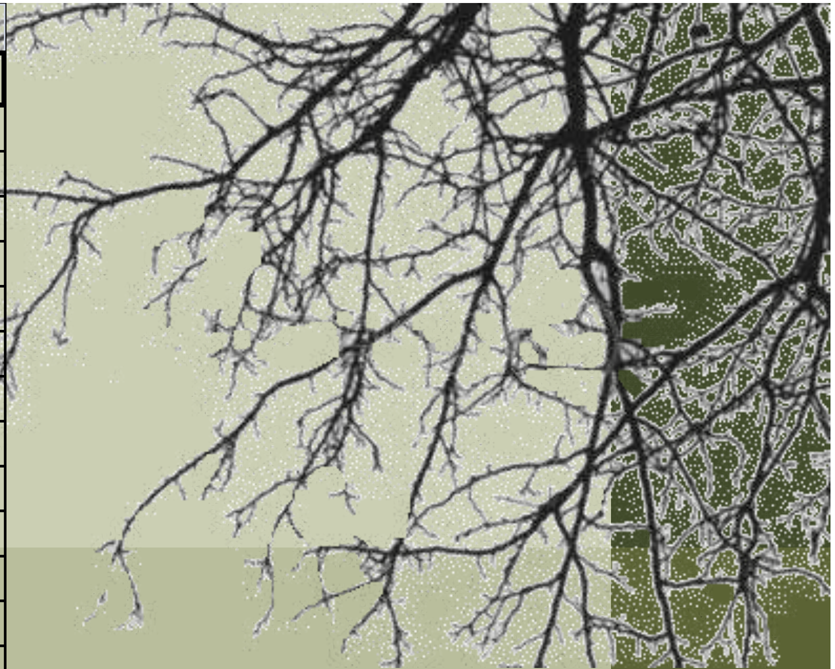


Bokamoso

02 UNISA Sunnyside Campus, Pretoria

Best Commercial Paving Plan in Gauteng, 1997

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
Knopjeslaagte 95/Peachtree	ROD	EIA
Knopjeslaagte 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 68 (Ross)	In Progress	Opinion
Monavoni X 53	In Progress	BA & Opinion
Mooikloof (USN)	In Progress	Opinion
Norwood Mall/Sandspruit	In Progress	Opinion
Riversong X 9	In Progress	Opinion
Sud Chemie	In Progress	Opinion
USN Benjoh Fishing Resort	In Progress	Opinion



