

# *Draft Environmental Impact Assessment Report Monavoni Extension 44*

*Gaut: 002/08-09/N0588*

*October 2013*



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**RMS BOREHOLE PROFILES (2006)**  
(MONAVONI EXTENSION 31)

## Borehole Profile

Page 1 of 1

**Project:** MONAVONI EXTENSION 43.

**Hole No.** 43/01

**Machine:** Thor(15 Bar)

**Logged:** es      **Date:** 27/06/2009

**Contractor:** J K DEVELOPMENTS cc

**Rest Level:** -7m(1475mamsl)

**Date:** 20/06/2009

**Date:** 22/06/09      **Job No:** 09124mona43

Chip Size(mm)	Pen. Speed	Depth (m)	Profile	Description
<5	0'25"	1	[Profile: Dark brown, silty SAND with scattered fine, manganocrete nodules and some quartz grains; colluvium.]	Dark brown, silty <b>SAND</b> with scattered fine, manganocrete nodules and some quartz grains; colluvium.
	0'23"	2		
	0'24"	3		Dark khaki, slightly sandy <b>SILT</b> with occasional fine, dark brown, manganocrete nodules (contamination); residual syenite.
<3	0'26"	4	[Profile: Dark khaki, slightly sandy SILT with occasional fine, dark brown, manganocrete nodules (contamination); residual syenite.]	
	0'30"	5		
	0'28"	6		
	0'26"	7		
	0'36"	8		
	0'44"	9		
<10	1'49"	10	[Profile: Grey, weathered, closely fractured(?), slightly altered, hard rock DOLOMITE.]	Grey, weathered, closely fractured(?), slightly altered, hard rock <b>DOLOMITE</b> .
	1'56"	11		
	1'58"	12		
	2'24"	13		Interpreted as solid dolomite below 12m. No visible change in sample composition below 12m.
	3'16"	14		
	3'09"	15		
	3'06"	16		
	3'09"	17		
<b>EOH</b>	3'10"	18		
				<p><b>NOTES:</b></p> <ol style="list-style-type: none"> <li>1) Hole stopped at 18m after penetrating 6m of "assumed", solid bedrock (as instructed).</li> <li>2) Ground water not encountered during drilling operations.</li> <li>3) Water rest level at -7,0m when hole backfilled a few days later.</li> </ol>

Prepared by: R.M.S P O Box 32107, GLENSTANTIA 0010      Tel: 012 993 2049      Cell: 082 551 6034

**Collar Elevation:** 1482m amsl

**Coords: Y** (29) 91 385      **X:** 2 863 479  
(Hand-held GPS - wgs84)



## Borehole Profile

Page 1 of 1

**Project:** MONAVONI EXTENSION 43.

**Hole No.** 43/02

**Machine:** Thor(15Bar)

**Logged:** es      **Date:** 01/07/2009

**Contractor:** J K DEVELOPMENTS cc

**Rest Level:** Dry

**Date:** 20/06/2009

**Date:** 22/06/09      **Job No:** 09124mon43

Chip Size(mm)	Pen. Speed	Depth (m)	Profile	Description
<10	0'26"	1	[Profile: Dotted pattern]	Brown, silty <b>SAND</b> with traces of dark brown, manganocrete nodules and milky white, quartz fragments; colluvium.
	0'47"	2		
	1'50"	3		
<5	0'26"	4	[Profile: Horizontal lines]	Brown to dark brown with some light grey, slightly clayey <b>SILT</b> ; residual shale(?).
	0'22"	5		Light brownish khaki, clayey <b>SILT</b> ; residual syenite.
	0'26"	6		
	0'25"	7		
	0'19"	8		Dark brown to chocolate brown, silty <b>CLAY</b> with traces of chocolate brown clay(wad); residual dolomite.
	0'20"	9		
	0'19"	10		
	0'10"	11		No samples below 10m.
0	0'08"	12	[Profile: Vertical lines]	Interpreted as solid rock below 14m. Uncertain of origin but probably dolomite.
	0'09"	13		
	1'45"	14		
	2'16"	15		
	3'04"	16		
	3'18"	17		
	3'26"	18		
	3'20"	19		
	3'15"	20		
	EOH			
				<p><b>NOTES:</b></p> <p>1) Hole stopped at 20m after penetrating 6m of "assumed", solid bedrock (as instructed).</p> <p>2) Ground water not encountered during drilling operations.</p> <p>3) Hole dry when backfilled a few days later.</p>

Prepared by: R.M.S P O Box 32107, GLENSTANTIA 0010      Tel: 012 993 2049      Cell: 082 551 6034

**Collar Elevation:** 1486m amsl

**Coords:** Y (29)91 760      X: 2 863 590  
(Hand-held GPS - wgs84)



## Borehole Profile

Page 1 of 1

**Project:** MONAVONI EXTENSION 44.

**Hole No.** 44/03

**Machine:** Thor(15Bar)

**Logged:** es

**Date:** 01/07/2009

**Contractor:** J K DEVELOPMENTS cc

**Rest Level:** Dry

**Date:** 05/06/2009

**Date:** 20/06/09 **Job No:** 09124monX44

Chip Size(mm)	Pen. Speed	Depth (m)	Profile	Description
<10	0'20"	1		Brown, silty <b>SAND</b> with traces of dark brown, manganocrete nodules; colluvium.
	0'25"	2		Light khaki, slightly sandy <b>SILT</b> ; residual syenite.
	0'23"	3		
<5	0'26"	4		
	0'20"	5		Dark chocolate brown speckled red, silty <b>CLAY</b> with minor, chocolate brown clay(wad); residual dolomite.
	0'18"	6		
	0'21"	7		Dark chocolate brown, silty <b>CLAY (WAD)</b> with scattered, dark grey, weathered, dolomite fragments; residual dolomite.
	1'16"	8		Dark grey, weathered to slightly weathered, fractured(?), hard rock <b>DOLOMITE</b> with scattered, brown clay(wad); residual dolomite (with contamination from above).
	1'49"	9		
	1'40"	10		Grey to light grey, weathered to slightly weathered, fractured(?), hard rock <b>DOLOMITE</b> .
	1'41"	11		
	1'33"	12		
	2'11"	13		
	3'45"	14		
<10	1'43"	15		
	1'50"	16		Becoming dark grey below 15m.
	1'34"	17		
	1'53"	18		
	2'35"	19		Some altered, dolomite fragments below 18m. No visible reason for increase in penetration times.
	3'35"	20		Scattered, weathered, syenite fragments below 19m.
	3'56"	21		Light grey, weathered, slightly altered, hard rock <b>SYENITE</b> .
	4'03"	22		Dark grey, weathered to slightly, weathered, hard rock <b>SYENITE</b> .
	4'18"	23		
EOH	4'35"	24		
				<b>NOTES:</b>
				1) Hole stopped at 24m after penetrating 6m of solid syenite bedrock (as instructed).
				2) Ground water not encountered during drilling operations.
				3) Hole dry when backfilled a few days later.

Prepared by: R.M.S P O Box 32107, GLENSTANTIA 0010 Tel: 012 993 2049 Cell: 082 551 6034

**Collar Elevation:** 1469m amsl

**Coords:** Y (29)91 556 X:2 862 957  
(Hand-held GPS - wgs84)

# Borehole Profile

**Project:** MONAVONI EXTENSION 43.

**Hole No.** 43/04

**Machine:** Thor(15Bar)

**Logged:** es    **Date:** 30/06/2009

**Contractor:** J K DEVELOPMENTS cc

**Rest Level:** -7m(1470mamsl)

**Date:** 03/06/2009

**Date:** 22/06/09    **Job No:** 09124mon43

Chip Size(mm)	Pen. Speed	Depth (m)	Profile	Description
<15	1'20"	1		Dark grey weathered brown, weathered, hard rock <b>DOLOMITE</b> fragments in a trace matrix of brown, silty sand; residual dolomite (interpreted as surface slabs of hard rock dolomite).
	0'50"	2		
	0'42"	3		
	0'34"	4		
<10	0'43"	5		Dark brown, slightly clayey <b>SILT</b> with minor, dark brown silt(wad) and grey weathered brown, dolomite fragments; residual dolomite (boulders of dolomite?).
	0'14"	6		
<15 ▼ -7m	0'43"	7		Dark chocolate brown, clayey <b>SILT (WAD)</b> with traces of fine, brown, manganconcrete nodules; residual dolomite.
	0'18"	8		
<5	0'16"	9		
	0'19"	10		
<10	0'34"	11		Dark chocolate brown, clayey <b>SILT (WAD)</b> with traces of grey, weathered, dolomite fragments; residual dolomite (interpreted as boulders of dolomite).
	1'26"	12		Grey, weathered, fractured, hard rock <b>DOLOMITE</b> in a trace matrix of brown sandy silt(wad).
	1'54"	13		Grey, weathered to slightly weathered, fractured(?), hard rock <b>DOLOMITE</b> .
	1'51"	14		Becoming solid between 14m and 18m. No visual change in sample composition.
	2'36"	15		
	3'13"	16		
	3'16"	17		
	3'24"	18		
	1'56"	19		
	1'54"	20		
	1'44"	21		
	1'48"	22		
	2'40"	23		More graphitic below 22m.
	1'44"	24		
	1'51"	25		
	1'32"	26		
	1'57"	27		
	1'38"	28		
	1'19"	29		Grey to dark grey, weathered to slightly weathered, fractured(?), hard rock <b>DOLOMITE</b> .
	2'11"	30		

Prepared by: R.M.S P O Box 32107, GLENSTANTIA 0010    Tel: 012 993 2049    Cell: 082 551 6034

**Collar Elevation:** 1477m amsl

**Coords:** Y (29) 91 600    X: 2 862 957  
(Hand-held GPS - wgs84)





## Borehole Profile

Page 1 of 1

**Project:** MONAVONI EXTENSION 43.

**Hole No.** 43/05

**Machine:** Thor (15Bar)

**Logged:** es      **Date:** 30/06/2009

**Contractor:** J K DEVELOPMENTS cc

**Rest Level:** Dry

**Date:** 08/06/2009

**Date:** 20/06/09      **Job No:** 09124mon43

Chip Size(mm)	Pen. Speed	Depth (m)	Profile	Description	
<10	0'21"	1		Brown to reddish brown, silty <b>SAND</b> with traces of quartz grains, chert fragments and manganocrete nodules; colluvium.	
	0'25"	2		Light khaki to light olive khaki, sandy <b>SILT</b> ; residual syenite.	
<3	0'32"	3			
	0'28"	4			
	0'39"	5			
	0'56"	6			
<10	1'40"	7			Dark grey, weathered to slightly weathered, fractured(?), hard rock, graphitic <b>DOLOMITE</b> .
	1'57"	8			
	2'19"	9			
	1'44"	10			
	1'53"	11			
	1'50"	12			
	1'48"	13			
	1'54"	14			
	1'49"	15			
	1'47"	16			
2'09"	17			Interpreted as solid dolomite. No visible change in sample composition below 16m.	
3'10"	18				
<15	3'14"	19			
	3'18"	20			
	3'15"	21			
<b>EOH</b>	3'09	22			
				<p><b>NOTES:</b></p> <ol style="list-style-type: none"> <li>1) Hole stopped at 22m after penetrating 6m of solid, dolomite bedrock (as instructed).</li> <li>2) Ground water not encountered during drilling operations.</li> <li>3) Hole dry when backfilled a few days later.</li> </ol>	

Prepared by: **R.M.S P O Box 32107, GLENSTANTIA 0010**      **Tel:** 012 993 2049      **Call:** 082 551 6034

**Collar Elevation:** 1478m amsl

**Coords: Y** (29)91 480      **X:** 2 863 369  
(Hand-held GPS - wgs84)



## Borehole Profile

Page 1 of 1

**Project:** MONAVONI EXTENSION 44.

**Hole No.** 44/07

**Machine:** Thor(15Bar)

**Logged:** es      **Date:** 09/07/2009

**Contractor:** J K DEVELOPMENTS cc

**Rest Level:** -6m (1468mamsl)

**Date:** 05/06/2009

**Date:** 20/06/09      **Job No:** 09124monX43

Chip Size(mm)	Pen. Speed	Depth (m)	Profile	Description		
<5	0'20"	1		Reddish brown, silty <b>SAND</b> with traces of fine, manganocrete nodules; colluvium.		
	0'23"	2		Light khaki, sandy <b>SILT</b> with scattered fine, dark brown manganocrete nodules; residual syenite.		
	0'25"	3		Brown to dark brown mottled khaki, clayey <b>SILT</b> with scattered fine, manganocrete nodules and traces of chocolate brown silt(wad); residual dolomite.		
	0'23"	4				
	0'24"	5				
▼ -6m	0'21"	6	Dark chocolate brown, clayey <b>SILT (WAD)</b> with occasional fine, brown, manganocrete nodules; residual dolomite.			
	0'56"	7	Grey stained light brown, highly weathered to weathered, hard rock <b>DOLOMITE</b> fragments in a trace matrix of light brown, sandy silt; residual dolomite (possibly boulders).			
	1'58"	8	Grey, weathered to slightly weathered, slightly shaly, fractured(?), hard rock <b>DOLOMITE</b> .			
<10	1'46"	9		1'40"	10	
	1'38"	11				
	1'36"	12				
	1'35"	13				
	1'00"	14		As above but trace matrix of light brown, slightly waddy silt suggests very closely fractured zone.		
<15	0'58"	15		1'06"	16	Grey, weathered to slightly weathered, fractured, hard rock <b>DOLOMITE</b> .
	1'48"	17				
<10	1'56"	18		1'50"	19	
	1'36"	20				
	1'40"	21		Interpreted as solid dolomite below 21m. No visible change in sample composition.		
	2'11"	22				
	3'02"	23				
	3'06"	24				
	3'04"	25				
	3'08"	26				
	3'04"	27				
	EOH					<b>NOTES:</b>
				1)	Hole stopped at 27m after penetrating 6m of solid, dolomite bedrock (as instructed).	
				2)	Ground water not encountered during drilling operations.	
			3)	Water rest level at -6,0m when hole backfilled a few days later.		

Prepared by: R.M.S P O Box 32107, GLENSTANTIA 0010      Tel: 012 993 2049      Cell: 082 551 6034

**Collar Elevation:** 1474m amsl

**Coords:** Y (29) 91 689      X: 2 863 309  
(Hand-held GPS - wgs84)



## Borehole Profile

Page 1 of 1

**Project:** MONAVONI EXTENSION 44.

**Hole No.** 44/08

**Machine:** Thor(15Bar)

**Logged:** es      **Date:** 8/07/2009

**Contractor:** J K DEVELOPMENTS cc

**Rest Level:** Dry

**Date:** 08/06/2009

**Date:** 20/06/09      **Job No:** 09124monX43

Chip Size(mm)	Pen. Speed	Depth (m)	Profile	Description
<3	0'24"	1		Brown to dark reddish brown, silty <b>SAND</b> with occasional fine, manganocrete nodules; colluvium.
<10	0'57"	2		Dark grey, weathered to slightly weathered, fractured(?), hard rock <b>DOLOMITE</b> .
	1'49"	3		
	1'25"	4		
<15	1'19"	5		Dark brown to chocolate brown, silty <b>CLAY</b> with traces of grey weathered brown, hard rock, dolomite fragments and minor chocolate brown clay(wad); residual dolomite.
	0'18"	6		
	0'15"	7		Dark chocolate brown, silty <b>CLAY (WAD)</b> with occasional fine, brown, manganocrete nodules; residual dolomite.
<5	0'17"	8		
	0'24"	9		
	0'50"	10		Olive, sandy <b>SILT</b> with traces of olive, highly weathered, syenite fragments; residual syenite.
<10	0'48"	11		
	1'20"	12		Grey, weathered to highly weathered, fractured(?), hard rock, shaly <b>DOLOMITE</b> in a minor matrix of grey, silty sand.
	1'48"	13		
<15	1'17"	14		Dark grey, weathered, hard rock <b>SLATE</b> .
	0'56"	15		
	1'18"	16		Grey, weathered to highly weathered, <b>SHALE</b> fragments, dark grey, <b>SLATE</b> fragments and occasional off-white, highly weathered, <b>GRANITE</b> fragments in a minor matrix of grey, sandy silt; residual shale (contact zone).
<10	1'54"	17		
	1'35"	18		Light grey, silty <b>SAND</b> with traces of off-white speckled grey, highly weathered, hard rock, granite fragments; residual granite (possibly a fractured rock).
	1'58"	19		
<15	0'56"	20		Light olive silty <b>SAND</b> with traces of olive, highly weathered, syenite fragments; residual syenite.
	0'54"	21		
	0'40"	22		Off-white speckled grey, weathered, fractured(?), hard rock <b>GRANITE</b> .
<15	1'49"	23		
	1'53"	24		
	1'29"	25		Dark grey speckled white and light grey, hard rock <b>GRANITE</b> .
<15	2'34"	26		
	3'18"	27		
	3'10"	28		
EOH	3'29"	29		<b>NOTES:</b> 1) Hole stopped at 31m after penetrating 6m of solid granite bedrock (as instructed). 2) Ground water not encountered during drilling operations. 3) Hole dry when backfilled a few days later.
	3'34"	30		
	3'28"	31		

Prepared by: R.M.S P O Box 32107, GLENSTANTIA 0010      Tel: 012 993 2049      Cell: 082 551 6034

**Collar Elevation:** 1475m amsl

**Coords:** Y (29)91 842      X: 2 863 327  
(Hand-held GPS - wgs84)

## Borehole Profile

Page 1 of 1

**Project:** MONAVONI EXTENSION 44.

**Hole No.** 44/09

**Machine:** Thor(15Bar)

**Logged:** es     **Date:** 02/07/2009

**Contractor:** J K DEVELOPMENTS CC

**Rest Level:** -9,0m(1455mamsl)

**Date:** 08/06/2009

**Date:** 20/06/09     **Job No:** 09124monX43

Chip Size(mm)	Pen. Speed	Depth (m)	Profile	Description
<5	0'18"	1		Dark brown, silty <b>SAND</b> with scattered dark brown, manganocrete nodules and some quartz grains; colluvium.
	0'24"	2		
<10	0'28"	3		Grey to light grey, weathered, <b>DOLOMITE</b> fragments in a trace matrix of grey, silty sand; residual dolomite. (Interpreted as boulders). Some wad fragments below 3m.
	0'54"	4		
	1'51"	5		Grey, weathered to slightly weathered, fractured(?), shaly, hard rock <b>DOLOMITE</b> .
<15	1'48"	6		
	1'56"	7		
	1'38"	8		Some grey weathered brown, weathered to highly weathered, dolomite fragments below 7m.
	1'49"	9		Dark grey, weathered to slightly weathered, fractured(?), hard rock <b>DOLOMITE</b> .
▼ -9m	2'26"	10		
<10	3'11"	11		
	3'15"	12		
	1'41"	13		
	1'46"	14		
<15	1'50"	15		Dark grey weathered brown, weathered, fractured(?), hard rock <b>DOLOMITE</b> .
	1'54"	16		No compositional change from 16m and 18m.
<10	2'31"	17		
	3'06"	18		Grey to light grey, highly weathered, <b>SHALE</b> fragments and dark grey almost black, translucent, <b>QUARTZITE</b> fragments in a trace matrix of light brown to greyish brown, silty sand; residual quartzite (Black Reef Formation?).
<15	0'55"	19		
	0'23"	20		Light grey, highly weathered, soft rock, <b>SHALE</b> fragments in a trace matrix of grey, sandy silt; residual shale (Black Reef Formation?).
<10	1'36"	21		Dark grey, weathered and some grey stained brown, weathered, hard rock, graphitic, <b>DOLOMITE</b> fragments in a trace matrix of grey, silty sand; residual dolomite. (Interpreted as horizon of Black Reef Formation).
	1'25"	22		
	1'28"	23		Grey, weathered, hard rock, shaly, <b>DOLOMITE</b> fragments in a trace matrix of grey, sandy silt.
	1'34"	24		Black, slightly weathered, soft rock, graphitic <b>SLATE</b> . (Interpreted as base of Black Reef Formation).
	1'47"	25		
<15	2'25"	26		Dark grey speckled white, weathered to slightly weathered, hard rock <b>GRANITE</b> .
	3'07"	27		
	3'14"	28		<b>NOTES:</b>
	3'18"	29		1) Hole stopped at 31m after penetrating 6m of solid granite bedrock (as instructed).
	3'24"	30		2) Ground water not encountered during drilling operations.
	3'21"	31		3) Water rest level at -9,0m when hole backfilled a few days later.
EOH				

Prepared by: R.M.S P O Box 32107, GLENSTANTIA 0010     Tel: 012 993 2049     Cell: 082 551 6034

**Collar Elevation:** 1464m amsl

**Coords:** Y (29) 91 875     X: 2 863 074  
(Hand-held GPS - wgs84)

## Borehole Profile

Page 1 of 1

**Project:** MONAVONI EXTENSION 44.

**Hole No.** 44/10

**Machine:** Thor(15Bar)

**Logged:** es     **Date:** 7/07/2009

**Contractor:** J K DEVELOPMENTS cc

**Rest Level:** -9,0m(1462mamsl)

**Date:** 04/06/2009

**Date:** 20/06/09     **Job No:** 09124monX43

Chip Size(mm)	Pen. Speed	Depth (m)	Profile	Description
<15	0'44"	1 -		Reddish brown to dark reddish brown, silty <b>SAND</b> with minor, dark brown, manganocrete nodules; colluvium.
	0'28"	2 -		
	0'30"	3 -		
<10	0'25"	4 -		Khaki, silty <b>SAND/sandy SILT</b> with occasional, khaki, highly weathered, syenite fragments; residual syenite.
	0'20"	5 -		
	0'35"	6 -		
	0'30"	7 -		
	0'36"	8 -		
<15 ▼ -9m	1'40"	9 -		Grey, weathered to slightly weathered, fractured(?), hard rock <b>DOLOMITE</b> .
	1'20"	10 -		
0	0'04"	11 -		No samples recovered between 10m and 13m.
	0'08"	12 -		
	0'09"	13 -		
<10	1'15"	14 -		Dark grey, weathered to slightly weathered, fractured(?), hard rock <b>DOLOMITE</b> in a trace matrix of brown sandy silt.
	1'10"	15 -		
	1'44"	16 -		Grey to dark grey, weathered to slightly weathered, fractured(?), hard rock <b>DOLOMITE</b> .
	1'52"	17 -		
	1'38"	18 -		Consistent profile to 27m.
	1'56"	19 -		
	1'54"	20 -		Interpreted as solid dolomite below 21m. No visible change in sample composition.
	1'50"	21 -		
	2'03"	22 -		
	3'04"	23 -		
	3'16"	24 -		
	3'09"	25 -		
	3'11"	26 -		
	3'17"	27 -		
<b>EOH</b>				
				<p><b>NOTES:</b></p> <ol style="list-style-type: none"> <li>1) Hole stopped at 27m after penetrating 6m of solid, dolomite bedrock (as instructed).</li> <li>2) Ground water not encountered during drilling operations.</li> <li>3) Water rest level at -9,0m when hole backfilled a few days later.</li> </ol>

Prepared by: R.M.S P O Box 32107, GLENSTANTIA 0010     Tel: 012 993 2049     Cell: 082 551 6034

**Collar Elevation:** 1471m amsl

**Coords: Y** (29)91 621     **X:** 2 863 181  
(Hand-held GPS - wgs84)



## Borehole Profile

Page 1 of 1

**Project:** MONAVONI EXTENSION 44.

**Hole No.** 44/11

**Machine:** Thor(15Bar)




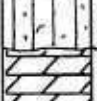
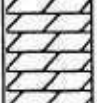

**Logged:** es     **Date:** 01/07/2009

**Contractor:** J K DEVELOPMENTS cc

**Rest Level:** -10m(1461mamsl)

**Date:** 04/06/2009

**Date:** 20/06/09     **Job No:** 09124monX43

Chip Size(mm)	Pen. Speed	Depth (m)	Profile	Description		
<15	0'28"	1 -		Reddish brown, silty <b>SAND</b> with traces of dark brown, manganocrete nodules and translucent, quartz fragments; colluvium.		
	1'49"	2 -			Light khaki olive, sandy <b>SILT</b> ; residual syenite.	
	1'35"	3 -				
	0'43"	4 -				
<3	0'34"	5 -				
	0'35"	6 -				
▼ -10m	0'33"	7 -				
	2'18"	8 -		Grey, weathered, fractured, hard rock <b>DOLOMITE</b> .		
	2'44"	9 -				
	3'14"	10 -		Consistent profile to end of borehole at 23m.		
	1'44"	11 -				
	1'41"	12 -		Becoming dark grey below 12m.		
	1'40"	13 -				
	1'38"	14 -				
	<10	1'48"		15 -		
		1'54"		16 -		
1'57"		17 -	Interpreted as solid dolomite bedrock below 17m. No visible change in sample composition.			
2'05"		18 -				
EOH	3'16"	19 -				
	3'15"	20 -				
	3'19"	21 -				
	3'10"	22 -				
	3'15"	23 -				
NOTES:						
				1) Hole stopped at 23m after penetrating 6m of solid, dolomite bedrock (as instructed).		
				2) Ground water not encountered during drilling operations.		
				3) Water rest level at -10,0m when hole backfilled a few days later.		