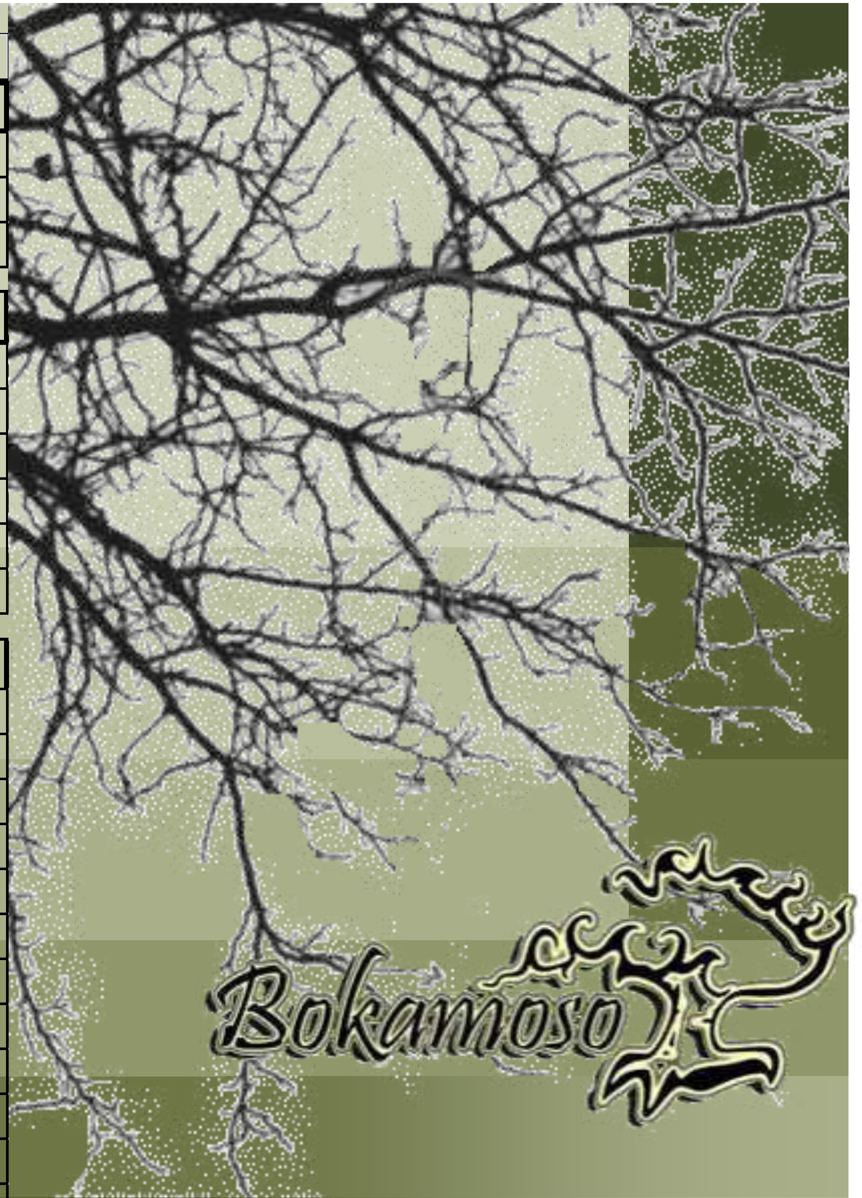
The adjacent list host the status of our current projects. Only a selected amount of projects are displayed.

07 Current Environmental Projects

071 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 Ryneveld Reservoir	In Progress	ECO
Project Shelter	In Progress	ECO
S24 G		
Wonderboom	In Progress	S24 G
Mogwasi Guest houses	Completed	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 Potch	In Progress	WULA
Jozini Shopping Centre	In Progress	WULA+BA
K60	Completed	WULA
Maloto Roads	In Progress	WULA
Kwazele Sewage Works	In Progress	WULA
Monavoni External Services	In Progress	WULA+BA
Nyathi Eco Estate	In Progress	WULA
Prairie Giants X 3	In Progress	WULA
Waveside Water Bottling Plant	Completed	WULA