Prepared by: R.M.S P O Box 32107, GLENSTANTIA 0010     Tel: 012 993 2049     Cell: 082 551 6034

**Collar Elevation:** 1471m amsl

**Coords:** Y (29)91 425     X: 2 862 973  
(Hand-held GPS - wgs84)

# Borehole Profile

**Project:** MONAVONI EXTENSION 44.

**Hole No.** 44/12

**Machine:** Thor(15Bar)

**Logged:** es      **Date:** 02/07/2009

**Contractor:** J K DEVELOPMENTS cc

**Rest Level:** -7m (1463mamsl)

**Date:** 04/06/2009

**Date:** 20/06/09      **Job No:** 09124monX43

Chip Size(mm)	Pen. Speed	Depth (m)	Profile	Description
<5	0'24"	1	-	Reddish brown to dark reddish brown, silty <b>SAND</b> with traces of dark brown, manganocrete nodules; colluvium.
	0'25"	2		
<10 ▼ -7m	0'33"	3	-	Reddish brown to dark reddish brown, clayey <b>SILT</b> with minor, dark brown, manganocrete nodules; reworked residual syenite(?).  Some grey weathered syenite fragments below 4m.  Dark grey to greenish grey, weathered, closely fractured(?), hard rock <b>SYENITE</b> .  Becoming solid syenite below 8m.
	0'48"	4		
	0'59"	5		
	1'56"	6		
	1'44"	7		
	1'49"	8		
	3'06"	9		
	4'11"	10		
	1'28"	11		
	0'30"	12		
<15	0'53"	13	-	Dark grey weathered brown in places, weathered, hard rock, <b>DOLOMITE</b> fragments in a trace matrix of brown, silty sand and trace amounts of brown silt(wad); residual dolomite. (Interpreted as very closely fractured bedrock).
	0'58"	14		
	1'15"	15		
	1'50"	16		
<10	1'53"	17	-	Grey to dark grey, weathered, slightly shaly, fractured(?), hard rock <b>DOLOMITE</b> .  Interpreted as solid <b>DOLOMITE</b> below 21m. No visible change in sample composition.
	1'58"	18		
	1'55"	19		
	1'50"	20		
	1'48"	21		
	2'05"	22		
	3'07"	23		
	3'15"	24		
	3'00"	25		
	3'08"	26		
	3'05"	27		
<b>EOH</b>				<p><b>NOTES:</b></p> <ol style="list-style-type: none"> <li>1) Hole stopped at 27m after penetrating 6m of solid, dolomite bedrock (as instructed).</li> <li>2) Ground water not encountered during drilling operations.</li> <li>3) Water rest level at -7,0m when hole backfilled a few days later.</li> </ol>

Prepared by: R.M.S P O Box 32107, GLENSTANTIA 0010      Tel: 012 993 2049      Call: 082 551 6034

**Collar Elevation:** 1470m amsl

**Coords:** Y (29)91 595      X: 2 863 059  
(Hand-held GPS - wgs84)

## Borehole Profile

**Project:** MONAVONI EXTENSION 44.

**Hole No.** 44/13

**Machine:** Thor(15Bar)

**Logged:** es      **Date:** 20/06/2009

**Contractor:** J K DEVELOPMENTS cc

**Rest Level:** Dry

**Date:** 04/06/2009

**Date:** 20/06/09      **Job No:** 09124monX43

Chip Size(mm)	Pen. Speed	Depth (m)	Profile	Description
<15	0'40"	1	-	Reddish brown, silty <b>SAND</b> with traces of dark brown, manganocrete nodules; colluvium (possibly tends to manganocrete in places).
	1'08"	2		
<3	0'50"	3	-	Light brownish khaki, sandy <b>SILT</b> ; residual syenite.
	0'22"	4		
<10	0'47"	5	-	Some dolomite fragments below 4m.
	1'49"	6		Grey to dark grey, weathered to slightly weathered, fractured(?), graphitic, hard rock <b>DOLOMITE</b> ,
	1'50"	7		Some shale fragments between 7m and 8m and again between 10m and 11m.
	1'47"	8		
	2'14"	9		
	3'01"	10		
	1'30"	11		
	2'04"	12		Becoming dark grey, slightly weathered below 11m.
	1'45"	13		
	1'56"	14		
	1'55"	15		
	2'06"	16		
	3'17"	17		Interpreted as solid dolomite below 16m. No change in sample composition.
	3'13"	18		
	3'10"	19		
	3'11"	20		
	3'14"	21		
	EOH			
				<p><b>NOTES:</b></p> <p>1) Hole stopped at 21m after penetrating 6m of solid, dolomite bedrock (as instructed).</p> <p>2) Ground water not encountered during drilling operations.</p> <p>3) Hole dry when backfilled a few days later.</p>

Prepared by: R.M.S P O Box 32107, GLENSTANTIA 0010      Tel: 012 993 2049      Cell: 082 551 6034

**Collar Elevation:** 1474m amsl

**Coords:** Y (29) 91 896      X: 2 862 990  
(Hand-held GPS - wgs84)



## Borehole Profile

Page 1 of 2

**Project:** MONAVONI EXTENSION 44.

**Hole No.** 44/14

**Machine:** Thor(15Bar)

**Logged:** es      **Date:** 07/07/2009

**Contractor:** J K DEVELOPMENTS cc

**Rest Level:** Dry

**Date:** 05/06/2009

**Date:** 20/06/09      **Job No:** 09124monX43

Chip Size(mm)	Pen. Speed	Depth (m)	Profile	Description		
<15	0'28"	1	[Profile: Brown to light brown, silty SAND with traces of translucent quartz and brown, manganocrete nodules; colluvium.]	Brown to light brown, silty <b>SAND</b> with traces of translucent quartz and brown, manganocrete nodules; colluvium.		
	0'52"	2				
	0'30"	3				
	0'41"	4				
<5	0'35"	5	[Profile: Light khaki, sandy SILT with traces of translucent quartz and fine, olive speckled grey, highly weathered syenite fragments; residual syenite.]	Light khaki, sandy <b>SILT</b> with traces of translucent quartz and fine, olive speckled grey, highly weathered syenite fragments; residual syenite.		
	0'44"	6				
	0'41"	7				
<10	0'53"	8	[Profile: Light olive, silty SAND with minor, olive speckled grey, weathered to highly weathered, syenite fragments; residual syenite (possibly as very soft rock).]	Light olive, silty <b>SAND</b> with minor, olive speckled grey, weathered to highly weathered, syenite fragments; residual syenite (possibly as very soft rock).		
	1'07"	9				
	1'00"	10				
	1'13"	11				
	1'04"	12				
	1'09"	13				
	1'00"	14				
	1'03"	15				
	1'33"	16				
	1'55"	17				
	1'44"	18				
	1'30"	19				
<15	1'05"	20	[Profile: Olive speckled grey, highly weathered to weathered, fractured(?), soft rock SYENITE.]	Olive speckled grey, highly weathered to weathered, fractured(?), soft rock <b>SYENITE</b> .		
<10	0'52"	21				
	1'20"	22				
<10 ▲ -25m	1'00"	23				
	0'50"	24			[Profile: Dark grey, weathered and grey weathered brown, hard rock, DOLOMITE fragments and some olive, highly weathered, SYENITE fragments in a minor matrix of light brown, sandy silt; residual dolomite (contact zone).]	Dark grey, weathered and grey weathered brown, hard rock, <b>DOLOMITE</b> fragments and some olive, highly weathered, <b>SYENITE</b> fragments in a minor matrix of light brown, sandy silt; residual dolomite (contact zone).
	0'40"	25				
	1'27"	26				
	1'40"	27				
	2'06"	28				
	3'04"	29				
	2'40"	30				

Prepared by: R.M.S P O Box 32107, GLENSTANTIA 0010      Tel: 012 993 2049      Cell: 082 551 6034

**Collar Elevation:** 1474m amsl

**Coords:** Y (29)91 365      X: 2 862 757  
(Hand-held GPS - wgs84)

## Borehole Profile

**Project:** MONAVONI EXTENSION 44

**Hole No.** 44/14 (Contd).

**Machine:** Thor(15Bar)

**Logged:** es      **Date:** 07/07/2009

**Contractor:** J K DEVELOPMENTS cc

**Rest Level:**

**Date:** 05/06/2009

**Date:**

**Job No:** 09124MonX44

Chip Size(mm)	Pen. Speed	Depth (m)	Profile	Description
<10  EOH	3'04"	31	-	Dark grey, slightly weathered, hard rock DOLOMITE.
	4'00"	32	-	
	4'15"	33	-	
				<p><b>NOTES:</b></p> <p>1) Hole stopped at 33m after penetrating 6m of solid, dolomite bedrock (as instructed).</p> <p>2) Ground water strike between 25m and 26m during drilling operations.</p> <p>3) Hole dry when backfilled a few days later.</p>



## Borehole Profile

**Project:** MONAVONI EXTENSION 44.

**Hole No.** 44/16

**Machine:** Thor(15Bar)

**Logged:** es      **Date:** 27/06/2009

**Contractor:** J K DEVELOPMENTS cc

**Rest Level:** -7m (1453mamsl)

**Date:** 04/06/2009

**Date:** 20/06/09      **Job No:** 09124monX43

Chip Size(mm)	Pen. Speed	Depth (m)	Profile	Description
	0'27"	1		Light reddish brown, silty <b>SAND</b> with traces of fine, quartz grains; colluvium.
<5	0'38"	2		Light khaki, sandy <b>SILT</b> with occasional translucent, quartz grains; residual syenite.
	0'35"	3		
	0'43"	4		
<15	0'40"	5		Fragments of grey, weathered syenite between 4m and 5m.
<5	0'35"	6		Dark chocolate brown almost black speckled red, silty <b>CLAY (WAD)</b> ; residual dolomite.
▼ -7,0m	2'29"	7		
	1'44"	8		
	1'50"	9		Grey, weathered to slightly weathered, fractured(?), hard rock <b>DOLOMITE</b> in a trace matrix of greyish brown sand.
	1'58"	10		
	1'41"	11		Grey, slightly weathered to weathered, hard rock <b>DOLOMITE</b> .
	1'44"	12		
<10	1'50"	13		
	3'07"	14		Grey to greenish grey, weathered to slightly weathered, hard rock <b>SYENITE</b> .
	3'33"	15		Some dolomite fragments between 14m and 15m.
	3'40"	16		
	4'00"	17		
	3'58"	18		
	3'50"	19		
<b>EOH</b>		20		
				<b>NOTES:</b>
				1) Hole stopped at 20m after penetrating 6m of solid, syenite bedrock (as instructed).
				2) Ground water not encountered during drilling operations.
				3) Water rest level at -7,0m when hole backfilled a few days later.

Prepared by: R.M.S P O Box 32107, GLENSTANTIA 0010      Tel: 012 993 2049      Cell: 082 551 6034

**Collar Elevation:** 1460m amsl

**Coords:** Y (29)91 859      **X:** 2 862 810  
(Hand-held GPS - wgs84)



## Borehole Profile

**Project:** MONAVONI EXTENSION 44.

**Hole No.** 44/17

**Machine:** Thor(15Bar)































**Logged:** es      **Date:** 07/07/2009

**Contractor:** J K DEVELOPMENTS cc

**Rest Level:** -6m(1457mamsl)

**Date:** 04/06/2009

**Date:** 20/06/09      **Job No:** 09124monX43

Chip Size(mm)	Pen. Speed	Depth (m)	Profile	Description
<15	0'47"	1		Light brown, silty <b>SAND</b> with traces of milky white quartz and brown, highly weathered, syenite fragments; colluvium.
	0'42"	2		Light olive, sandy <b>SILT</b> with traces of fine, khaki olive speckled white, highly weathered, syenite fragments; residual syenite.
	0'38"	3		
	0'33"	4		
	0'36"	5		
<3	0'40"	6		Syenite fragments becoming olive below 5m (possibly as very soft rock below 6m).
	0'53"	7		
	0'52"	8		
	0'57"	9		
	0'59"	10		
<5	1'29"	11		Olive grey to khaki olive, highly weathered, soft rock <b>SYENITE</b> .
	1'22"	12		
<15	1'25"	13		Olive green stained brown, highly weathered, "altered", very soft rock, <b>SYENITE</b> fragments and brown, "blocky", <b>WAD</b> fragments in a minor matrix of chocolate brown, clay(wad); residual syenite with lenses of dolomite (contact zone).
	1'11"	14		
	1'00"	15		
<5	0'40"	16		Chocolate brown, clayey <b>SILT(WAD)</b> with minor, olive green, highly weathered, "altered" syenite fragments; residual dolomite with stringers of syenite.
	0'38"	17		
<10	1'30"	18		Grey to light grey, weathered to slightly weathered, fractured(?), hard rock <b>DOLOMITE</b> .
	1'40"	19		
	1'50"	20		
	1'20"	21		
	1'35"	22		
	1'40"	23		
	1'49"	24		Consistent profile to 39m.
	1'52"	25		
▲ -25m	1'46"	26		
	1'50"	27		
	1'53"	28		
	3'19"	29		
	3'03"	30		

Prepared by: R.M.S P O Box 32107, GLENSTANTIA 0010      Tel: 012 993 2049      Cell: 082 551 6034

**Collar Elevation:** 1463m amsl

**Coords:** Y (29)91 743      X: 2 862 794  
(Hand-held GPS - wgs84)

## Borehole Profile

**Project:** MONAVONI EXTENSION 44.

**Hole No.** 44/17 (Contd).

**Machine:** Thor (15Bar)

**Logged:** es      **Date:** 07/07/2009

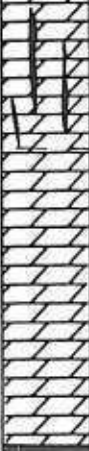
**Contractor:** J K DEVELOPMENTS cc

**Rest Level:**

**Date:** 04/06/2009

**Date:**

**Job No:** 09124monX43

Chip Size(mm)	Pen. Speed	Depth (m)	Profile	Description	
	1'40"	31		Grey to light grey weathered to slightly weathered fractured(?) hard rock DOLOMITE.	
	1'47"	32			
	1'51"	33			
	2'05"	34			Interpreted as solid dolomite below 33m. No visible change in the sample composition.
<10	3'03"	35			
	3'14"	36			
	3'00"	37			
	3'06"	38			
EOH	3'02"	39			
<p><b>NOTES:</b></p> <ol style="list-style-type: none"> <li>1) Hole stopped at 39m after penetrating 6m of solid, dolomite bedrock (as instructed).</li> <li>2) Ground water strike between 25m and 26m during drilling operations.</li> <li>3) Water rest level at -6,0m when hole backfilled a few days later.</li> </ol>					

## Borehole Profile

Page 1 of 1

**Project:** MONAVONI EXTENSION 44.

**Hole No.** 44/18

**Machine:** Thor (15Bar)

**Logged:** es      **Date:** 30/06/2009

**Contractor:** J K DEVELOPMENTS CC

**Rest Level:** -5m (1457mamsl)

**Date:** 05/06/2009

**Date:** 20/06/09      **Job No:** 09124monX43

Chip Size(mm)	Pen. Speed	Depth (m)	Profile	Description
<15	0'44"	1	[Profile: Silty Sand]	Reddish brown, silty <b>SAND</b> with traces of dark brown, manganocrete nodules and white, quartz fragments; colluvium.
	1'25"	2		
	2'40"	3		
<5 ▼ -5m	0'30"	4	[Profile: Clay]	Dark brown to chocolate brown speckled red, silty <b>CLAY</b> with minor, chocolate brown clay(wad); residual dolomite.
	0'34"	5		
<10	0'23"	6	[Profile: Syenite]	Scattered syenite fragments below 6m.
	1'30"	7		
	2'47"	8		
	3'40"	9		
	3'35"	10		
	3'00"	11		
EOH	3'13"	12	[Profile: Syenite]	Dark grey speckled white, weathered to slightly weathered, hard rock <b>SYENITE</b> .
	3'30"	13		
<p><b>NOTES:</b></p> <p>1) Hole stopped at 13m after penetrating 6m of solid, syenite bedrock (as instructed).</p> <p>2) Ground water not encountered during drilling operations.</p> <p>3) Water rest level at -5,0m when hole backfilled a few days later.</p>				

Prepared by: R.M.S P O Box 32107, GLENSTANTIA 0010      Tel: 012 993 2049      Cell: 082 551 6034

**Collar Elevation:** 1474m amsl

**Coords:** Y (29)91 689      X: 2 863 309  
(Hand-held GPS - wgs84)

## Borehole Profile

**Project:** MONAVONI EXTENSION 44.

**Hole No.** 44/20

**Machine:** Thor(15Bar)

**Logged:** es      **Date:** 27/06/2009

**Contractor:** J K DEVELOPMENTS cc

**Rest Level:** Dry

**Date:** 05/06/2009

**Date:** 20/06/09      **Job No:** 09124monX43

Chip Size(mm)	Pen. Speed	Depth (m)	Profile	Description
<10	0'26"	1		Light reddish brown, silty SAND with traces of ferricrete nodules and milky white, quartz fragments; colluvium.
<20	0'28"	2		Light khaki, sandy SILT/silty SAND with traces of khaki speckled grey, highly weathered, syenite fragments; residual syenite (possibly as soft rock in situ).
	0'33"	3		
<10	0'30"	4		Tends to silty gravel in places. (Interpreted as very closely fractured, soft rock syenite).
	0'36"	5		
<15	0'50"	6		
	0'55"	7		
<5	0'54"	8		Grey, weathered to highly weathered, fractured(?), hard rock SYENITE.
	1'58"	9		
<10	1'43"	10		Grey, weathered, hard rock SYENITE.
	2'14"	11		
	4'11"	12		
	4'30"	13		
	4'49"	14		
	5'06"	15		
	5'00"	16		
	EOH			
				<p><b>NOTES:</b></p> <p>1) Hole stopped at 16m after penetrating 6m of solid, syenite bedrock (as instructed).</p> <p>2) Ground water not encountered during drilling operations.</p> <p>3) Hole dry backfilled a few days later.</p>

Prepared by: R.M.S P O Box 32107, GLENSTANTIA 0010      Tel: 012 993 2049      Cell: 082 551 6034

**Collar Elevation:** 1462m amsl

**Coords:** Y (29)91 467      X: 2 862 677  
(Hand-held GPS - wgs84)



## Borehole Profile

**Project:** MONAVONI EXTENSION 44.

**Hole No.** 44/19

**Machine:** Thor(15Bar)

**Logged:** es      **Date:** 27/06/2009

**Contractor:** J K DEVELOPMENTS cc

**Rest Level:** -8m(1451mamsl)

**Date:** 05/06/2009

**Date:** 20/06/09      **Job No:** 09124monX43

Chip Size(mm)	Pen. Speed	Depth (m)	Profile	Description
	0'25"	1		Dark brown, silty <b>SAND</b> with minor, milky white stained dark brown, quartz fragments and brown, manganocrete nodules; colluvium.
	0'28"	2		White stained brown, highly weathered, <b>CHERT</b> fragments and subordinate, dark brown, manganocrete nodules in a trace matrix of brown, sandy silt and trace amounts of brown silt(wad); residual dolomite(?).
	0'36"	3		Dark grey, weathered, <b>CHERT</b> fragments in a trace matrix of brown, sandy silt and trace amounts of brown silt(wad); residual dolomite (chert boulders?)
	0'56"	4		Grey, weathered to highly weathered, hard rock, <b>DOLOMITE</b> fragments and some "shaly", dolomite fragments in a trace matrix of grey, sandy silt; residual dolomite (possibly as very closely fractured bedrock).
<15	0'58"	6		Grey stained brown, weathered, hard rock, <b>DOLOMITE</b> fragments in a trace matrix of brown, sandy silt(wad); residual dolomite. (Interpreted as very closely fractured dolomite bedrock)
	0'55"	7		Grey stained brown, weathered, hard rock, <b>DOLOMITE</b> fragments in a trace matrix of brown, sandy silt(wad); residual dolomite. (Interpreted as very closely fractured dolomite bedrock)
▼ -8,0m	0'50"	8		Grey stained brown, weathered, hard rock, <b>DOLOMITE</b> fragments in a trace matrix of brown, sandy silt(wad); residual dolomite. (Interpreted as very closely fractured dolomite bedrock)
	0'52"	9		Grey stained brown, weathered, hard rock, <b>DOLOMITE</b> fragments in a trace matrix of brown, sandy silt(wad); residual dolomite. (Interpreted as very closely fractured dolomite bedrock)
	0'50"	10		Grey stained brown, weathered, hard rock, <b>DOLOMITE</b> fragments in a trace matrix of brown, sandy silt(wad); residual dolomite. (Interpreted as very closely fractured dolomite bedrock)
	0'46"	11		Grey stained brown, weathered, hard rock, <b>DOLOMITE</b> fragments in a trace matrix of brown, sandy silt(wad); residual dolomite. (Interpreted as very closely fractured dolomite bedrock)
	0'41"	12		Grey stained brown, weathered, hard rock, <b>DOLOMITE</b> fragments in a trace matrix of brown, sandy silt(wad); residual dolomite. (Interpreted as very closely fractured dolomite bedrock)
	0'42"	13		Grey stained brown, weathered, hard rock, <b>DOLOMITE</b> fragments in a trace matrix of brown, sandy silt(wad); residual dolomite. (Interpreted as very closely fractured dolomite bedrock)
	0'39"	14		Grey stained brown, weathered, hard rock, <b>DOLOMITE</b> fragments in a trace matrix of brown, sandy silt(wad); residual dolomite. (Interpreted as very closely fractured dolomite bedrock)
	1'50"	15		Grey to greenish grey, weathered, hard rock <b>SYENITE</b> .
	4'13"	16		Grey to greenish grey, weathered, hard rock <b>SYENITE</b> .
<10	4'02"	17		Grey to greenish grey, weathered, hard rock <b>SYENITE</b> .
	4'28"	18		Grey to greenish grey, weathered, hard rock <b>SYENITE</b> .
	4'11"	19		Grey to greenish grey, weathered, hard rock <b>SYENITE</b> .
	5'01"	20		Grey to greenish grey, weathered, hard rock <b>SYENITE</b> .
EOH	4'45"	21		Grey to greenish grey, weathered, hard rock <b>SYENITE</b> .
				<b>NOTES:</b>
				1) Hole stopped at 21m after penetrating 6m of solid, syenite bedrock (as instructed).
				2) Ground water not encountered during drilling operations.
				3) Water rest level at -8,0m when hole backfilled a few days later.