07 Current Environmental Projects

073 Objection, DFA & WULA

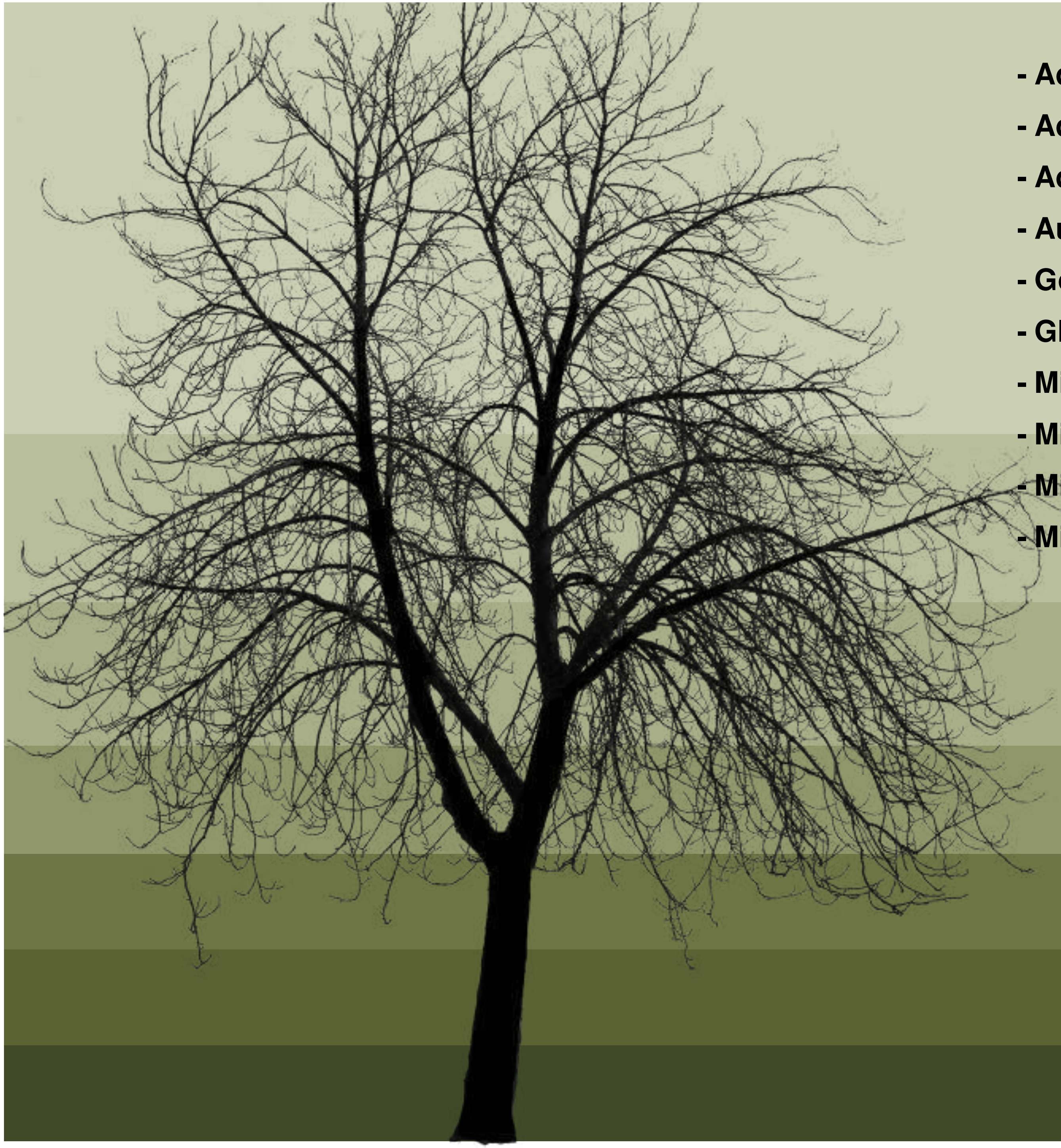
Project Name	Status	Project
Environmental Management Plan(EMP)		
Heidelberg X 12	ROD	EMP
Monavoni Shopping Centre	Completed	EMP
Forest Hill Development	Completed	EMP
Weltevreden Farm 105KQ	Completed	EMP+EIA
Raslouw Holding 93	Completed	EMP+BA
Durley Development	Completed	EMP+BA
Rooihuiskraal North X 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		
Menlyn Advertising	Completed	Signage
The Villa Mall	Completed	Signage+EMP+BA

07 Current Environmental Projects

074 EMP, Rehabilitation , Waste Management & Signage Application

08 Indicative Clients

- 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



- 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

09 Tools

Qualifications And Experience In The Field Of Environmental Planning And Management (Lizelle Gregory (Member Bokamoso)):

Qualifications:

-Qualified as ***Landscape Architect*** *at UP 1991;*
-Qualified as ***Professional Landscape Architect in 1997****;*
-A Registered Member at The ***South African Council for the Landscape Architect Profession (SACLAP)*** *with Practise Number:* ***PrLArch97078****;*
- A Registered Member at the ***International Association for Impact Assessment Practitioners (IAIA)****;*
- Qualified as an ***Environmental Auditor in July 2008*** *and also became a Member of the International Environmental Management Association (IEMAS) in 2008.*