Prepared by: R.M.S P O Box 32107, GLENSTANTIA 0010      Tel: 012 993 2049      Cell: 082 551 6034

**Collar Elevation:** 1459m amsl

**Coords:** Y (29)91 376      X: 2 862 620  
(Hand-held GPS - wgs84)

## Borehole Profile

Page 1 of 1

**Project:** MONAVONI EXTENSION 44.

**Hole No.** 44/21

**Machine:** Thor (15Bar)

**Logged:** es      **Date:** 10/06/2008

**Contractor:** J K DEVELOPMENT cc

**Rest Level:** Dry

**Date:** 18/04/2008

**Date:** -

**Job No:** 08111hrp1

Chip Size(mm)	Pen. Speed	Depth (m)	Profile	Description
<10	0'17"	1	-	Brown, silty <b>SAND</b> with scattered, dark brown, manganocrete nodules and milky white, quartz fragments; colluvium.
	2'46"	2	-	
<5	2'19"	3	-	Dark brown, slightly sandy, clayey <b>SILT</b> with traces of dark brown, manganocrete nodules and occasional, quartz fragments and trace amounts of dark brown clay(wad); residual dolomite.
	2'13"	4	-	
	1'41"	5	-	
<10	1'51"	6	-	Light grey to grey speckled white in places, weathered, fractured(?), hard rock <b>SYENITE</b> .
	1'50"	7	-	
	1'17"	8	-	
<15	1'39"	9	-	Grey speckled white, weathered, hard rock <b>SYENITE</b> .
	2'21"	10	-	
<10	3'26"	11	-	
	3'32"	12	-	
	3'42"	13	-	
	3'52"	14	-	
<b>EOH</b>	3'50"	15	-	
				<p><b>NOTES:</b></p> <p>1) Hole stopped at 15m after penetrating 6m of solid, syenite bedrock (as requested).</p> <p>2) Ground water not encountered during drilling operations.</p> <p>3) No water rest level recorded.</p>

Prepared by: R.M.S P O Box 32107, GLENSTANTIA 0010      Tel: 012 993 2049      Cell: 082 551 6034

**Collar Elevation:** 1461m amsl

**Coords: Y:** (29)91 740      **X:** 2 862 721  
(Hand-held GPS - wgs84)

## Borehole Profile

**Project:** MONAVONI EXTENSION 44.

**Hole No.** 44/19

**Machine:** Thor(15Bar)

**Logged:** es     **Date:** 27/06/2009

**Contractor:** J K DEVELOPMENTS CC

**Rest Level:** -8m(1451mams1)

**Date:** 05/06/2009

**Date:** 20/06/09     **Job No:** 09124monX43

Chip Size(mm)	Pen. Speed	Depth (m)	Profile	Description
	0'25"	1		Dark brown, silty <b>SAND</b> with minor, milky white stained dark brown, quartz fragments and brown, manganocrete nodules; colluvium.
	0'28"	2		White stained brown, highly weathered, <b>CHERT</b> fragments and subordinate, dark brown, manganocrete nodules in a trace matrix of brown, sandy silt and trace amounts of brown silt(wad); residual dolomite(?).
	0'36"	3		
	0'56"	4		Dark grey, weathered, <b>CHERT</b> fragments in a trace matrix of brown, sandy silt and trace amounts of brown silt(wad); residual dolomite (chert boulders?)
	1'29"	5		
<15 ▼ -8,0m	0'58"	6		Grey, weathered to highly weathered, hard rock, <b>DOLOMITE</b> fragments and some "shaly", dolomite fragments in a trace matrix of grey, sandy silt; residual dolomite (possibly as very closely fractured bedrock).
	0'55"	7		
	0'50"	8		
	0'52"	9		
	0'50"	10		
	0'46"	11		Grey stained brown, weathered, hard rock, <b>DOLOMITE</b> fragments in a trace matrix of brown, sandy silt(wad); residual dolomite. (Interpreted as very closely fractured dolomite bedrock)
	0'41"	12		
	0'42"	13		
	0'39"	14		
<10	1'50"	15		Grey to greenish grey, weathered, hard rock <b>SYENITE</b> .
	4'13"	16		
	4'02"	17		
	4'28"	18		
	4'11"	19		
	5'01"	20		
	4'45"	21		
EOH				
<p><b>NOTES:</b></p> <ol style="list-style-type: none"> <li>1) Hole stopped at 21m after penetrating 6m of solid, syenite bedrock (as instructed).</li> <li>2) Ground water not encountered during drilling operations.</li> <li>3) Water rest level at -8,0m when hole backfilled a few days later.</li> </ol>				

Prepared by: R.M.S P O Box 32107, GLENSTANTIA 0010     Tel: 012 993 2049     Cell: 082 551 6034

**Collar Elevation:** 1459m amsl

**Coords:** Y (29)91 376     X: 2 862 620  
(Hand-held GPS - wgs84)

**RMS BOREHOLE PROFILES (2009)**  
**(MONAVONI EXTENSIONS 43 AND 44)**



# Borehole Profile

**Project:** MONOVANI EXT. 31  
**Machine:** SUPER ROCK (19 Bar; 800cfm)  
**Contractor:** H Erwee Drilling  
**Date:** 13/12/2006

**Hole No. 6**  
**Logged:** es      **Date:** 21/12/2006  
**Rest Level:** Dry  
**Date:** 14/12/06      **Job No:** 06150Mon31

Chip Size(mm)	Pen. Speed	Depth (m)	Profile	Description
<15	0'17"	1 -		Reddish brown, sandy SILT with occasional fine, manganocrete nodules and some milky white quartz; colluvium.
<5	0'15"	2 -		Brown, sandy SILT with scattered dark brown, manganocrete nodules; reworked residual syenite.
	0'18"	3 -		
	0'34"	4 -		
	0'27"	5 -		Brown to dark brown, slightly clayey SILT with traces of dark grey dolomite and trace amounts of chocolate brown silt (wad); residual dolomite.
<10	1'34"	6 -		Grey and dark grey, weathered, DOLOMITE fragments in a trace matrix of greyish brown, sandy silt; residual dolomite (possibly boulders of dolomite).
	1'27"	7 -		
	0'43"	8 -		
	1'50"	9 -		
	3'44"	10 -		Olive grey to dark grey, weathered, hard rock SYENITE.
	4'16"	11 -		
	4'11"	12 -		
	4'18"	13 -		
EOH	3'04"	14 -		Grey to light grey, weathered, hard rock DOLOMITE and some slightly altered DOLOMITE between 13m and 14m.
	3'10"	15 -		
<b>NOTES:</b>				
				1) Hole stopped at 15m after penetrating about 6m of solid bedrock (as instructed).
				2) Ground water not encountered during drilling operations.
				3) Hole dry when backfilled.

Prepared by: R.M.S P O Box 32107, GLENSTANTIA 0010      Tel: 012 993 2049      Cell: 082 551 6034

# Borehole Profile

**Project:** MONOVANI EXT. 31  
**Machine:** THOR (16 Bar; 800cfm)  
**Contractor:** H Erwee Drilling  
**Date:** 06/02/2007

**Hole No.** 16  
**Logged:** es    **Date:** 09/02/2007  
**Rest Level:** Dry  
**Date:** 9/02/07    **Job No:** 06150MonX31

Chip Size(mm)	Pen. Speed	Depth (m)	Profile	Description
<10	0'30"	1	-	Light brown, sandy <b>SILT</b> with some brown, manganocrete nodules colluvium.
<3	0'39"	2	-	Light olive khaki, sandy <b>SILT</b> ; residual syenite.
	0'48"	3	-	
	0'40"	4	-	
<10	0'59"	5	-	Olive speckled grey, highly weathered, very closely, fractured <b>SYENITE</b> (possibly boulders at contact zone).
<15	0'40"	6	-	
<10	3'22"	7	-	Grey and light grey mottled white, weathered, hard rock, slightly altered <b>DOLOMITE</b> .
	3'46"	8	-	
	3'39"	9	-	
	3'03"	10	-	
<15	3'59"	11	-	Olive, highly weathered, closely fractured, hard rock <b>SYENITE</b> (contact zone).
<10	4'13"	12	-	Olive grey speckled white, highly, weathered, hard rock <b>SYENITE</b> .
EOH	5'36"	13	-	
				<p><b>NOTES:</b></p> <p>1) Hole stopped at 14m after penetrating about 6m of solid bedrock (as instructed).</p> <p>2) Ground water not encountered during drilling operations.</p> <p>3) Hole dry when backfilled a few days later.</p>

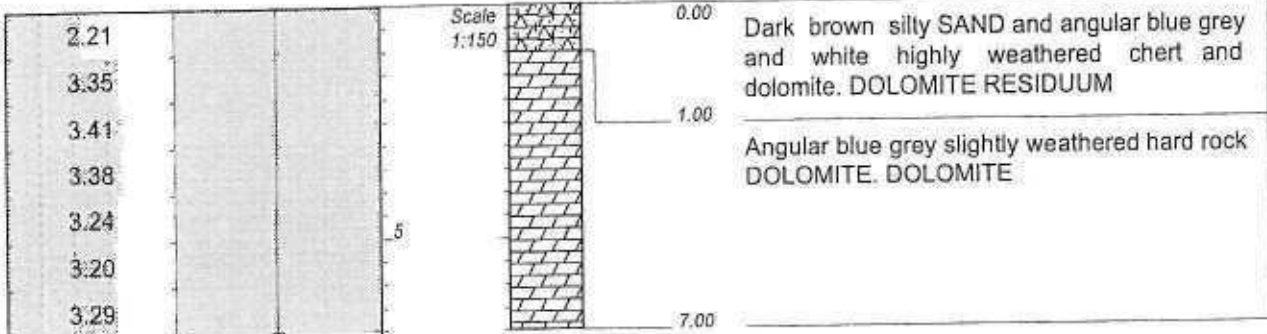
Prepared by: R.M.S P O Box 32107, GLENSTANTIA 0010    Tel: 012 993 2049    Cell: 082 551 6034

**Collar Elevation:** 1481 mamsl

**Coords: Y:** 91 340    **X:** 2 863 391



**VGI BOREHOLE PROFILES (2005)**



NOTES

- 1) No waterstrikes recorded.
- 2) No water added.

1	2	3
Penetr time min.s/m	Air return	Sample recov

CONTRACTOR:  
MACHINE : 18 Bar, 950 cfm  
DRILLED BY : S BOTHA  
PROFILED BY : B BALITHO  
TYPE SET BY : A GERBER  
SETUP FILE : PERCUSI.SET

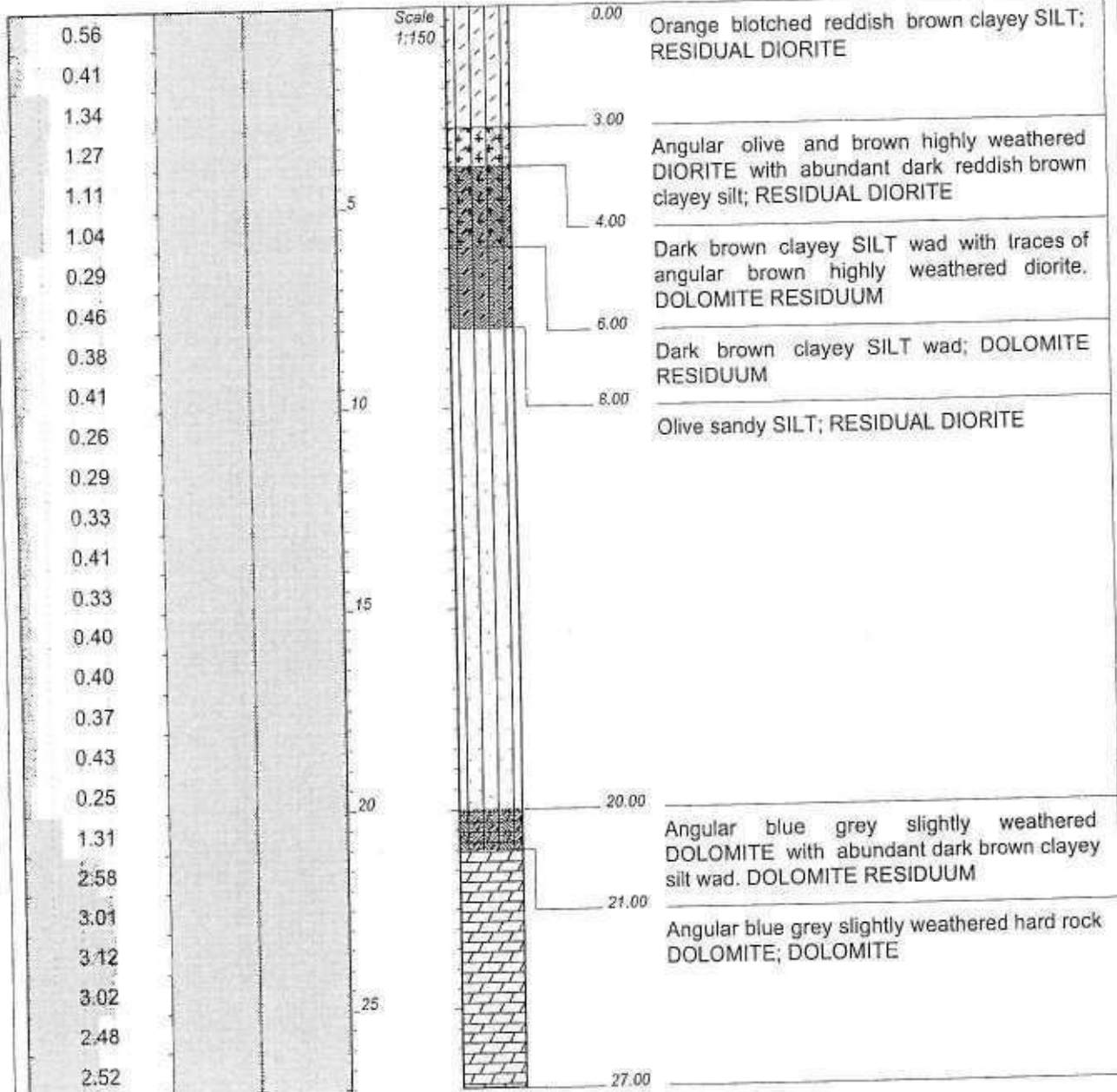
INCLINATION : 90 DEGREES  
DIAM : 165 mm  
DATE : 2005/11/26  
DATE : 2005/12/01

ELEVATION : mamsi  
X-COORD : -91452  
Y-COORD : -2862559

HOLE No: MT/MV19/132

DATE : 25/04/06 18:17  
TEXT : ...IVGI302-11200604-1.TXT





NOTES  
1) No waterstrikes recorded.  
2) No water added.

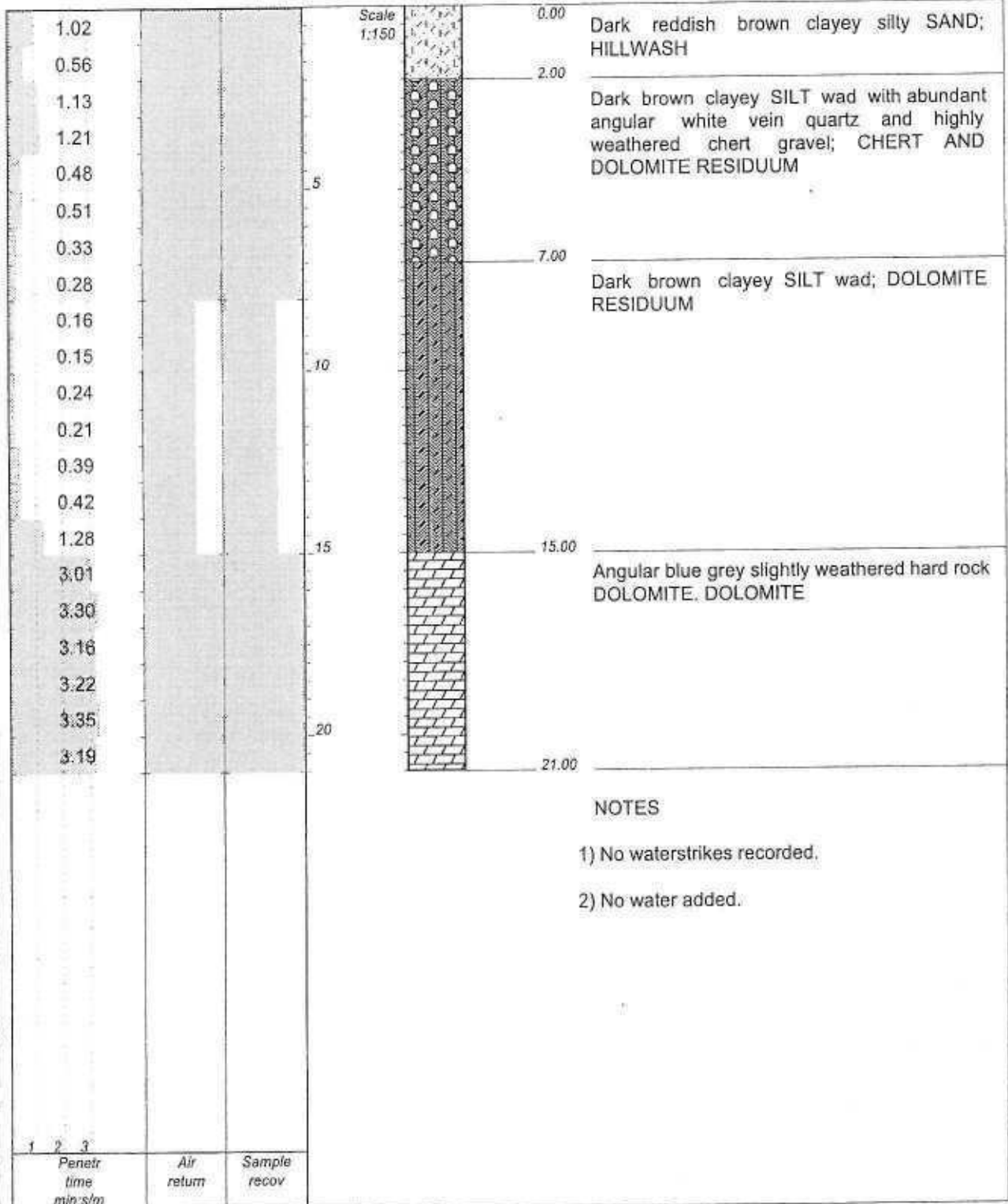
1	2	3
Penetr time min.s/m	Air return	Sample recov

CONTRACTOR:  
MACHINE: 18 Bar; 950 cfm  
DRILLED BY: AJ SCHUTTE  
PROFILED BY: B BALITHO  
TYPE SET BY: A GERBER  
SETUP FILE: PERCUSI.SET

INCLINATION: 90 DEGREES  
DIAM: 165 mm  
DATE: 2005/11/26  
DATE: 2005/12/06  
DATE: 25/04/06 18:17  
TEXT: ..\VGI302-1\200604-1.TXT

ELEVATION: mamsl  
X-COORD: -91654  
Y-COORD: -2862983

HOLE No: MT/MV19/133



NOTES

- 1) No waterstrikes recorded.
- 2) No water added.

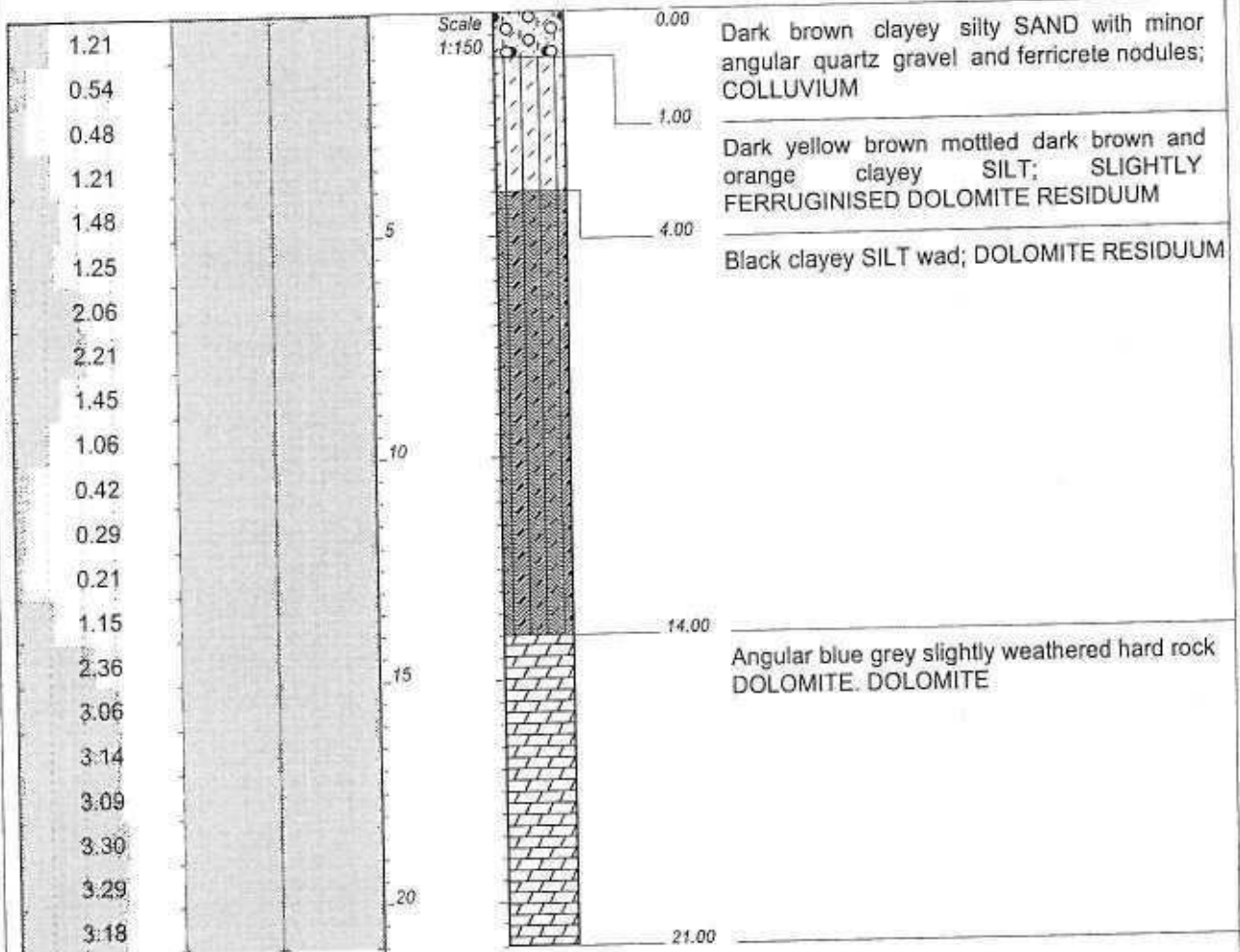
CONTRACTOR :  
MACHINE : 18 Bar; 950 cfm  
DRILLED BY : AJ SCHUTTE  
PROFILED BY : B BALITHO  
TYPE SET BY : A GERBER  
SETUP FILE : PERCUSI,SET

INCLINATION : 90 DEGREES  
DIAM : 165 mm  
DATE : 2005/11/28  
DATE : 2005/12/06  
DATE : 25/04/06 18:17  
TEXT : ..\VGI302~11200604~1.TXT

ELEVATION : mamsl  
X-COORD : -91610  
Y-COORD : -28663388

HOLE No: MT/MV19/134





NOTES

- 1) No waterstrikes recorded.
- 2) No water added.