Working Experience:

-Worked part time at Eco-Consult – 1988-1990;
-Worked part time at ***Plan Associates as Landscape Architect in training*** *– 1990-1991;*
-Worked as Landscape Architect at ***Environmental Design Partnership (EDP)*** *from 1992 - 1994*
-Practised under ***Lizelle Gregory Landscape Architects*** *from 1994 until 1999;*
*-****Lectured*** *at Part-Time at* ***UP*** *(1999) – Landscape Architecture and* ***TUT*** *(1998- 1999)- Environmental Planning and Plant Material Studies;*
-Worked as ***part time Landscape Architect and Environmental Consultant at Plan Associates*** *and* ***managed their environmental division for more that 10 years*** *– 1993 – 2008 (assisted the* ***PWV Consortium*** *with various road planning matters which amongst others included environmental Scans, EIA's, Scoping reports etc.)*
-Renamed business as ***Bokamoso in 2000*** *and is the only member of Bokamoso Landscape Architects and Environmental Consultants CC;*
*-****More than 20 years experience in the compilation of Environmental Reports,*** *which amongst others included the compilation of various* ***DFA Regulation 31 Scoping Reports****, EIA's for EIA applications in terms of the applicable environmental legislation, Environmental Management Plans, Inputs for Spatial Development Frameworks, DP's, EMF's etc. Also included EIA Application on and adjacent to mining land and slimes dams (i.e. Brahm Fisherville, Doornkop)*

Qualifications And Experience In The Field Of Landscape Architecture (Lizelle Gregory (Member Bokamoso)):

Landscape Architecture:

-Compiled landscape and rehabilitation plans for more than 22 years.

The most significant landscaping projects are as follows:
-Designed the Gardens of the Witbank Technicon (a branch of TUT). Also supervised the implementation of the campus gardens (2004);
-Lizelle Gregory was the Landscape Architect responsible for the paving and landscape design at the UNISA Sunnyside Campus and received a Corobrick Golden Award for the paving design at the campus (1998-2004);
-Bokamoso assisted with the design and implementation of a park for the City of Johannesburg in Tembisa (2010);
-The design and implementation of the landscape gardens (indigenous garden) at the new Coca-Cola Valpre Plant (2012-2013);
-Responsible for the rehabilitation and landscaping of Juksei River area at the Norwood Shopping Mall (johannesburg) (2012-2013);
-Designed and implemented a garden of more than 3,5ha in Randburg (Mc Arthurpark). Bokamoso also seeded the lawn for the project (more than 2,5 ha of lawn successfully seeded) (1999);
-Bokamoso designed and implemented more than 800 townhouse complex gardens and submitted more than 500 Landscape Development Plans to CTMM for approval (1995 – 2013);
-Assisted with Landscape Designs and the Masterplan at Eco-Park (M&T Developments) (2005-2011);
-Bokamoso designed and implemented an indigenous garden at an office park adjacent to the Bronberg. In this garden it was also necessary to establish a special garden for the Juliana Golden Mole. During a recent site visit it was established that the moles are thriving in this garden. Special sandy soils had to be imported and special indigenous plants had to be established in the natural section of the garden.

-Lizelle Gregory also owns her own landscape contracting business**. For the past 20 years she trained more than 40 PDI jobless people (sourced from a church in Mamelodi)** to become landscape contracting workers. All the workers are (on a continuous basis) placed out to work at nurserys and other associated industries;
-Over the past 20 years the Bokamoso team compiled more than 800 landscape development plans and also implemented most of the gardens. Bokamoso also designed and implemented the irrigation for the gardens (in cases where irrigation was required). Lizelle regarded it as important to also obtain practical experience in the field of landscape implementation.