1	2	3
Penetr time min:s/m	Air return	Sample recov

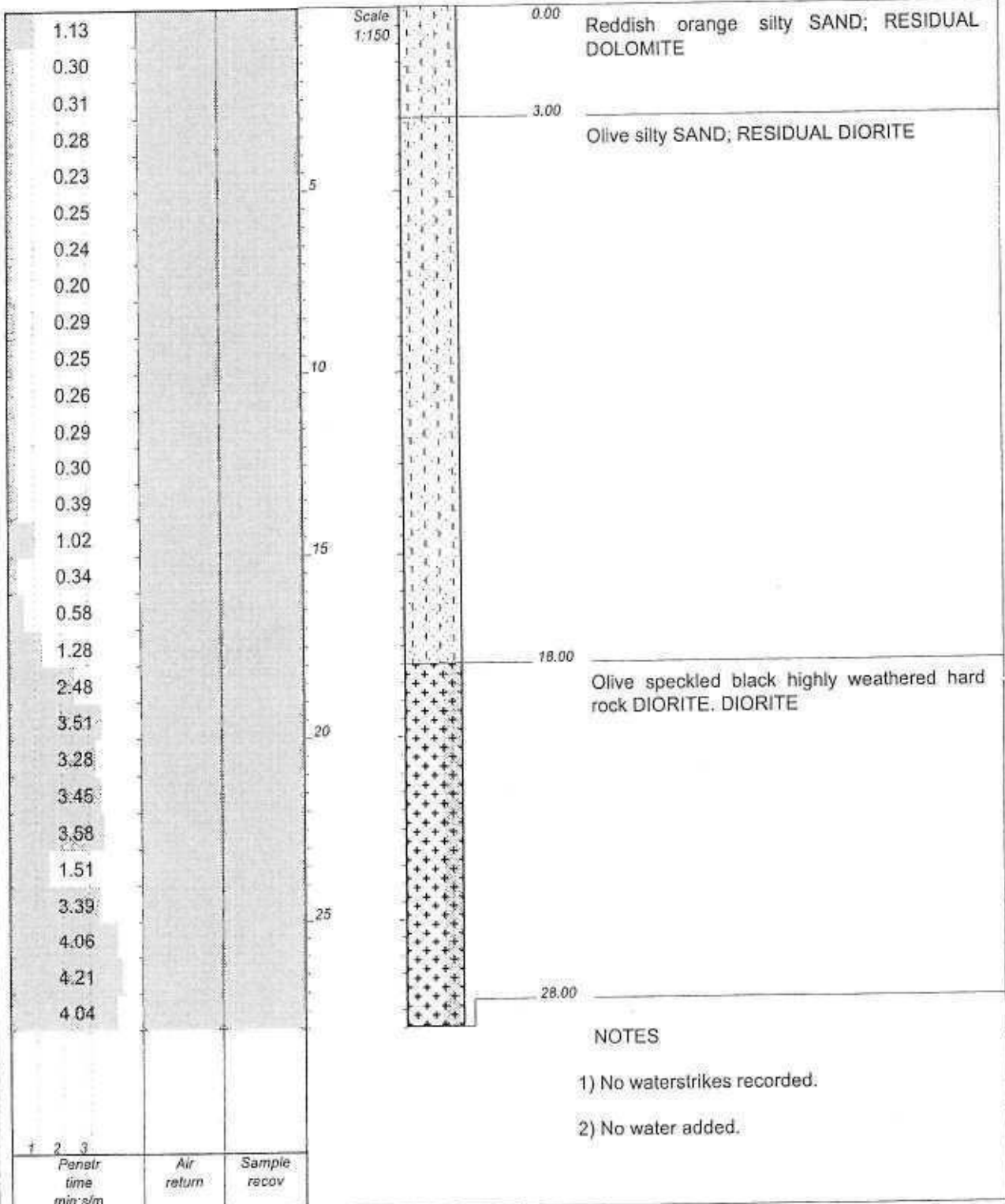
CONTRACTOR :  
MACHINE : 18 Bar; 950 cfm  
DRILLED BY : S BOTHA  
PROFIED BY : B BALITHO  
TYPE SET BY : A GERBER  
SETUP FILE : PERCUSI.SET

INCLINATION : 90 DEGREES  
DIAM : 165 mm  
DATE : 2005/11/26  
DATE : 2005/12/05

DATE : 25/04/06 18:18  
TEXT : ..\VGI302-11200604-1.TXT

ELEVATION : mamsl  
X-COORD : -91501  
Y-COORD : 2863320

HOLE No: MT/MV19/136



NOTES  
1) No waterstrikes recorded.  
2) No water added.

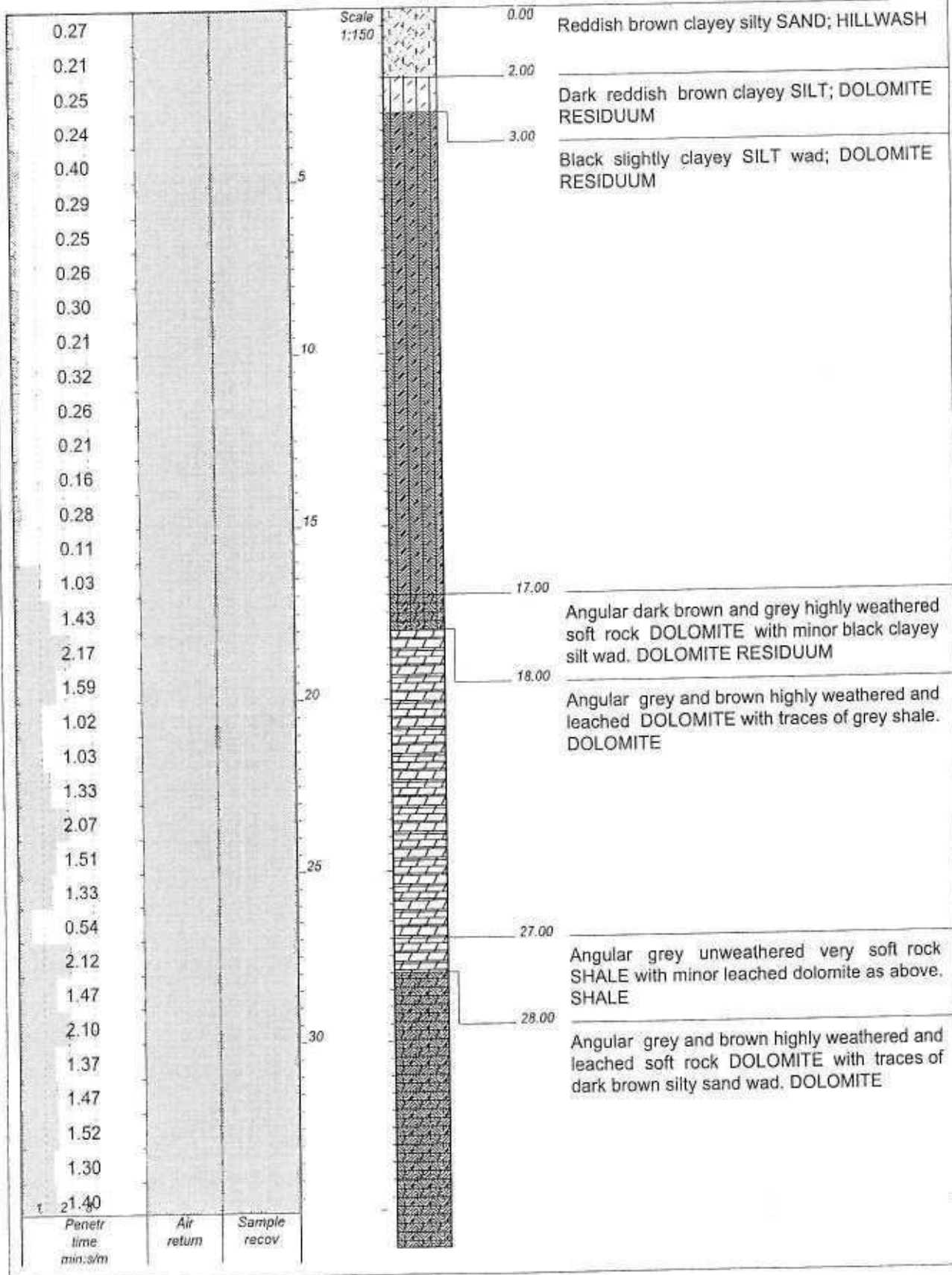
CONTRACTOR :  
MACHINE : 18 Bar; 950 cfm  
DRILLED BY : AJ SCHUTTE  
PROFILED BY : B BALITHO  
TYPE SET BY : A GERBER  
SETUP FILE : PERCUSI.SET

INCLINATION : 90 DEGREES  
DIAM : 165 mm  
DATE : 2005/11/26  
DATE : 2005/12/06  
DATE : 25/04/06 18:18  
TEXT : ...VGI302-11200604-1.TXT

ELEVATION : mamsi  
X-COORD : -91655  
Y-COORD : -2862736

HOLE No: MT/MV19/139







NOTES

- 1) No waterstrikes recorded.
- 2) No water added.
- 3) Driller reports a small fracture at 18m.

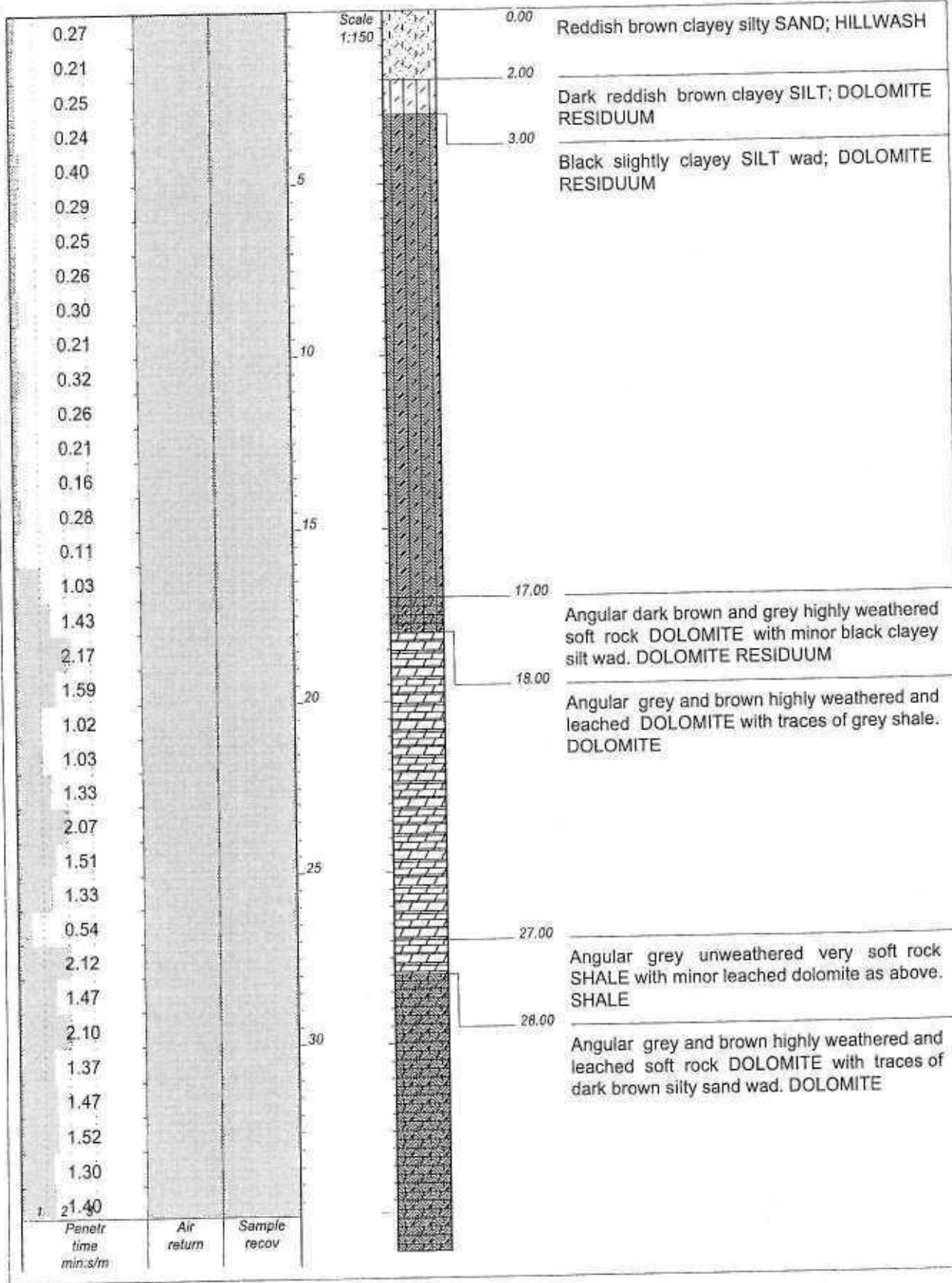
1	2	3
Penetr time min:sm	Air return	Sample recov

CONTRACTOR :  
 MACHINE : 18 Bar; 950 cfm  
 DRILLED BY : AJ SCHUTTE  
 PROFILED BY : B BALITHO  
 TYPE SET BY : A GERBER  
 SETUP FILE : PERCUSI.SET

INCLINATION : 90 DEGREES  
 DIAM : 165 mm  
 DATE : 2005/11/29  
 DATE : 2005/12/05  
 DATE : 25/04/06 18:18  
 TEXT : ..\VGI302-11200604-1.TXT

ELEVATION : mamsl  
 X-COORD : -91694  
 Y-COORD : -2863521

HOLE No: MT/MV19/143



35		
1	2	3
Penetr time min:s/m	Air return	Sample recov



36.00

NOTES

- 1) No waterstrikes recorded.
- 2) No water added.
- 3) Cavernous conditions at 18m and from 25 to 26m.
- 4) Driller reports possible fracture at 29m to 30m.

CONTRACTOR:  
MACHINE: 18 Bar; 950 cfm  
DRILLED BY: AJ SCHUTTE  
PROFILED BY: B BALITHO  
TYPE SET BY: A GERBER  
SETUP FILE: PERCUSI.SET

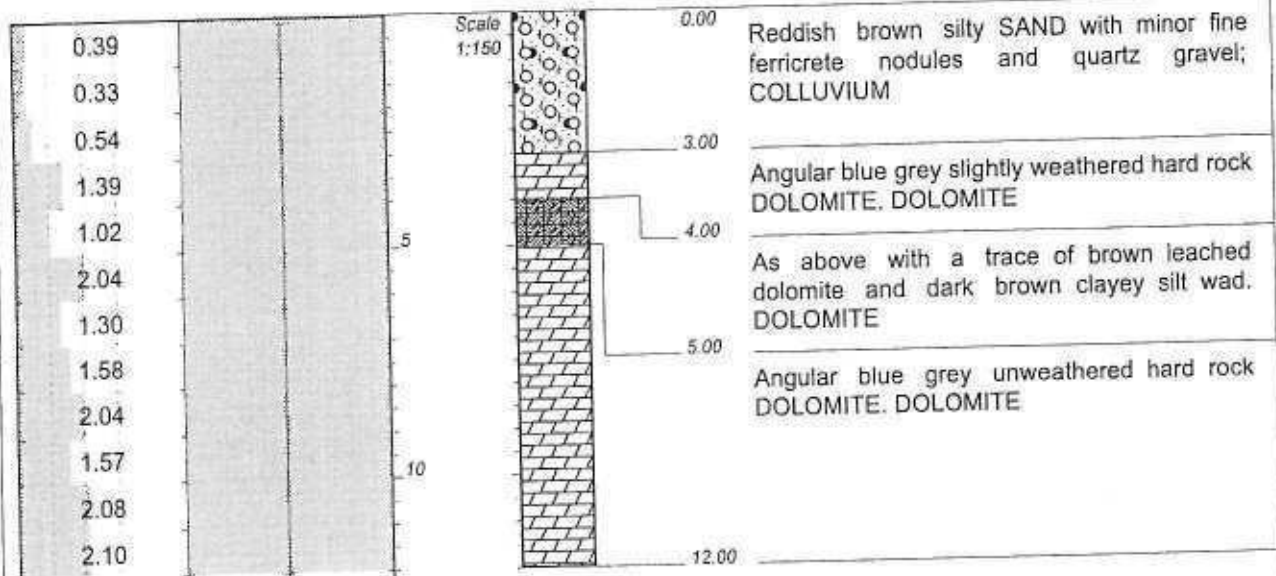
INCLINATION: 90 DEGREES  
DIAM: 165 mm  
DATE: 2005/11/29  
DATE: 2005/12/05

ELEVATION: mamsi  
X-COORD: -91544  
Y-COORD: -2863533

DATE: 25/04/06 18:18  
TEXT: ..\VGI302-11200604-1.TXT

HOLE No: MT/MV19/144





NOTES

- 1) No waterstrikes recorded.
- 2) No water added.
- 3) Driller reports a small fracture between 9m to 10m.

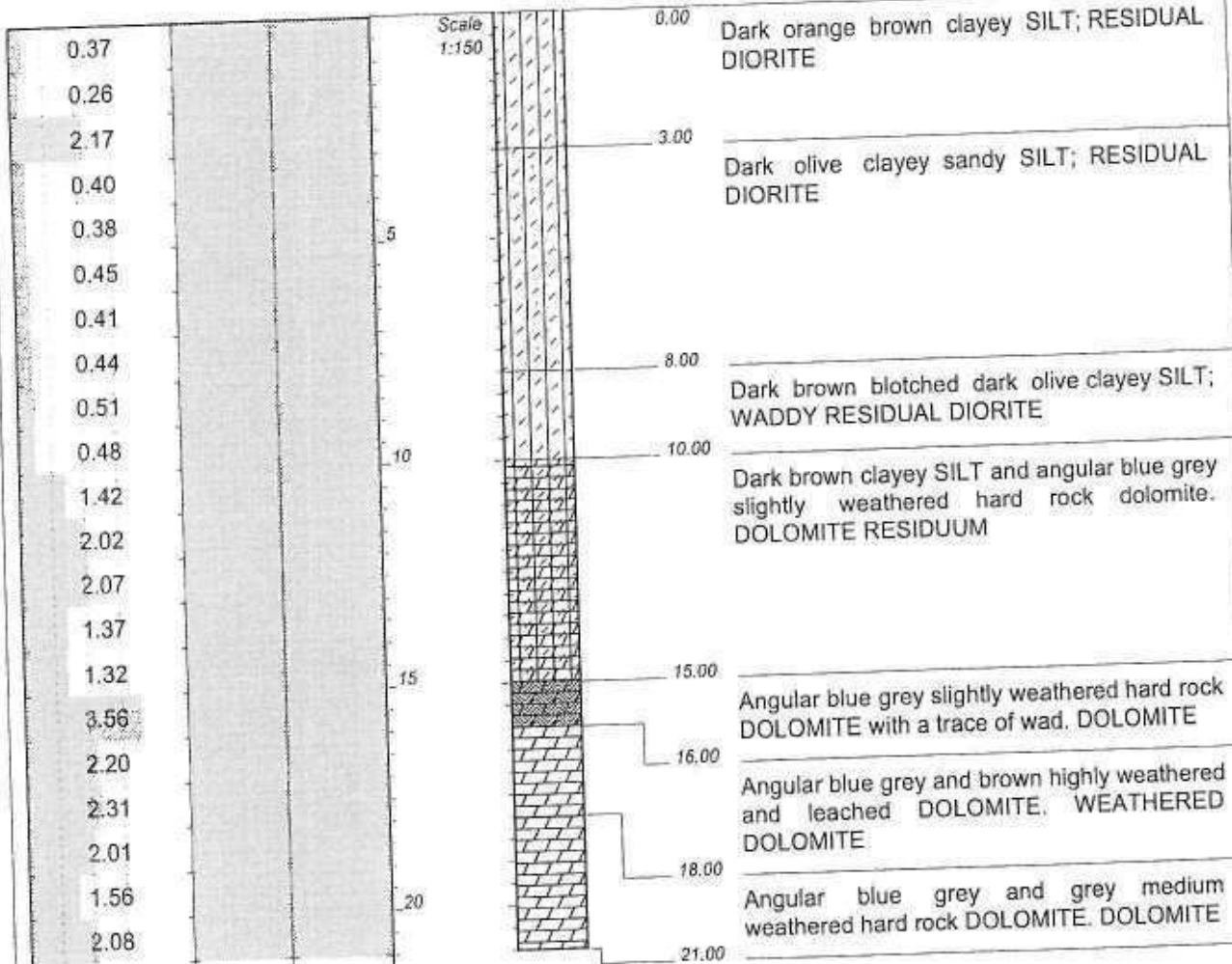
1	2	3
Penetr time mins/m	Air return	Sample recov

CONTRACTOR :  
 MACHINE : 18 Bar, 950 cfm  
 DRILLED BY : AJ SCHUTTE  
 PROFILED BY : B BALITHO  
 TYPE SET BY : A GERBER  
 SETUP FILE : PERCUSI.SET

INCLINATION : 90 DEGREES  
 DIAM : 165 mm  
 DATE : 2005/11/29  
 DATE : 2005/12/06  
 DATE : 25/04/06 18:18  
 TEXT : ..\VGI302-1\200604-1.TXT

ELEVATION : mamsl  
 X-COORD : -91738  
 Y-COORD : -2863122

HOLE No: MT/MV19/146



0.37		
0.26		
2.17		
0.40		
0.38		
0.45		
0.41		
0.44		
0.51		
0.48		
1.42		
2.02		
2.07		
1.37		
1.32		
3.56		
2.20		
2.31		
2.01		
1.56		
2.08		

NOTES

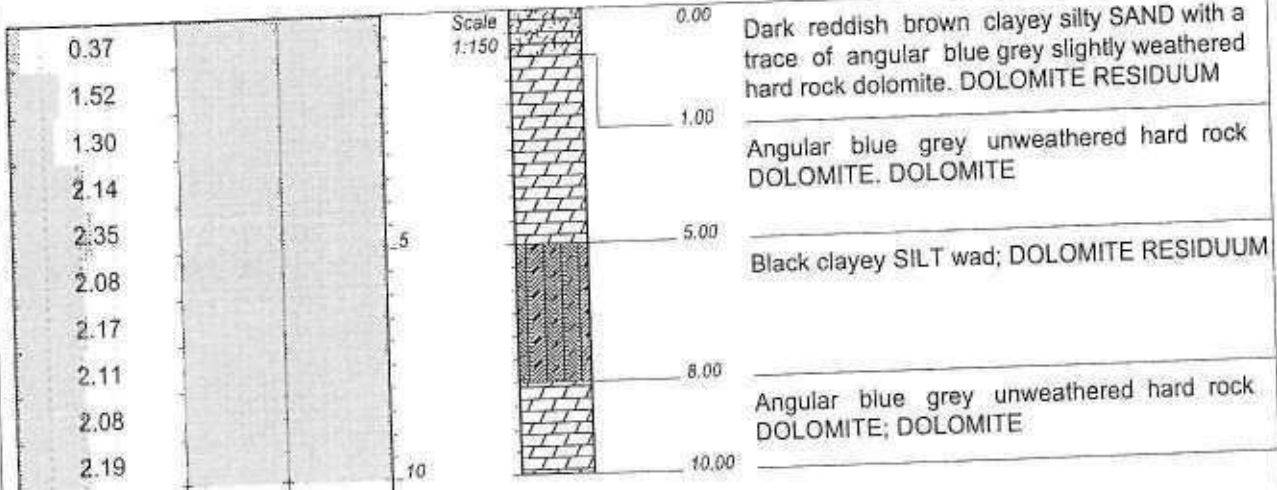
- 1) No waterstrikes recorded.
- 2) No water added.
- 3) Driller reports a small fracture at 15m.

1	2	3	Air return	Sample recov
Penetr time min:s/m				

CONTRACTOR :  
MACHINE : 18 Bar; 950 cfm  
DRILLED BY : AJ SCHUTTE  
PROFILED BY : B BALITHO  
TYPE SET BY : A GERBER  
SETUP FILE : PERCUSI.SET

INCLINATION : 90 DEGREES  
DIAM : 165 mm  
DATE : 2005/11/30  
DATE : 2005/12/06  
DATE : 25/04/06 18:18  
TEXT : ..\VGI302-1\200604-1.TXT

ELEVATION : mamsl  
X-COORD : -91797  
Y-COORD : -2862908



NOTES

- 1) No waterstrikes recorded.
- 2) No water added.

1	2	3
Penetr time min./m	Air return	Sample recov.

CONTRACTOR :  
MACHINE : 18 Bar; 950 cfm  
DRILLED BY : AJ SCHUTTE  
PROFILED BY : B BALITHO  
TYPE SET BY : A GERBER  
SETUP FILE : PERCUSI.SET

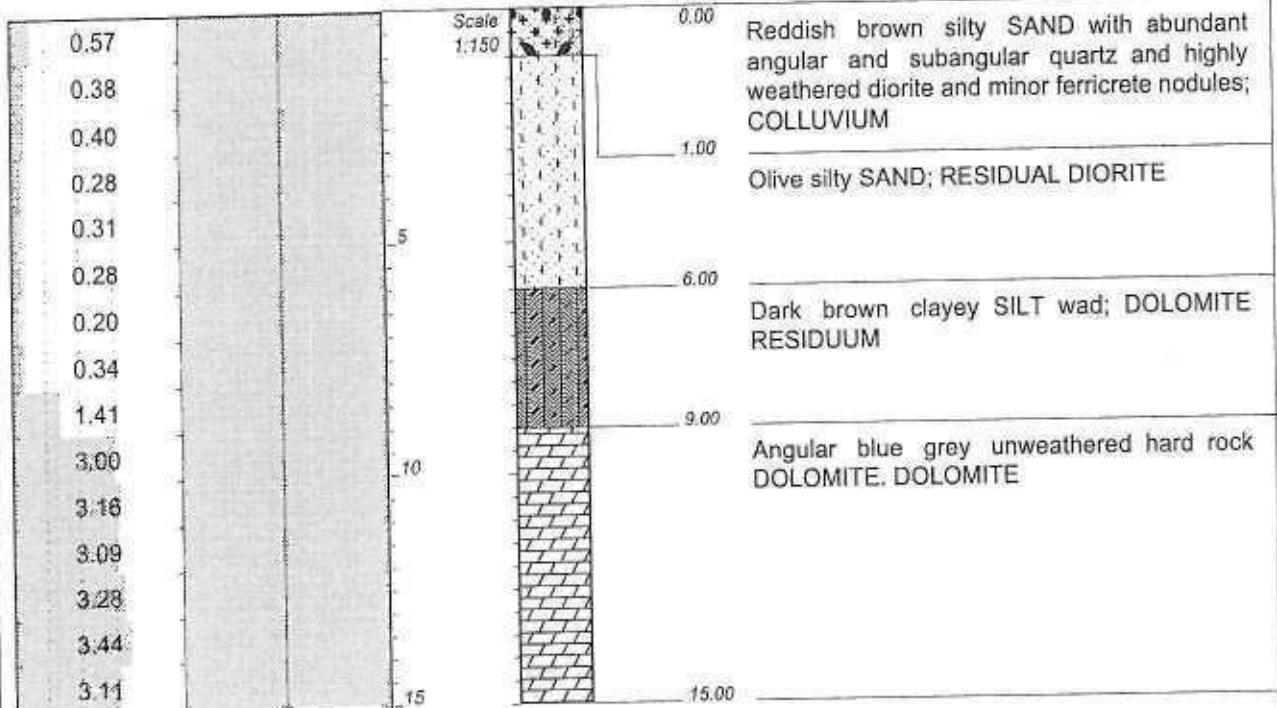
INCLINATION : 90 DEGREES  
DIAM : 165 mm  
DATE : 2005/11/29  
DATE : 2005/12/06

DATE : 25/04/06 18:18  
TEXT : .\VGI302-1\200604-1.TXT

ELEVATION : mamsi  
X-COORD : -91598  
Y-COORD : -2863277

HOLE No: MT/MV19/148





NOTES

- 1) No waterstrikes recorded.
- 2) No water added.

CONTRACTOR :  
MACHINE : 18 Bar; 950 cfm  
DRILLED BY : S BOTHA  
PROFILED BY : B BALITHO  
TYPE SET BY : A GERBER  
SETUP FILE : PERCUSI.SET

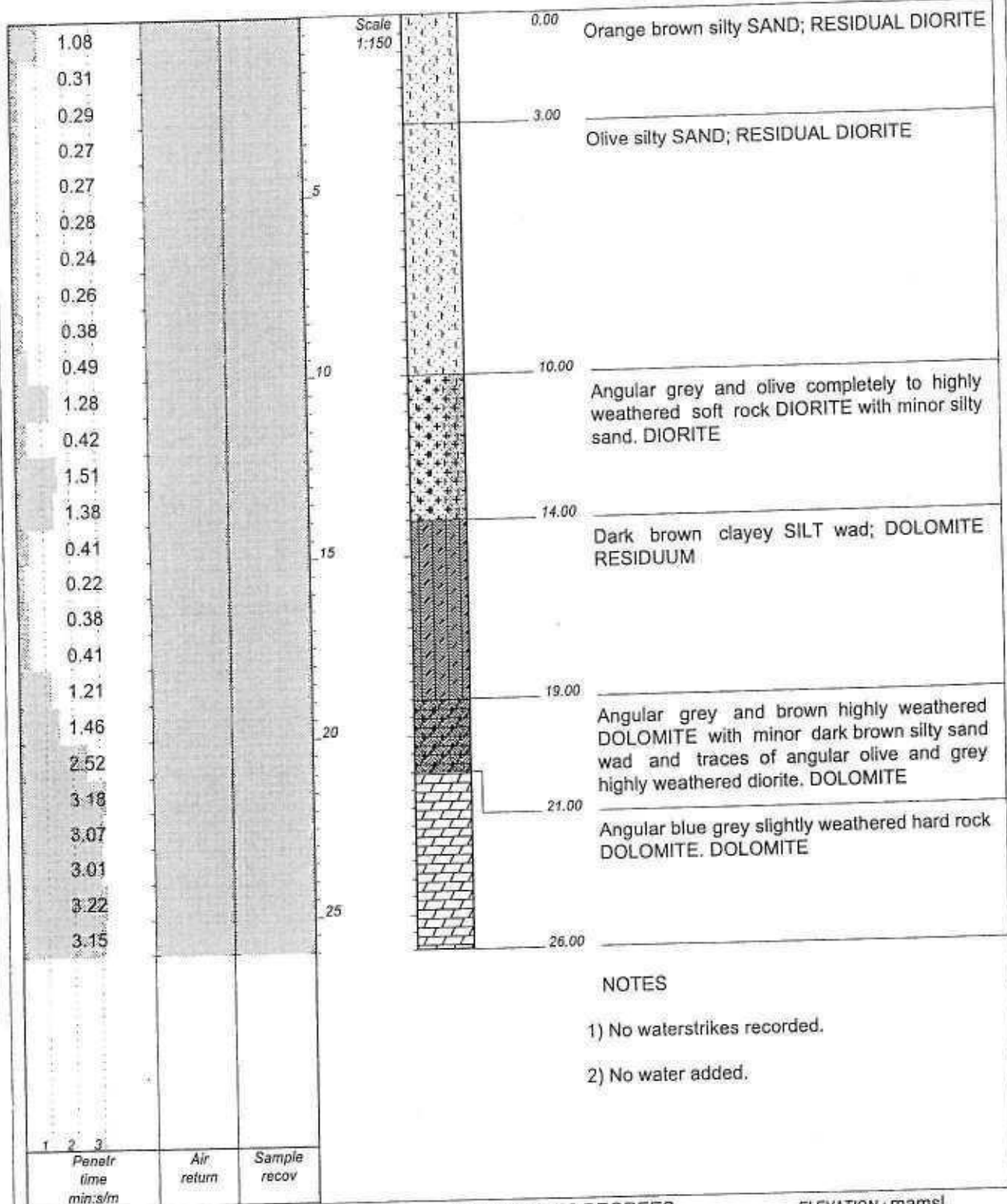
INCLINATION : 90 DEGREES  
DIAM : 165 mm  
DATE : 2005/11/29  
DATE : 2005/12/06

ELEVATION : mamsl  
X-COORD : -91414  
Y-COORD : -2863117

HOLE No: MT/MV19/150

DATE : 25/04/06 18:18  
TEXT : ..\VGI302-11200604-1.TXT





NOTES

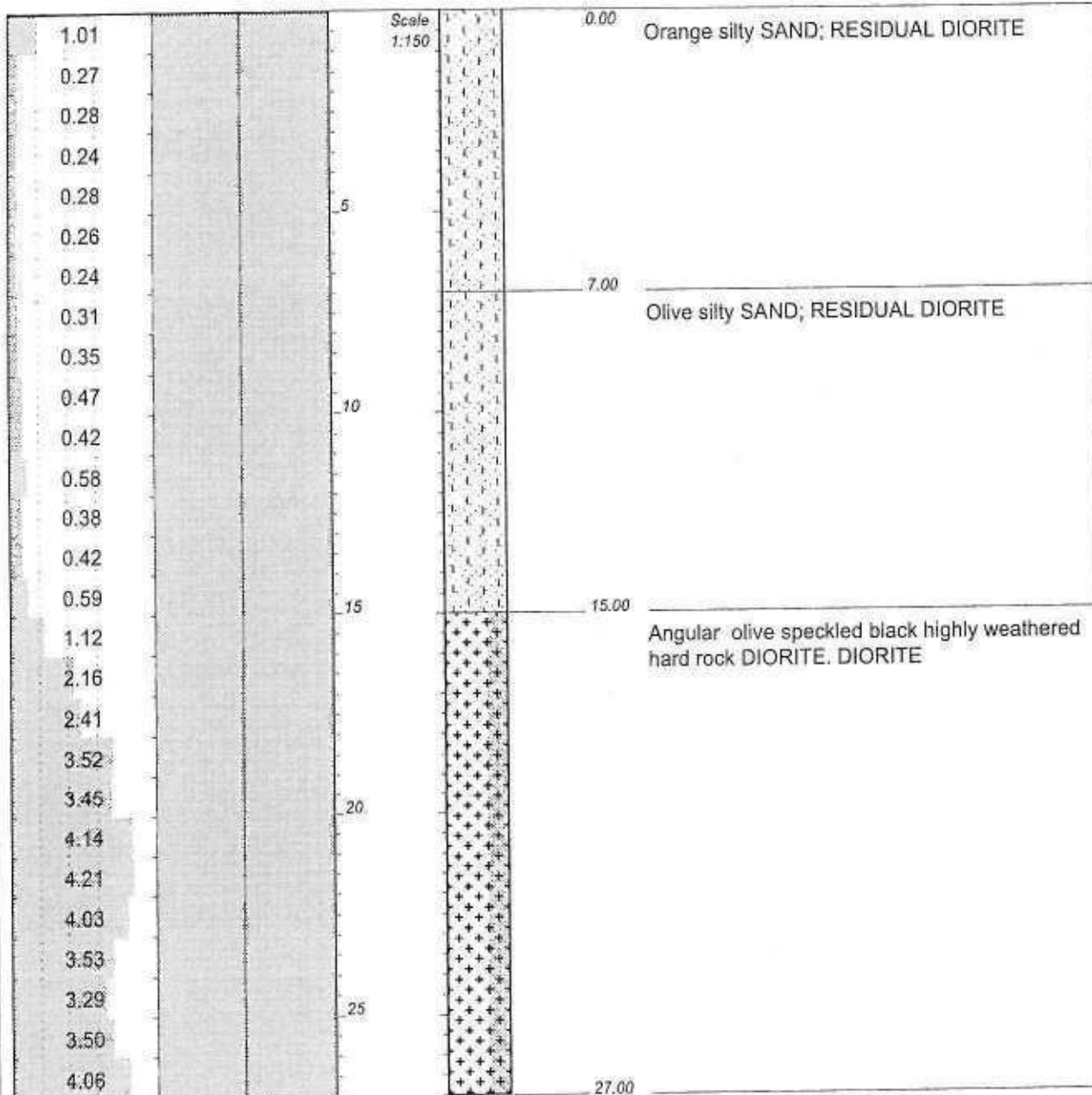
- 1) No waterstrikes recorded.
- 2) No water added.

CONTRACTOR :  
MACHINE : 18 Bar, 950 cfm  
DRILLED BY : S BOTHA  
PROFILED BY : B BALITHO  
TYPE SET BY : A GERBER  
SETUP FILE : PERCUSI.SET

INCLINATION : 90 DEGREES  
DIAM : 165 mm  
DATE : 2005/11/29  
DATE : 2005/12/06  
DATE : 25/04/08 18:18  
TEXT : ..\VGI302-1\200604-1.TXT

ELEVATION : mamsl  
X-COORD : -91340  
Y-COORD : -2863014

HOLE No: MT/MV19/154



NOTES

- 1) No waterstrikes recorded.
- 2) No water added.

1	2	3
Penetr time min./m	Air return	Sample recov

CONTRACTOR :  
MACHINE : 18 Bar; 950 cfm  
DRILLED BY : S BOTHA  
PROFILED BY : B BALITHO  
TYPE SET BY : A GERBER  
SETUP FILE : PERCUSI.SET

INCLINATION : 90 DEGREES  
DIAM : 165 mm  
DATE : 2005/11/29  
DATE : 2005/12/05  
DATE : 25/04/06 18:18  
TEXT : ..\VGI302-11200604-1.TXT

ELEVATION : mamsl  
X-COORD : -91627  
Y-COORD : -2862776

HOLE No: MT/MV19/155

**DOLOMITE TECHNOLOGY BOREHOLE PROFILES (2005)**

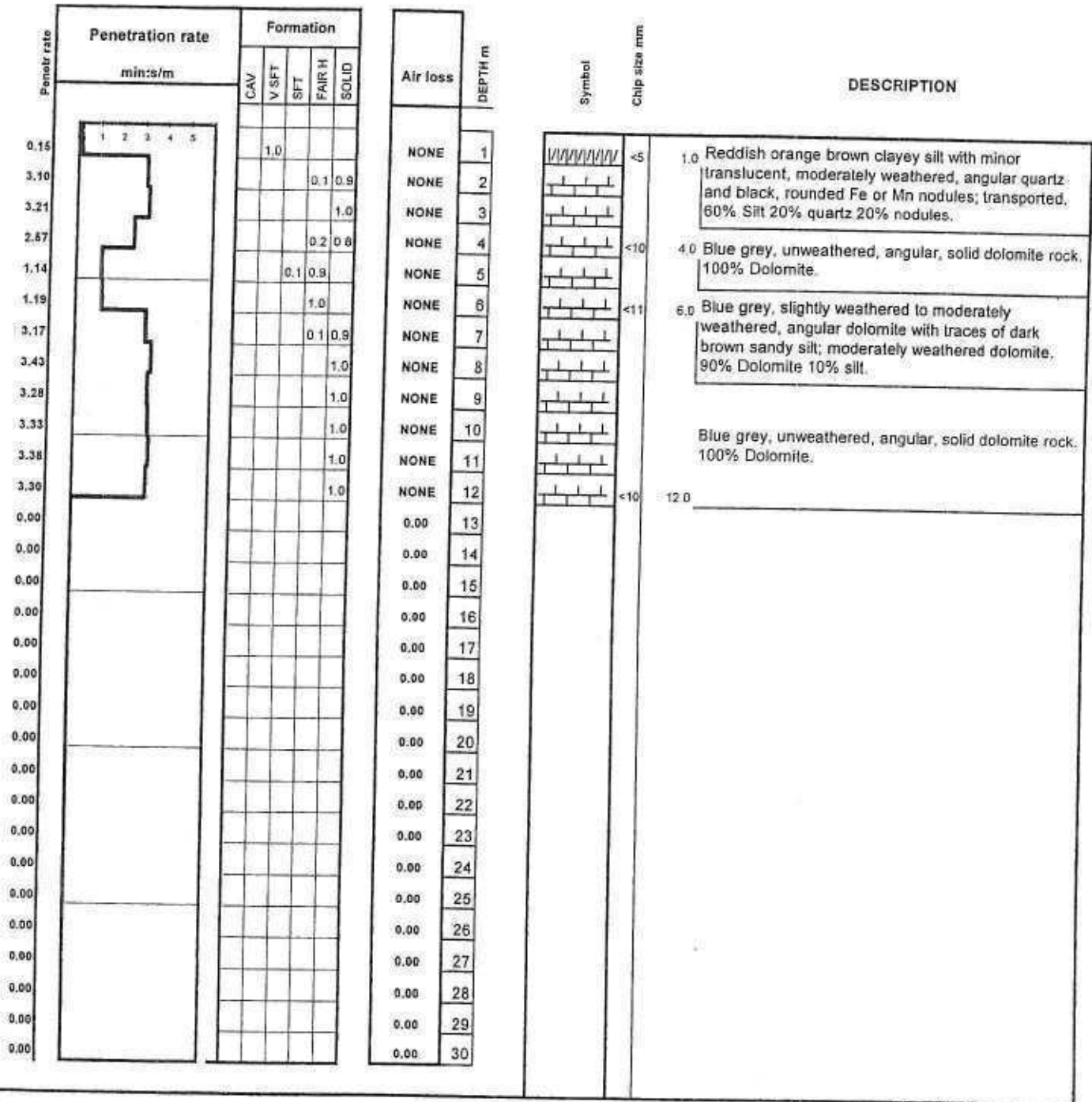
X= 2862648.278

Y= 91538.26

Z= 1460.623 masl

Project no: 0379-04P  
Project name: Stukgrond  
Date drilled: 20040602  
Date profiled: 20040604

Client: **M & T Development**  
Drill contractor: Hennie Erwee  
Driller: Jacob  
BH NO: **BH5127 (47)**



**Notes:**

1. No water encountered.
2. No sample and no air loss.
3. No water was applied during drilling.
4. Hammer rate was irregular between 1-2m, 4-5m and 6-7m

**Notes (continua):**



X= 2863165.388

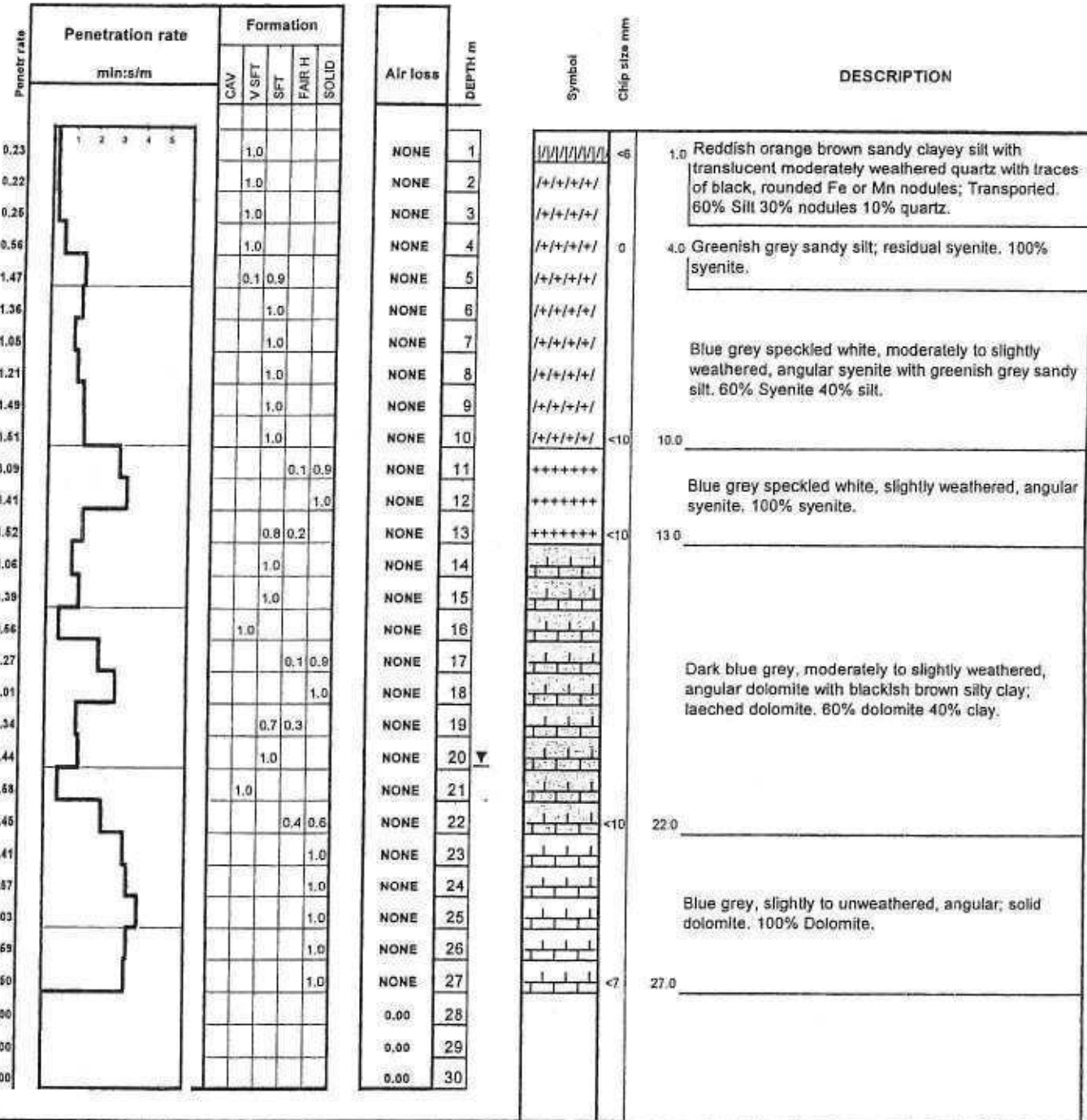
Y= 91244.122

Z= 1476.88

masl

Project no: 0379-04P  
 Project name: Stukgrond  
 Date drilled: 20040507  
 Date profiled: 20040510

Client: M & T Development  
 Drill contractor: Hennie Erwee  
 Driller: Jacob  
 BH NO: BH5207 (36)



Notes:

Notes (continue):

1. Water encountered at depth of 20m.
2. No sample and no air loss.
3. Water was applied during drilling between 7m - 8m, 19m - 20m, 25m - 27m.
4. Hammer rate was irregular between 4m - 5m, 10m - 11m, 12m - 13m, 15m - 16m, 18m - 19m and 20m - 21m.



X= 2862838.366

Y= 91452.792

Z= 1468.182 masl

Project no: 0379-04P  
Project name: Stukgrond  
Date drilled: 20040507  
Date profiled: 20040510

Client: M & T Development  
Drill contractor: Hennie Erwee  
Driller: Jacob  
BH NO: BH5220 (35)

Penetr rate min:s/m	Formation					Air loss	DEPTH m	Symbol	Chip size mm	DESCRIPTION
	CAV	V SFT	SFT	FAIR H	SOLID					
0.47						NONE	1	/+/+/+/+		
0.32						NONE	2	/+/+/+/+		
0.30						NONE	3	/+/+/+/+		
0.33						NONE	4	/+/+/+/+		
0.35						NONE	5	/+/+/+/+		
0.37						NONE	6	/+/+/+/+	<3	6.0
0.51						NONE	7	/+/+/+/+		
0.54						NONE	8	/+/+/+/+	<30	8.0
0.26		0.1	0.9			NONE	9			
1.27				0.1	0.9	NONE	10		<10	10.0
2.45					1.0	NONE	11			
3.29					1.0	NONE	12			
3.34					1.0	NONE	13			
3.27					1.0	NONE	14			
3.33					1.0	NONE	15			
3.29					1.0	NONE	16		<10	16.0
0.00						0.00	17			
0.00						0.00	18			
0.00						0.00	19			
0.00						0.00	20			
0.00						0.00	21			
0.00						0.00	22			
0.00						0.00	23			
0.00						0.00	24			
0.00						0.00	25			
0.00						0.00	26			
0.00						0.00	27			
0.00						0.00	28			
0.00						0.00	29			
0.00						0.00	30			

Notes:

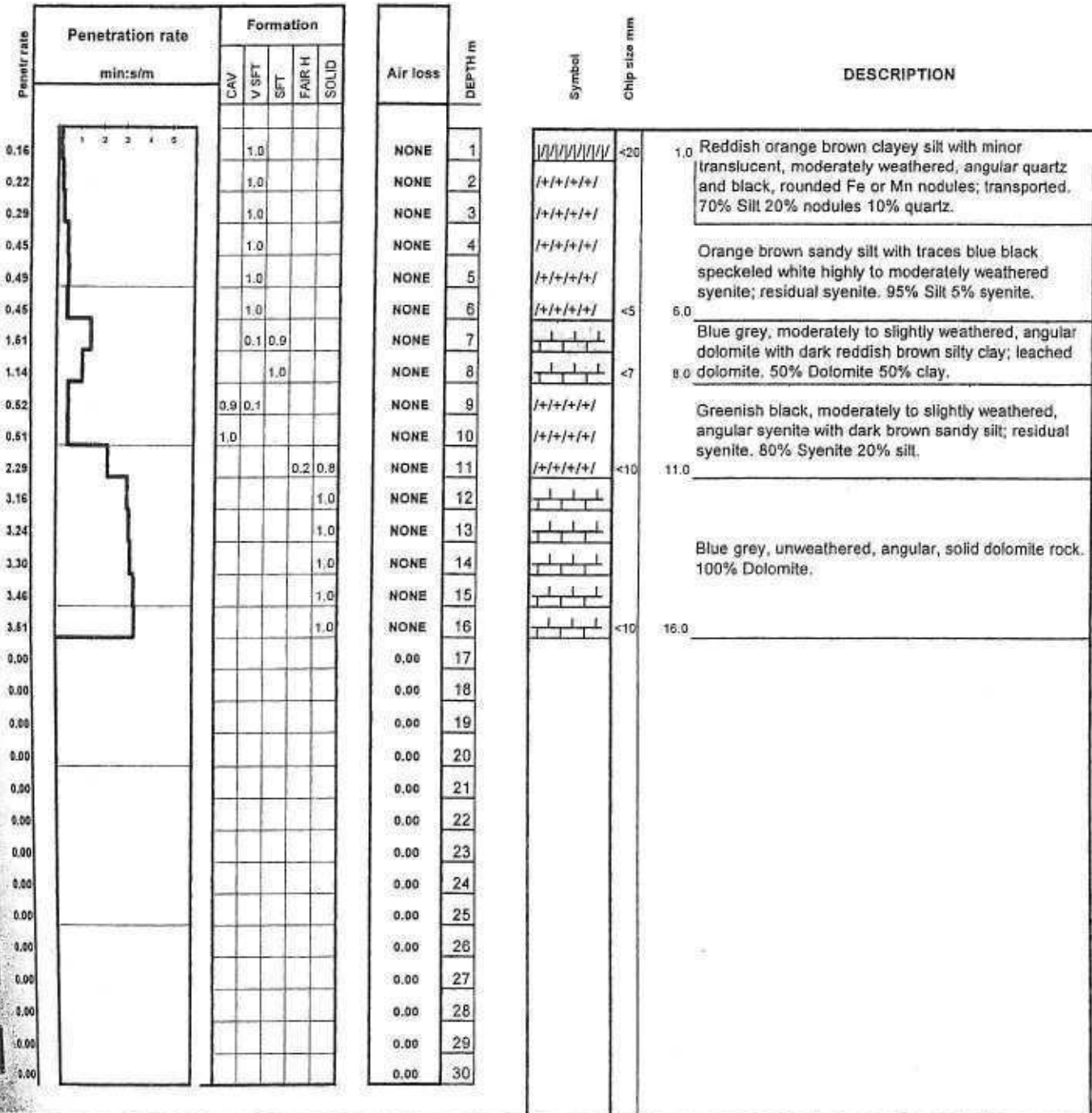
1. Water encountered at depth of 8m.
2. No sample and no air loss.
3. No water was applied during drilling.
4. Hammer rate was irregular between 9m - 10m.

Notes (continue):

X= 2862929.651 Y= 91431.716 Z= 1470.5 mast

Project no: 0379-04P  
 Project name: Stukgrond  
 Date drilled: 20040602  
 Date profiled: 20040604

Client: M & T Development  
 Drill contractor: Hennie Erwee  
 Driller: Jacob  
 BH NO: BH5317(48)



Notes:

- 1. No water encountered.
- 2. No sample and no air loss.
- 3. Water was applied during drilling between 10-11m.
- 4. Hammer rate was irregular between 5-7m, 8-9m and 10-11m

Notes (continue):

X= 2863217      Y= 91281      Z= 1478.16      masl

Project no: 0379-04P  
Project name: Stukgrond  
Date drilled: 20040419  
Date profiled: 20040422

Client: **M & T Development**  
Drill contractor: Hennie Erwee  
Driller: Adam  
BH NO: **BH5406(16)**

Penetr rate mins/m	Formation					Air loss	DEPTH m	Symbol	Chip size mm	DESCRIPTION
	CAV	V SFT	SFT	FAIR H	SOLID					
1						NONE	1		<5	1.0 Black, moderately weathered, rounded, Fe or Mn nodules and translucent white, moderately to slightly weathered iron stained quartz with brown silty sand; transported. 50% Sand 50% transported material.
2						NONE	2	/+/+/+/+		
3						NONE	3	/+/+/+/+		
4						NONE	4	/+/+/+/+	<5	4.0 Blue grey brown silty sand with minor blue grey speckled white, moderately, angular, syenite; residual syenite. 90% Silt 10% syenite.
5					1.0	NONE	5	+++++		
6					1.0	NONE	6	+++++		
7					1.0	NONE	7	+++++		
8					1.0	NONE	8	+++++		
9		0.2	0.8			NONE	9	+++++		Blue grey speckled white, moderately weathered to slightly weathered, angular, syenite. 100% Syenite.
10					1.0	NONE	10	+++++		
11					1.0	NONE	11	+++++		
12					1.0	NONE	12	+++++	<7	12.0
13						0.00	13			
14						0.00	14			
15						0.00	15			
16						0.00	16			
17						0.00	17			
18						0.00	18			
19						0.00	19			
20						0.00	20			
21						0.00	21			
22						0.00	22			
23						0.00	23			
24						0.00	24			
25						0.00	25			
26						0.00	26			
27						0.00	27			
28						0.00	28			
29						0.00	29			
30						0.00	30			
31						0.00	31			
32						0.00	32			
33						0.00	33			
34						0.00	34			
35						0.00	35			
36						0.00	36			
37						0.00	37			
38						0.00	38			
39						0.00	39			
40						0.00	40			
41						0.00	41			
42						0.00	42			
43						0.00	43			
44						0.00	44			
45						0.00	45			
46						0.00	46			
47						0.00	47			
48						0.00	48			
49						0.00	49			
50						0.00	50			

- Notes:
1. No water encountered.
  2. No sample and no air loss.
  3. No water was applied during drilling.
  4. Hammer rate was irregular between 3m - 4m.

Notes (continue):

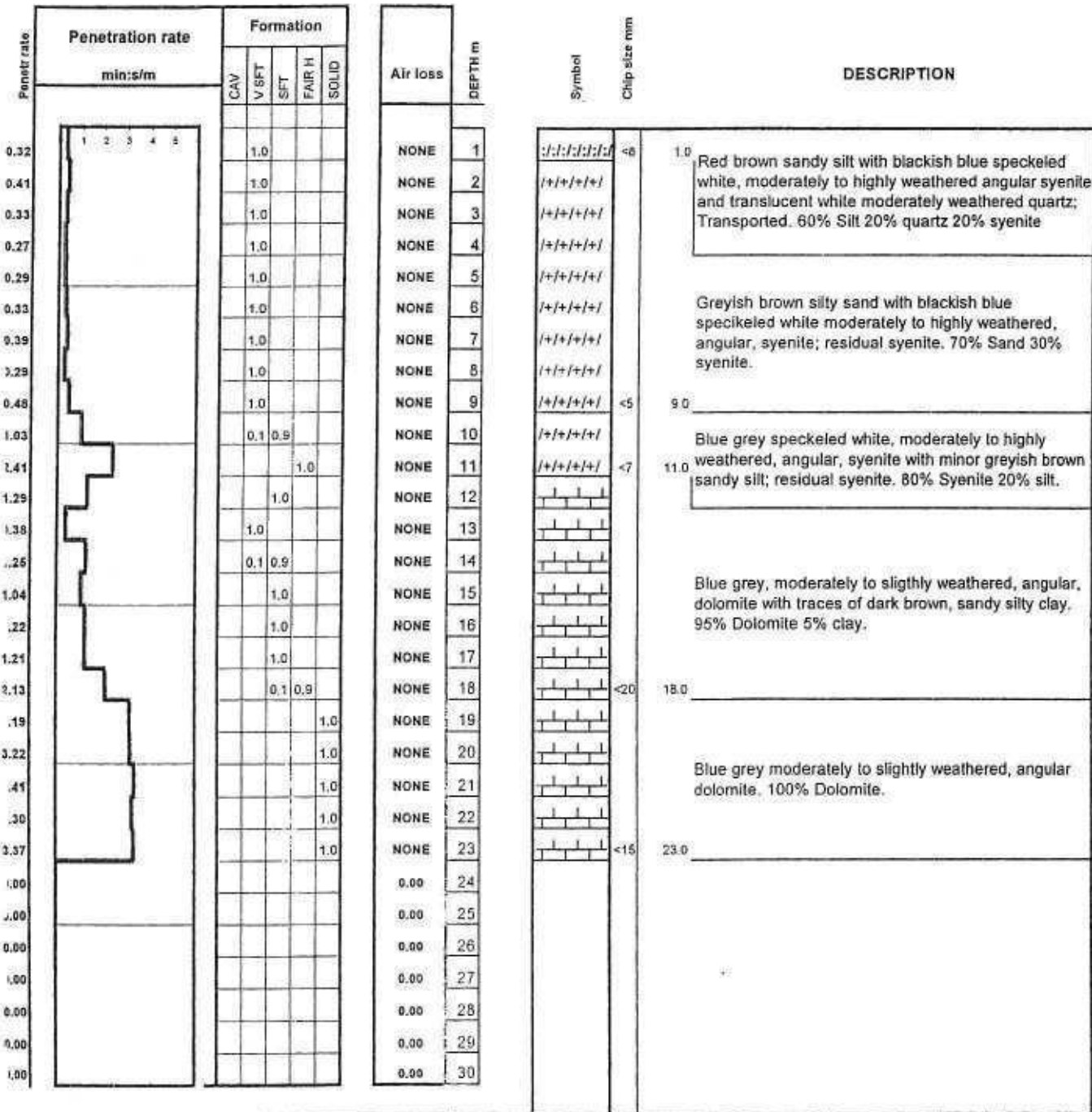
X= 2862846

Y= 91800

Z= 1468.57 masl

Project no: 0379-04P  
Project name: Stukgrond  
Date drilled: 20040419  
Date profiled: 200404

Client: M & T Development  
Drill contractor: Hennie Erwee  
Driller: Jacob  
BH NO: BH5823(18)



Notes:

- 1. No water encountered.
- 2. No sample and no air loss.
- 3. No water used during drilling.
- 4. Hammer rate was irregular between 9m - 10m, 11m - 12m, 13m - 14m and 17m - 18m

Notes (continue):

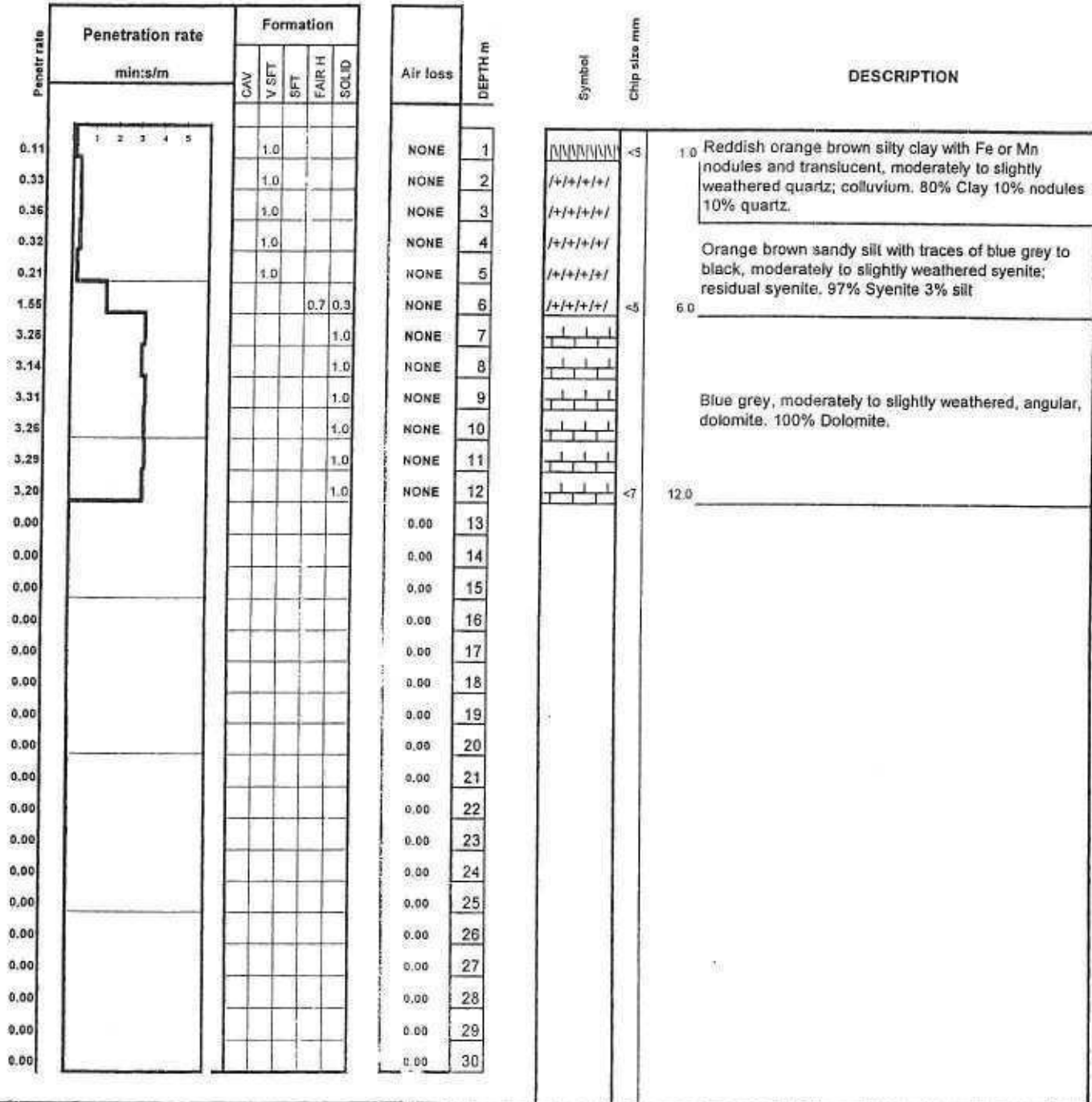
X= 2863135

Y= 91547

Z= 1471.86 masl

Project no: 0379-04P  
 Project name: Stukgrond  
 Date drilled: 20040419  
 Date profiled: 200404

Client: M & T Development  
 Drill contractor: Hennie Erwee  
 Driller: Jacob  
 BH NO: BH6013(17)



Notes:

1. No water encountered.
2. No sample and no air loss.
3. No water used during drilling
4. Hammer rate was irregular between 0m - 1m and 5m - 6m

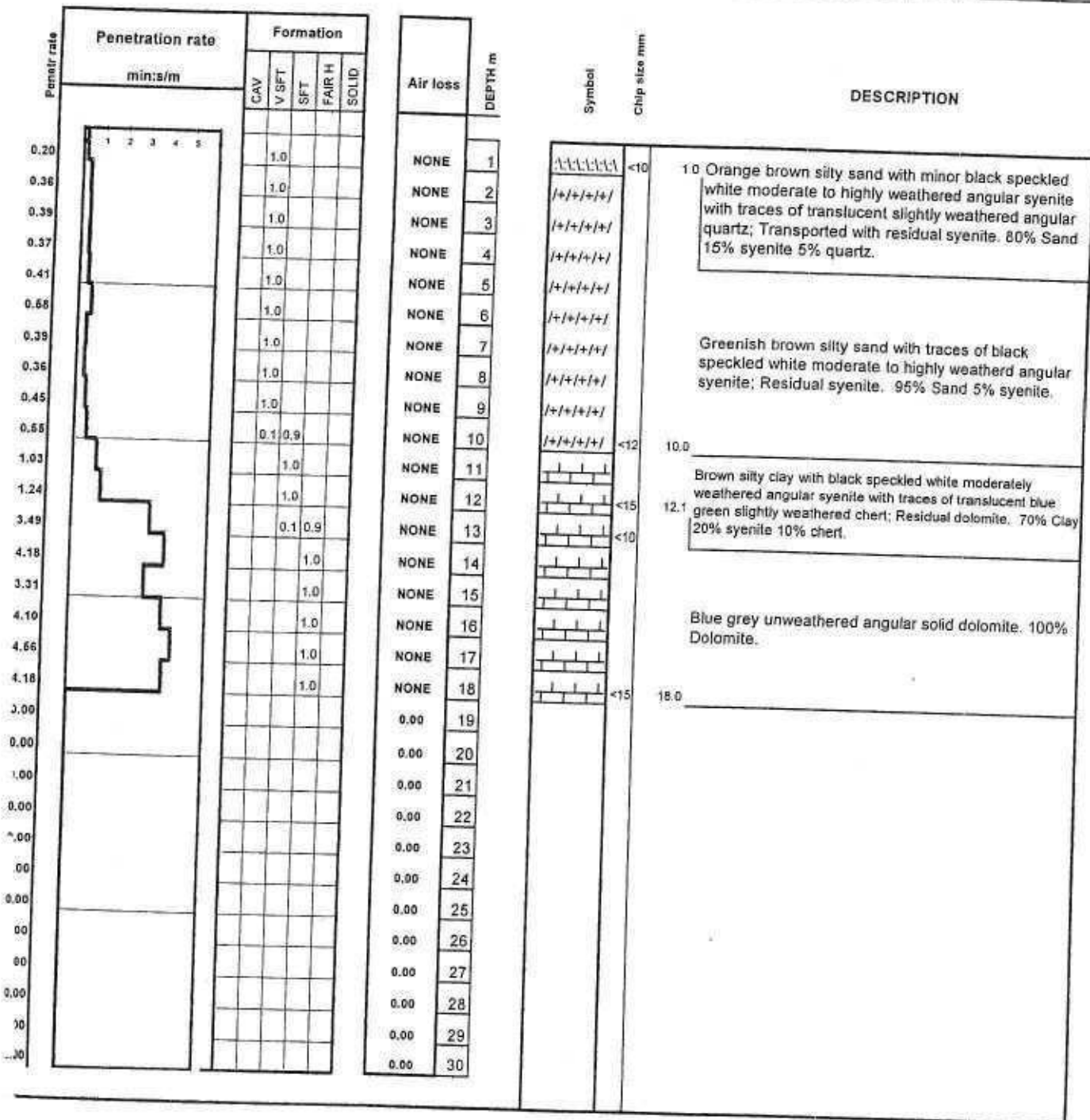
Notes (continue):



X= 2862801.00 Y= 91979.00 Z= 1461.93 masl

Project no: 0379-04P  
Project name: Stukgrond  
Date drilled: 20040708  
Date profiled: 20040714

Client: M & T Development  
Drill contractor: Hennie Erwee  
Driller: Adam  
BH NO: BH6127 (60)



Notes:

1. No water encountered.
2. No sample and no air loss.
3. Water used during drilling between 11 - 14m.
4. Hammer rate generally regular, except between 0-1m and 12-13m where it was irregular.

Notes (continue):

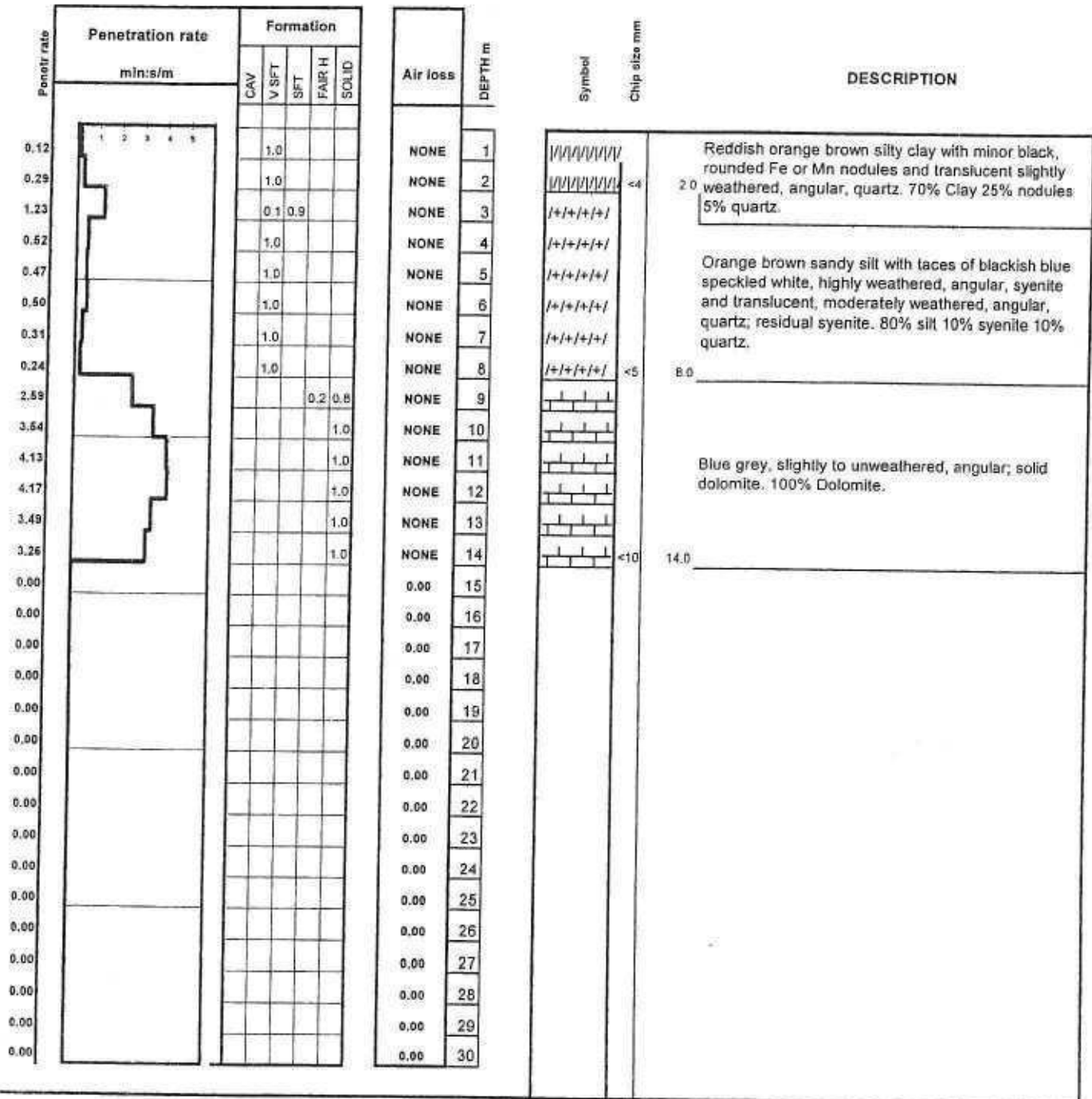
X= 2863457

Y= 91486

Z= 1480 46 masl

Project no: 0379-04P  
 Project name: Stukgrond  
 Date drilled: 20040511  
 Date profiled: 20040512

Client: M & T Development  
 Drill contractor: Hennie Erwee  
 Driller: Jacob  
 BH NO: BH6403 (37)



Notes:

- 1 No water encountered.
- 2. No sample and no air loss.
- 3. Water was apiled during drilling between 5m - 11m.
- 4 Hammer rate was irregular between 0m - 1m, 2m - 3m and 8m - 9m

Notes (continue):

X= 2863020.935 Y= 91802.108 Z= 1484.88 masl

Project no: 0379-04P  
Project name: Stukgrond  
Date drilled: 20040507  
Date profiled: 20040510

Client: M & T Development  
Drill contractor: Hennie Erwee  
Driller: Jacob  
BH NO: BH6521 (39)

Penetr rate	Penetration rate					Formation					Air loss	DEPTH m	Symbol	Chap size mm	DESCRIPTION
	min:s/m					CAV	V SFT	SFT	FAIR H	SOLID					
0.30	1	2	3	4	5	1.0					NONE	1		<7	1.0 Reddish orange brown sandy silty clay with translucent moderately weathered quartz with traces of black, rounded Fe or Mn nodules; Transported. 70% Clay 20% quartz 10% nodules.
0.29						1.0					NONE	2	/+/+/+/		
0.22						1.0					NONE	3	/+/+/+/		
0.19						1.0					NONE	4	/+/+/+/		Orange brown sandy silt with traces of blackish blue speckled white, highly to moderately weathered, angular; residual syenite. 90% Silt 10% syenite.
0.16						1.0					NONE	5	/+/+/+/	<10	5.0 Reddish black sandy silt (wad) with blue grey moderately weathered, angular; leached dolomite. 60% Silt 40% dolomite.
0.10						1.0					NONE	6		<20	
3.31										1.0	NONE	7			
3.20										1.0	NONE	8			
3.10										1.0	NONE	9			
3.12										1.0	NONE	10			Blue grey, slightly to unweathered, angular; solid dolomite. 100% Dolomite.
3.26										1.0	NONE	11			
3.40										1.0	NONE	12		<10	
0.00											0.00	13			
0.00											0.00	14			
0.00											0.00	15			
0.00											0.00	16			
0.00											0.00	17			
0.00											0.00	18			
0.00											0.00	19			
0.00											0.00	20			
0.00											0.00	21			
0.00											0.00	22			
0.00											0.00	23			
0.00											0.00	24			
0.00											0.00	25			
0.00											0.00	26			
0.00											0.00	27			
0.00											0.00	28			
0.00											0.00	29			
0.00											0.00	30			

Notes:

1. No water encountered.
2. No sample and no air loss
3. No water was applied during drilling.
4. Hammer rate was irregular between 0m - 1m and 4m - 5m.

Notes (continue):

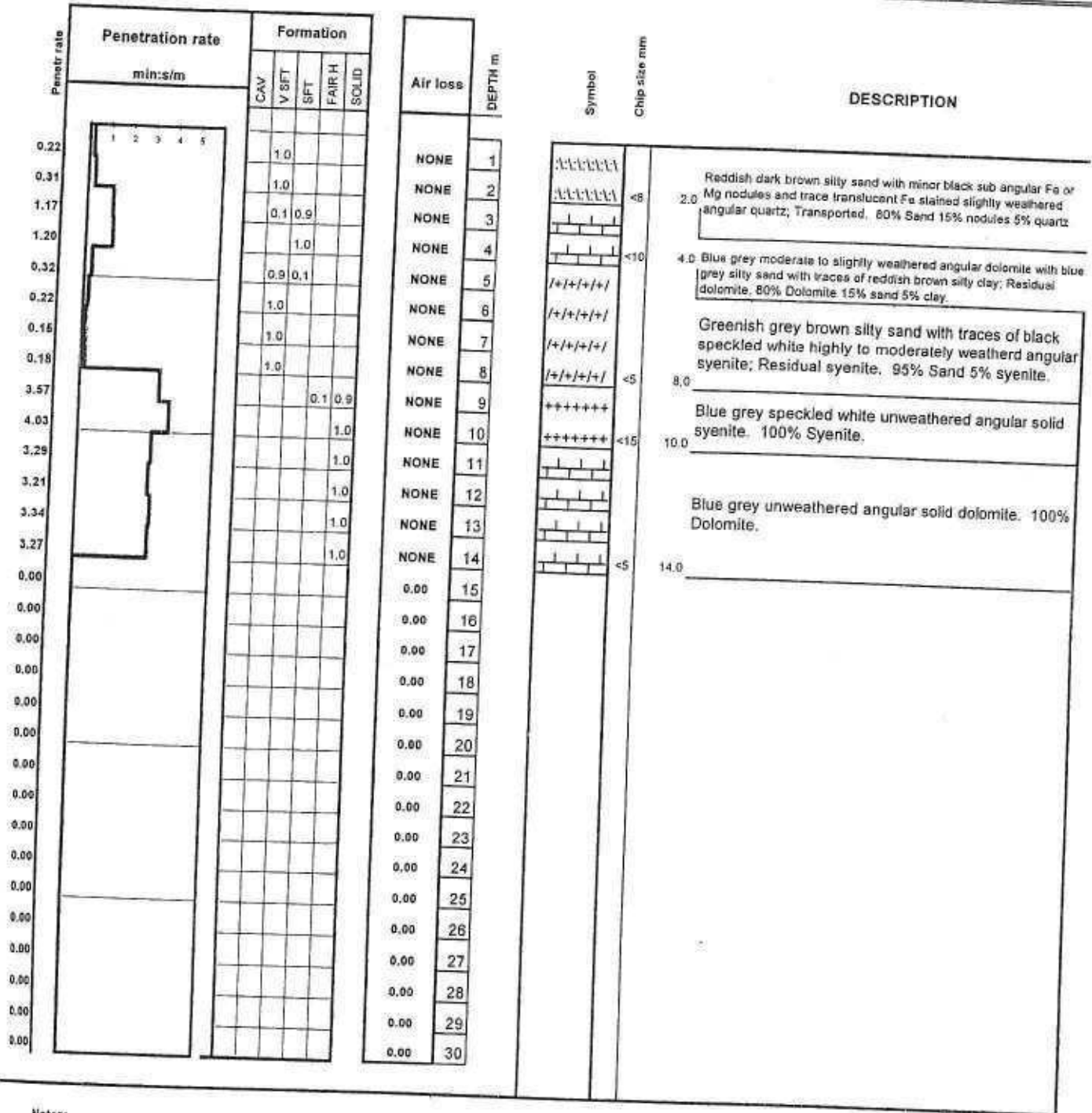
X= 2862891.00

Y= 91919.00

Z= 1459.50 masl

Project no: 0379-04P  
Project name: Stukgrond  
Date drilled: 20040708  
Date profiled: 20040714

Client: M & T Development  
Drill contractor: Hennie Erwee  
Driller: Jacob  
BH NO: BH6627 (61)



Notes:

1. No water encountered
2. No sample and no air loss
3. Water used during drilling between 10m - 14m.
4. Hammer rate generally regular, except between 2-3m, 4-5m and 8-9m where it was irregular.

Notes (continue):

X= 2863229      Y= 91738      Z= 1470.43      masl

Project no: 0379-04P  
Project name: Stukgrond  
Date drilled: 20040419  
Date profiled: 20040422

Client: **M & T Development**  
Drill contractor: Hennie Erwee  
Driller: Adam  
BH NO: **BH6714(19)**

Penetration rate min:s/m	Formation					Air loss	DEPTH m	Symbol	Chip size mm	DESCRIPTION
	CAV	V SFT	SFT	FAIR H	SOLID					
3.20		1.0				NONE	1		<15	Blue grey, moderately weathered, angular, dolomite with reddish orange dark brown, silty clay. 50% Dolomite 50% clay
1.8		1.0				NONE	2		<15	
2.0				1.0		NONE	3			
1.16				1.0		NONE	4			
0.3				1.0		NONE	5			
1.10				1.0		NONE	6			Blue grey moderately to slightly weathered, angular dolomite. 100% Dolomite.
0.26				1.0		NONE	7			
0.21				1.0		NONE	8			
0.37				1.0		NONE	9			
1.8				1.0		NONE	10		<10	
0.10						0.00	11			
0.00						0.00	12			
0.00						0.00	13			
0.00						0.00	14			
0.00						0.00	15			
0.00						0.00	16			
0.00						0.00	17			
0.00						0.00	18			
0.00						0.00	19			
0.00						0.00	20			
0.00						0.00	21			
0.00						0.00	22			
0.00						0.00	23			
0.00						0.00	24			
0.00						0.00	25			
0.00						0.00	26			
0.00						0.00	27			
0.00						0.00	28			
0.00						0.00	29			
0.00						0.00	30			

- Notes:
1. No water encountered.
  2. No sample and no air loss.
  3. No water used during drilling.
  4. Hammer rate was irregular between 0m - 2m.

Notes (continue):



X= 2863582

Y= 91620

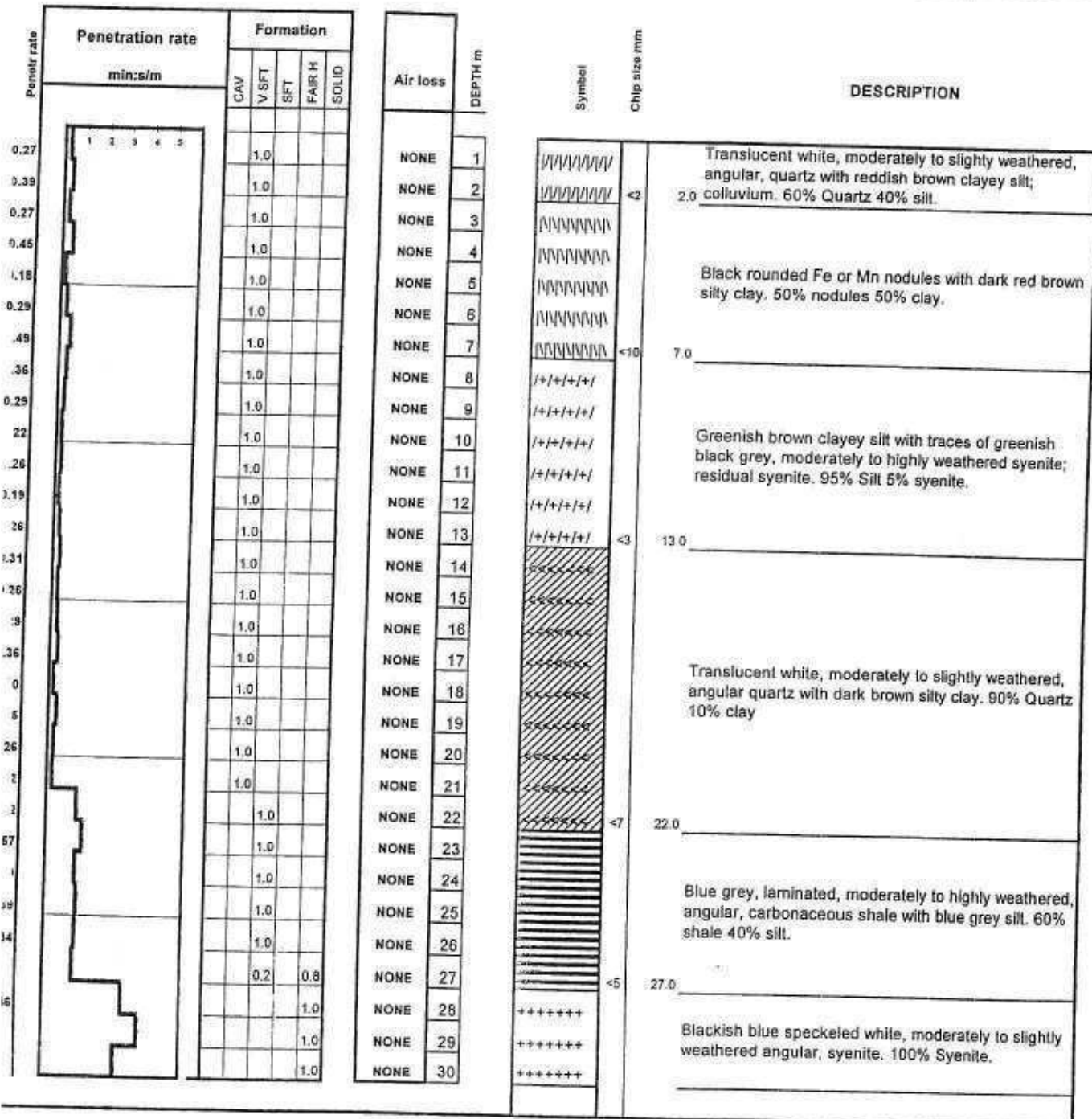
Z=

1485.01

masi

Project no: 0379-04P  
 Project name: Stukgrond  
 Date drilled: 20040419  
 Date profiled: 20040426

Client: M & T Development  
 Drill contractor: Hennie Erwee  
 Driller: Adam  
 BH NO: BH7002(20)



- Notes:
1. No water encountered
  2. No sample and no air loss.
  3. Water was applied during drilling at depth of 5m - 7m.
  4. Hammer rate was irregular between 27m - 28m.

Notes (continue):

X= 2863582

Y= 91620

Z= 1485.01 masl

Project no: 0379-04P  
Project name: Stukgrond  
Date drilled: 20040419  
Date profiled: 20040426

Client: **M & T Development**  
Drill contractor: Hennie Erwee  
Driller: Adam  
BH NO: **BH7002(20)**

Penetr rate min:s/m	Formation					Air loss	DEPTH m	Symbol	Chip size mm	DESCRIPTION
	CAV	V SFT	SFT	FAIR H	SOLID					
3.22	1	2	3	4	5	NONE	31	+++++++		
4.18						NONE	32	+++++++		
4.36						NONE	33	+++++++	<5	33.0
0.00						0.00	34			
0.00						0.00	35			
0.00						0.00	36			
0.00						0.00	37			
0.00						0.00	38			
0.00						0.00	39			
0.00						0.00	40			
0.00						0.00	41			
0.00						0.00	42			
0.00						0.00	43			
0.00						0.00	44			
0.00						0.00	45			
0.00						0.00	46			
0.00						0.00	47			
0.00						0.00	48			
0.00						0.00	49			
0.00						0.00	50			
0.00						0.00	51			
0.00						0.00	52			
0.00						0.00	53			
0.00						0.00	54			
0.00						0.00	55			
0.00						0.00	56			
0.00						0.00	57			
0.00						0.00	58			
0.00						0.00	59			
0.00						0.00	60			

Notes:

1. No water encountered.
2. No sample and no air loss.
3. Water was applied during drilling at depth of 5m - 7m.
4. Hammer rate was irregular between 27m - 28m.

Notes (continue):

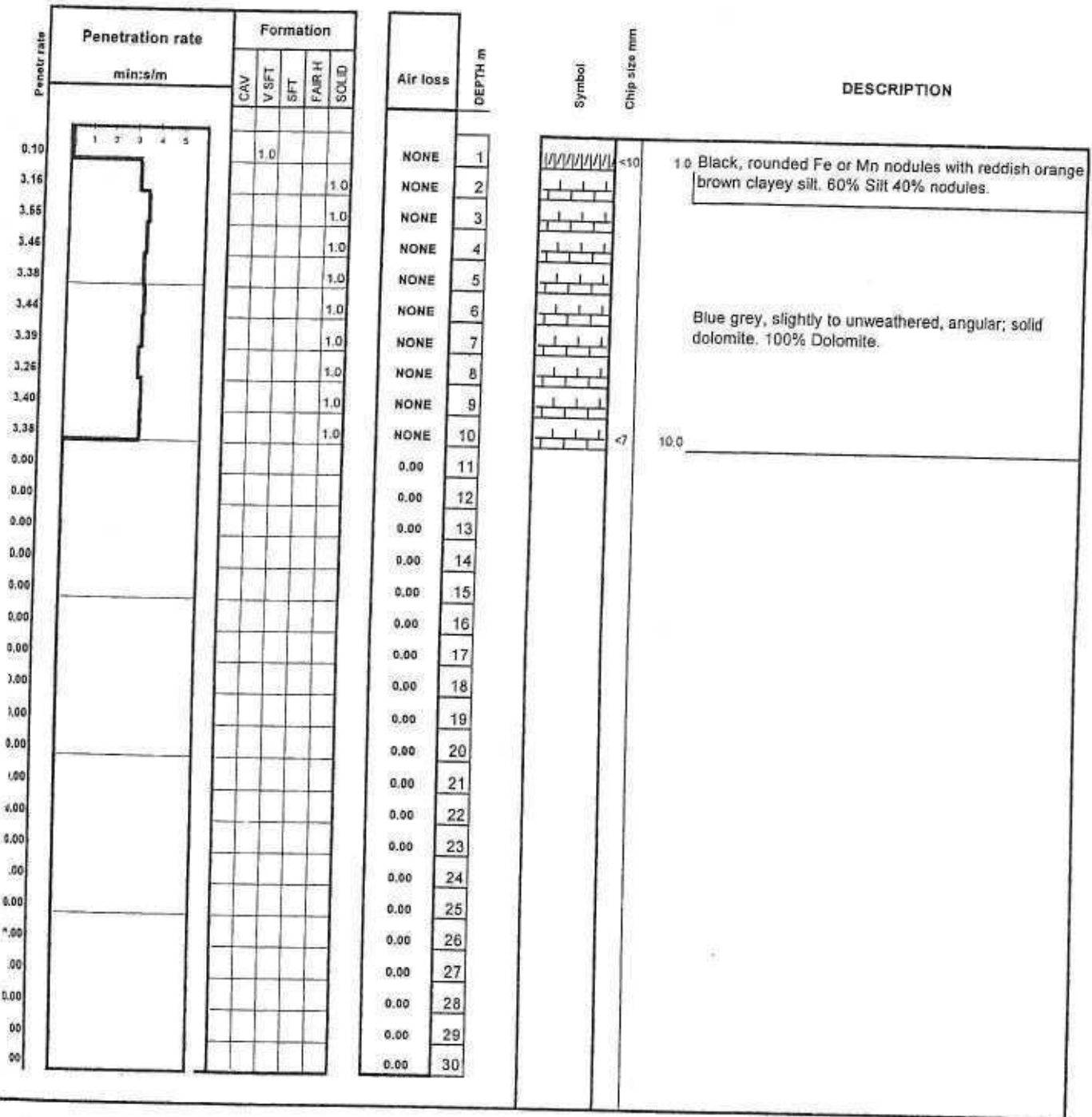
X= 2863405.518

Y= 91736.915

Z= 1476.515 masl

Project no: 0379-04P  
 Project name: Stukgrond  
 Date drilled: 20040507  
 Date profiled: 20040510

Client: M & T Development  
 Drill contractor: Hennie Erwee  
 Driller: Jacob  
 BH NO: BH7009 (38)



Notes:

1. No water encountered.
2. No sample or air loss
3. No water was applied during drilling.
4. Hammer rate was irregular between 0m - 1m

Notes (continue):

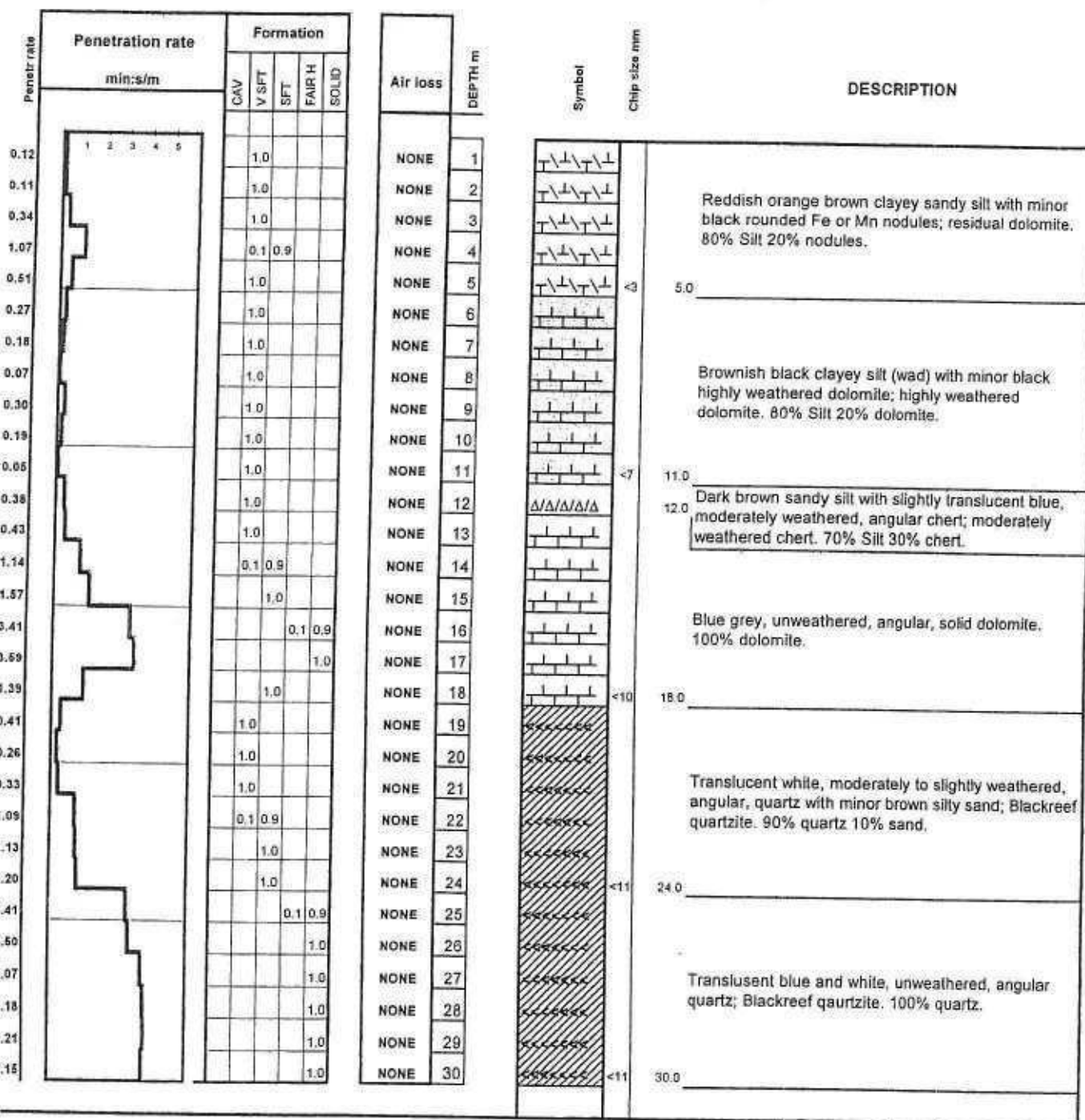
X= 2863207.513

Y= 91863.892

Z= 1468.94 masl

Project no: 0379-04P  
 Project name: Stukgrond  
 Date drilled: 20040603  
 Date profiled: 20040608

Client: **M & T Development**  
 Drill contractor: Hennie Erwee  
 Driller: Jacob  
 BH NO: **BH7017 (49)**



**Notes:**

1. No water was encountered.
2. No sample and no air loss.
3. No water was spilled during drilling.
4. Hammer rate was irregular between 3-4m, 6-7m, 9-10m, 13-14m, 15-16m, 17-18m, 21-22m and 24-25m.

**Notes (continue):**

5. Hammer rate was very irregular between 7-8m and 10-11m

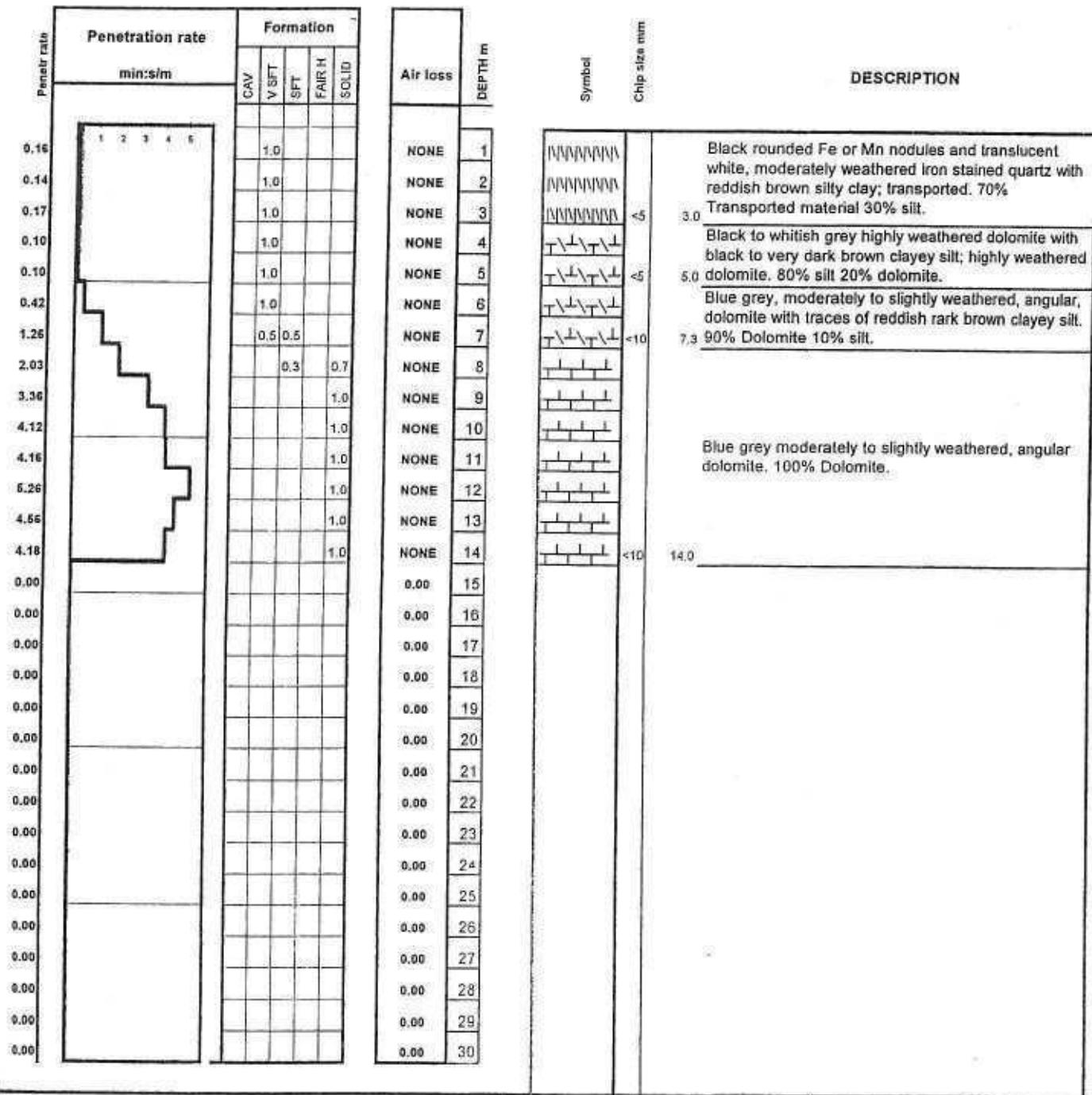
X= 2863530

Y= 91761

Z= 1482.00 masl

Project no: 0379-04P  
 Project name: Stukgrond  
 Date drilled: 20040419  
 Date profiled: 20040422

Client: M & T Development  
 Drill contractor: Hennie Erwee  
 Driller: Adam  
 BH NO: BH7306(21)



Notes:

1. No water encountered.
2. No sample and no air loss
3. No water used during drilling
4. Hammer rate was irregular between 0m - 5m.

Notes (continue):



X= 2863671.381

Y= 91708.9

Z= 1491.946

masl

Project no: 0379-04P  
Project name: Stukgrond  
Date drilled: 20040602  
Date profiled: 20040604

Client: M & T Development  
Drill contractor: Hennie Erwee  
Driller: Jacob  
BH NO: BH7401 (50)

Penetr rate	Penetration rate					Formation					Air loss	DEPTH m	Symbol	Chip size mm	DESCRIPTION	
	min:s/m					CAV	V SFT	SFT	FAIR H	SOLID						
0.26	1	2	3	4	5		1.0					NONE	1			Blue grey sandy silt with blue moderately to highly weathered, angular shale; residual shale. 70% Silt 30% shale.
0.27							1.0					NONE	2			
0.28							1.0					NONE	3			
0.42							1.0					NONE	4	Δ Δ Δ Δ Δ		
1.35						0.1	0.9					NONE	5	Δ Δ Δ Δ Δ		
2.02								0.2	0.8			NONE	6	Δ Δ Δ Δ Δ		
1.37								0.9	0.1			NONE	7	Δ Δ Δ Δ Δ		
0.29							1.0					NONE	8	Δ Δ Δ Δ Δ		
0.28							1.0					NONE	9	Δ Δ Δ Δ Δ		
0.39							1.0					NONE	10	Δ Δ Δ Δ Δ		
0.26							1.0					NONE	11	Δ Δ Δ Δ Δ		
0.26							1.0					NONE	12	Δ Δ Δ Δ Δ		
0.28							1.0					NONE	13	Δ Δ Δ Δ Δ	<12	
0.30							1.0					NONE	14	/+/+/+/+		
0.31							1.0					NONE	15	/+/+/+/+		
0.36							1.0					NONE	16	/+/+/+/+		
0.45							1.0					NONE	17	/+/+/+/+		
0.36							1.0					NONE	18	/+/+/+/+		
0.48							1.0					NONE	19	/+/+/+/+		
0.49							1.0					NONE	20	/+/+/+/+		
1.22						0.1	0.9					NONE	21	/+/+/+/+		
0.39							1.0					NONE	22	/+/+/+/+		
0.44							1.0					NONE	23	/+/+/+/+		
0.42							1.0					NONE	24	/+/+/+/+		
0.33							1.0					NONE	25	/+/+/+/+		
0.40							1.0					NONE	26	/+/+/+/+		
0.50							1.0					NONE	27	/+/+/+/+		
0.36							1.0					NONE	28	/+/+/+/+		
0.50							1.0					NONE	29	/+/+/+/+		
0.46							1.0					NONE	30	/+/+/+/+		

Notes:

- 1. No water was encountered
- 2. No sample and no air loss
- 3. Water was applied during drilling between 4-7m
- 4. Hammer rate was irregular between 4-5m, 7-8m, 20-21m, 35-36m and 37-38m.

Notes (continue):

X= 2863671.381

Y= 91708.9

Z= 1491.948 masl

Project no: 0379-04P  
Project name: Stukgrond  
Date drilled: 20040602  
Date profiled: 20040604

Client: M & T Development  
Drill contractor: Hennie Erwee  
Driller: Jacob  
BH NO: BH7401 (50)

Penetr rate min:s/m	Formation					Air loss	DEPTH m	Symbol	Chip size mm	DESCRIPTION
	CAV	V SFT	SFT	FAIR H	SOLID					
0.36		1.0				NONE	31	/+ /+ /+ /+		
0.41		1.0				NONE	32	/+ /+ /+ /+		
0.44		1.0				NONE	33	/+ /+ /+ /+		
0.45		1.0				NONE	34	/+ /+ /+ /+		
0.52		1.0				NONE	35	/+ /+ /+ /+		
1.01		0.4	0.6			NONE	36	/+ /+ /+ /+		Light orange yellow sandy silt with blue grey speckled white moderately to highly weathered, angular syenite, Highly weathered syenite. 70% Silt 30% syenite.
0.67		1.0				NONE	37	/+ /+ /+ /+		
1.08		0.1	0.9			NONE	38	/+ /+ /+ /+		Blue grey speckled white, moderately to slightly weathered, angular syenite with minor brown sandy silt; moderately weathered syenite, 80% Syenite 20% silt.
1.48		1.0				NONE	39	/+ /+ /+ /+		
1.18		1.0				NONE	40	/+ /+ /+ /+		
0.00						0.00	41			
0.00						0.00	42			
0.00						0.00	43			
0.00						0.00	44			
0.00						0.00	45			
0.00						0.00	46			
0.00						0.00	47			
0.00						0.00	48			
0.00						0.00	49			
0.00						0.00	50			
0.00						0.00	51			
0.00						0.00	52			
0.00						0.00	53			
0.00						0.00	54			
0.00						0.00	55			
0.00						0.00	56			
0.00						0.00	57			
0.00						0.00	58			
0.00						0.00	59			
0.00						0.00	60			

- Notes:
1. No water was encountered.
  2. No sample and no air loss.
  3. Water was applied during drilling between 4-7m
  4. Hammer rate was irregular between 4-5m, 7-8m, 20-21m, 35-36m and 37-38m.

Notes (continue):

X= 2863671.381

Y= 91708.9

Z= 1491.946 mast

Project no: 0379-04P  
Project name: Stukgrond  
Date drilled: 20040602  
Date profiled: 20040604

Client: M & T Development  
Drill contractor: Hennie Erwee  
Driller: Jacob  
BH NO: BH7401 (50)

Penetr rate	Penetration rate					Formation					Air loss	DEPTH m	Symbol	Chip size mm	DESCRIPTION
	min:s/m					CAV	V SFT	SFT	FAIR H	SOLID					
0.26	1	2	3	4	5	1.0					NONE	1	: : : : :		Blue grey sandy silt with blue moderately to highly weathered, angular shale; residual shale. 70% Silt 30% shale.
0.27						1.0					NONE	2	: : : : :		
0.28						1.0					NONE	3	: : : : :	<7	
0.42						1.0					NONE	4	Δ Δ Δ Δ Δ		
1.35						0.1	0.9				NONE	5	Δ Δ Δ Δ Δ		
2.02							0.2	0.8			NONE	6	Δ Δ Δ Δ Δ		
1.37							0.9	0.1			NONE	7	Δ Δ Δ Δ Δ		
0.29						1.0					NONE	8	Δ Δ Δ Δ Δ		
0.28						1.0					NONE	9	Δ Δ Δ Δ Δ		
0.35						1.0					NONE	10	Δ Δ Δ Δ Δ		
0.26						1.0					NONE	11	Δ Δ Δ Δ Δ		
0.26						1.0					NONE	12	Δ Δ Δ Δ Δ		
0.28						1.0					NONE	13	Δ Δ Δ Δ Δ	<12	
0.30						1.0					NONE	14	/+/+/+/+		
0.31						1.0					NONE	15	/+/+/+/+		
0.36						1.0					NONE	16	/+/+/+/+		
0.45						1.0					NONE	17	/+/+/+/+		
0.36						1.0					NONE	18	/+/+/+/+		
0.48						1.0					NONE	19	/+/+/+/+		
0.49						1.0					NONE	20	/+/+/+/+		
1.22						0.1	0.9				NONE	21	/+/+/+/+		
0.35						1.0					NONE	22	/+/+/+/+		
0.44						1.0					NONE	23	/+/+/+/+		
0.42						1.0					NONE	24	/+/+/+/+		
0.33						1.0					NONE	25	/+/+/+/+		
0.40						1.0					NONE	26	/+/+/+/+		
0.50						1.0					NONE	27	/+/+/+/+		
0.36						1.0					NONE	28	/+/+/+/+		
0.50						1.0					NONE	29	/+/+/+/+		
0.48						1.0					NONE	30	/+/+/+/+		

Notes:

1. No water was encountered
2. No sample and no air loss
3. Water was applied during drilling between 4-7m
4. Hammer rate was irregular between 4-5m, 7-8m, 20-21m, 35-36m and 37-38m

Notes (continue):

APPENDIX D

RISK CHARACTERISATION MAP

RISK CHARACTERISATION MAP





Prepared by:  
**RELLY MILNER and SHEDDEN**  
 PO Box 32107  
 GLENSTANTIA 0010  
 Tel: 012 993 2049  
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**TITLE: INHERENT RISK CHARACTERISATION**  
**LOCATION: MONAVONI EXTENSIONS 43 & 44**  
 SCALE: 1:5 000 JOB No: 09124mono4344 File No: ac\09\m4344

INHERENT RISK CHARACTERISATION (Buttrick et al 2001)

ZONE	RISK CLASS	SMALL SINKHOLE <2m	MEDIUM SINKHOLE >2m-<5m	LARGE SINKHOLE >5m-<15m	VERY LARGE SINKHOLE >15m	Risk of Doline Formation	Recommended type of development in order to maintain an acceptable Development Risk (based on draft SMS 1936 table 11)	NIBRC Dolomite Designation
+ A+	+ CLASS 1	LOW	LOW	LOW	LOW	LOW	Unrestricted residential (RNI-4; RL1-3; RH 1-3) and any commercial (CI-10) development. General precautionary measures.	D2
B	CLASS 3a	Low-Medium	Low-Medium	LOW	LOW	Low-Medium	Restricted residential (RN3-4; RL2-3; RH2-3) and any commercial (CI-10) development. General precautionary measures.	D3
C	CLASS 3b	MEDIUM	MEDIUM	LOW	LOW	Medium-High	Restricted residential (RN3-4; RL2-3; RH2-3) and any commercial (CI-10) development. Stringent precautionary measures. Risk of doline development higher than For Class 3c.	D3
D	CLASS 5	HIGH	MEDIUM	LOW	LOW	HIGH	Restricted residential (RN3-4; RH2-3) and most commercial (CI-8 & 10) development. Stringent precautionary measures. Risk of doline development is high.	D3
E	CLASS 6	HIGH	HIGH	MEDIUM	LOW	HIGH	Restricted commercial (C2, 4, 5, 7 & 9) development with stringent precautionary measures. No residential development unless additional exploratory work confirms suitability.	D4

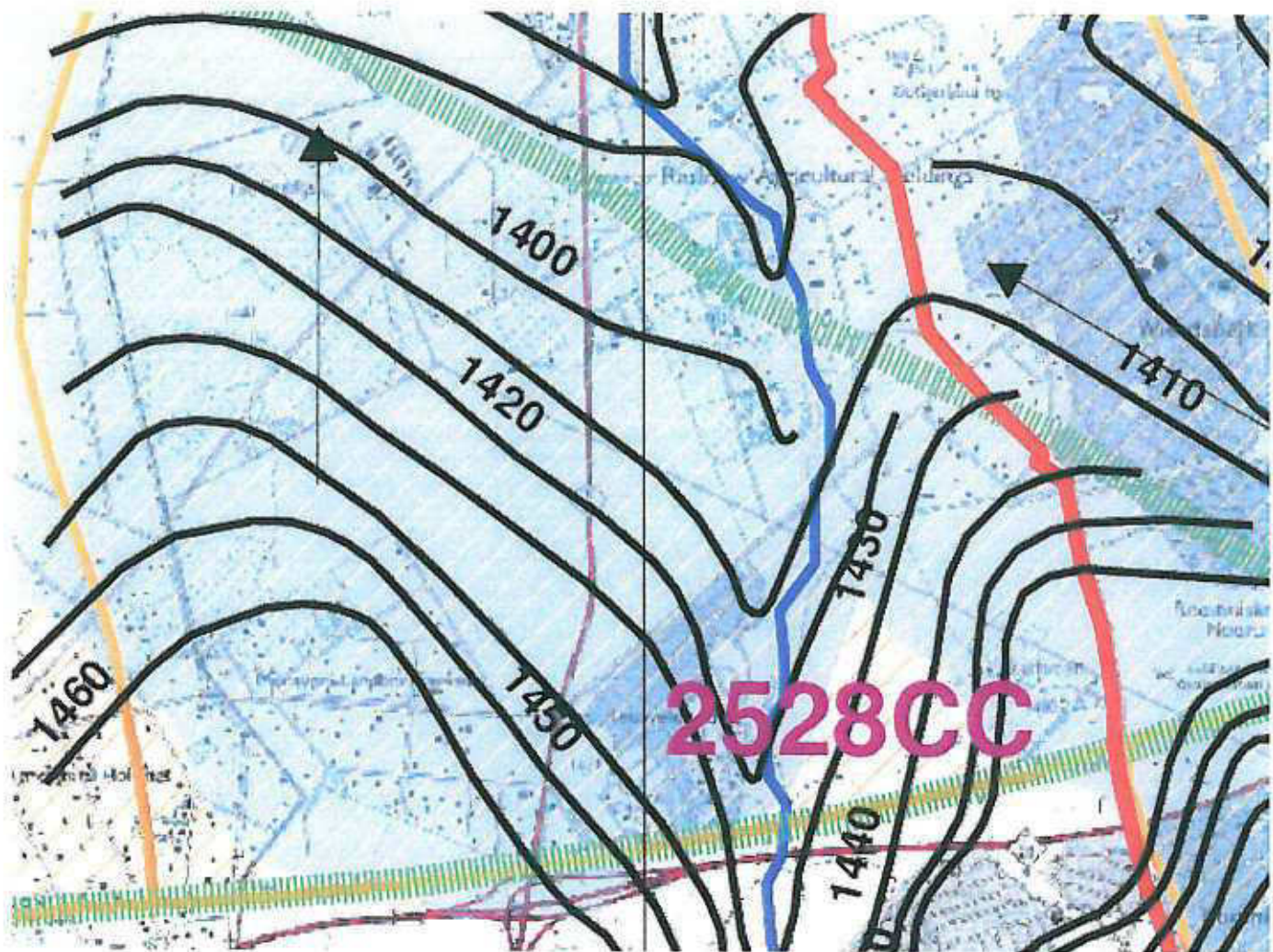
**LEGEND**

- 5-15 Dolomite bedrock intersected between 5m and 15m below the surface (fractured in places).
  - 19/146 Percussion borehole position and number (RMS 2009)
  - 6521(39) Percussion borehole position and number (VGI 2006)
- 1-22 Syenite intersected between 1m and 22m below the surface (residual syenite and/or bedrock).
  - 6521(39) Percussion borehole position and number (Dol Tech 2004)
- 2-10 Waddy soil intersected between 2m and 10m below the surface.
  - Black Reef Formation or granite at dep.

**APPENDIX E**

**HYDROLOGICAL MAP and REPORT**





Monavoni Extensions 43 & 44

Ground water level contour map and flow direction

[Excerpt from DWAF report No: GH3502 by P Hobbs]

[NOT TO SCALE]

# hobbs consulting

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November 2004

Dolomite Technology (Pty) Ltd  
P.O. Box 15147  
LYTTELTON  
0140

**Attention** Mr Emiel Kok

## COMMENT ON THE GROUNDWATER ENVIRONMENT IN THE VICINITY OF THE FARMS STUKGROND 382 JR AND BRAKFORTEIN 399 JR, GAUTENG PROVINCE

### 1. INTRODUCTION

Hobbs Consulting was approached by Dolomite Technology (Pty) Ltd to provide comment on the groundwater environment in the vicinity of the original topocadastral farms Stukgrond 382JR and Brakfontein 399JR within the jurisdiction of the Tshwane Metropolitan Council, Gauteng Province. The area, currently characterised by uncultivated farm land bordering on the Monavoni small holdings located to the south, is earmarked for residential development. As a consequence of its location in a dolomitic environment, the need to assess the geohydrology of the area is obviated. The subject area encompasses some ?? ha, and occupies an elevation of between 1420 and 1480 m above sea level on a north-northeasterly slope (Figure 1).

### 2. APPROACH and METHODOLOGY

This comment has obtained relevant geological and geohydrological information from a variety of available sources including the following:

- The published geological map 2528CC Lyttelton at scale 1:50 000.
- The published hydrogeological map 2526 Johannesburg at scale 1:500 000.
- Various published and unpublished geoscientific reports as referenced.
- The National Groundwater Data Base managed and maintained by the Department of Water Affairs and Forestry (DWA).
- Site-specific exploration borehole information sourced from geotechnical studies as provided by Dolomite Technology.

The site-specific exploration borehole information provided first-hand knowledge of the ambient groundwater environment. This information was evaluated with information obtained from the other sources to build a conceptual model of groundwater occurrence, movement and temporal (time-related) groundwater level fluctuations in the study area.





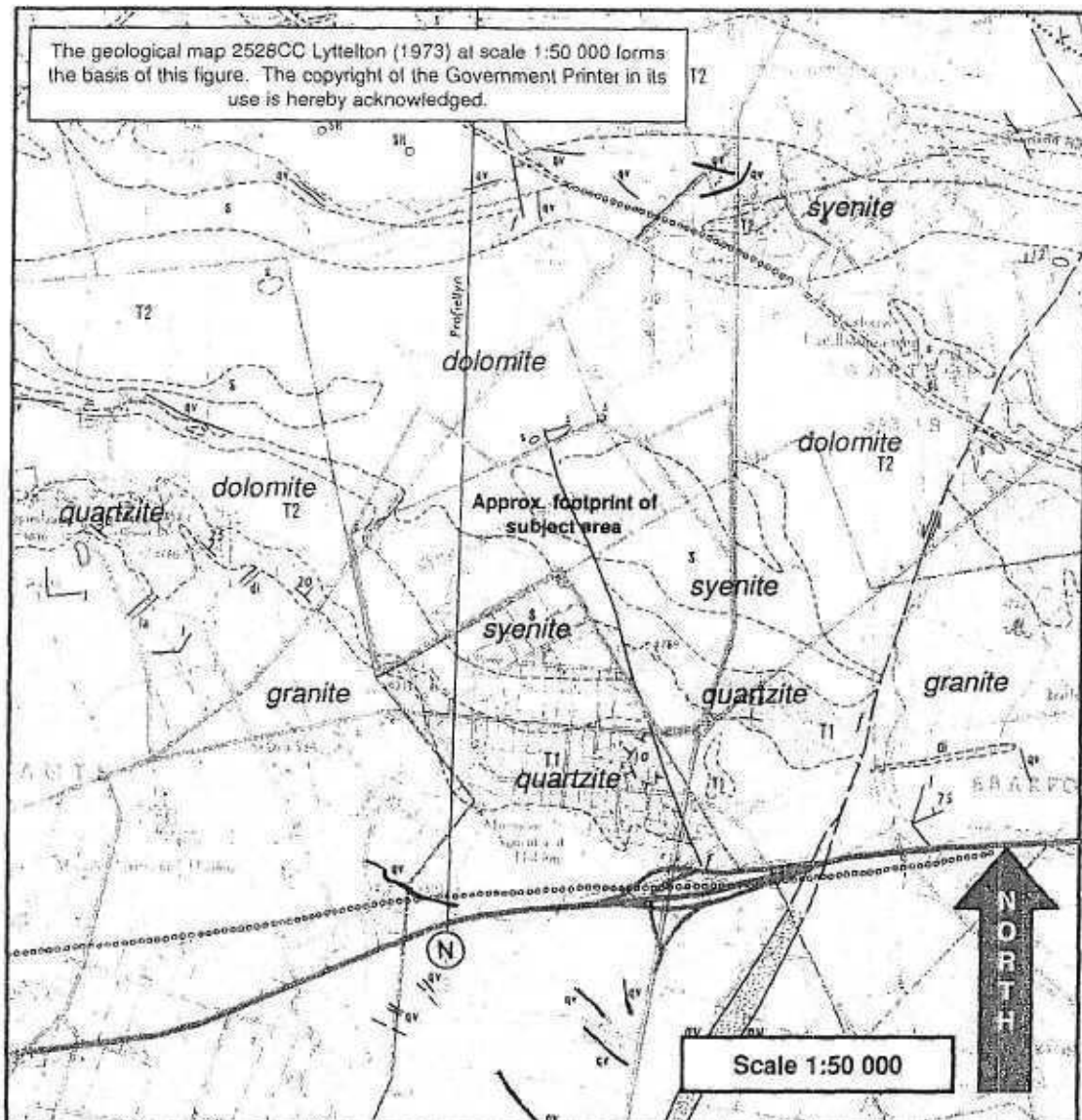


Figure 2. Geological setting of the subject area.

### 3.2 Geohydrology

The area lies within quaternary catchment A21B of the Crocodile (West) and Marico Water Management Area (WMA). This catchment is drained by the Hennops River and its tributaries to Hartbeespoort Dam. The site itself occurs within groundwater region 10, the Karst Belt region, defined by Vegter (2001) as encompassing the Vaalian strata comprising Chuniespoort dolomite and chert and subordinate Black Reef quartzite, conglomerate and shale.

The existence of high-yielding boreholes in the region testifies to the extraordinary yield potential and general availability of dolomitic groundwater resources in the region. The hydrogeological map 2526 Johannesburg (scale 1:500 000) indicates that the dolomitic strata support a median borehole yield (excluding dry boreholes) in the range >5 L/s.

## 4. DESCRIPTION OF THE GROUNDWATER ENVIRONMENT

### 4.1 Groundwater Occurrence and Yield

The subject area is shown in Figure 3 to be located in the Erasmia compartment as identified by Hobbs (2004). This compartment is formed by roughly north-south trending groundwater divides of which that forming the western boundary is shown in Figure 3. The divide forming the eastern boundary is located outside the map area.

It might be expected that groundwater occurrence within the geo-environment described in section 3 will be associated with both dolomitic and intrusive (syenite) strata, i.e. groundwater is likely to be encountered in either or both of these formations. Under circumstances where these formations are likely to be characterised by different geohydrological parameters such as hydrostatic head, yield and water chemistry, it is difficult to associate measurements of these parameters with a specific formation in those instances where a borehole intersecting both also encounters groundwater in each. In other words, such boreholes represent a mixed hydrostatic head and groundwater composition that is not uniquely representative of either of the aquifers intersected. Nevertheless, information presented by Hobbs (1988) indicates borehole yields in the order of 0.8 to 1.3 L/s for dolomite, and 0.1 to 0.6 L/s for syenite (Table 1).

### 4.2 Rest Water Level Depth

The DWAF regional investigation by Hobbs (1988) returned the information presented in Table 1 for the area of interest to this study. The approximate positions of the listed boreholes are shown in Figure 3.

**Table 1. Relevant regional groundwater information (after Hobbs, 1988).**

BOREHOLE ID	SURFACE ELEVATION (masl)	DEPTH TO REST WATER LEVEL (mbs)	REST WATER LEVEL ELEVATION (masl)	YIELD (L/s)	DATE	SURFACE GEOLOGY
33	1416	13.5	1402.5		01/1987	dolomite
34	1397	6.9	1390.1		01/1987	syenite
35	1425	21.9	1403.1		01/1987	dolomite
36	1420	1.6	1398.4		01/1987	dolomite
37	1427	4.9	1422.1	0.8	01/1987	dolomite
38	1420	5.4	1414.6	1.3	07/1986	dolomite
41	1468	22.2	1445.8		01/1987	granite
42	1415	14.8	1400.2		01/1987	dolomite
43	1480	26.9	1453.1	0.1	07/1986	syenite
44	1510	23.5	1486.6	0.6	01/1987	quartzite
61	1440	16.8	1423.2		07/1986	dolomite
62	1470	24.3	1445.7		07/1986	dolomite
72	1472	10.0	1462.0		01/1987	granite
73	1484	21.9	1462.2		01/1987	granite
74	1468	12.3	1455.7		01/1987	granite

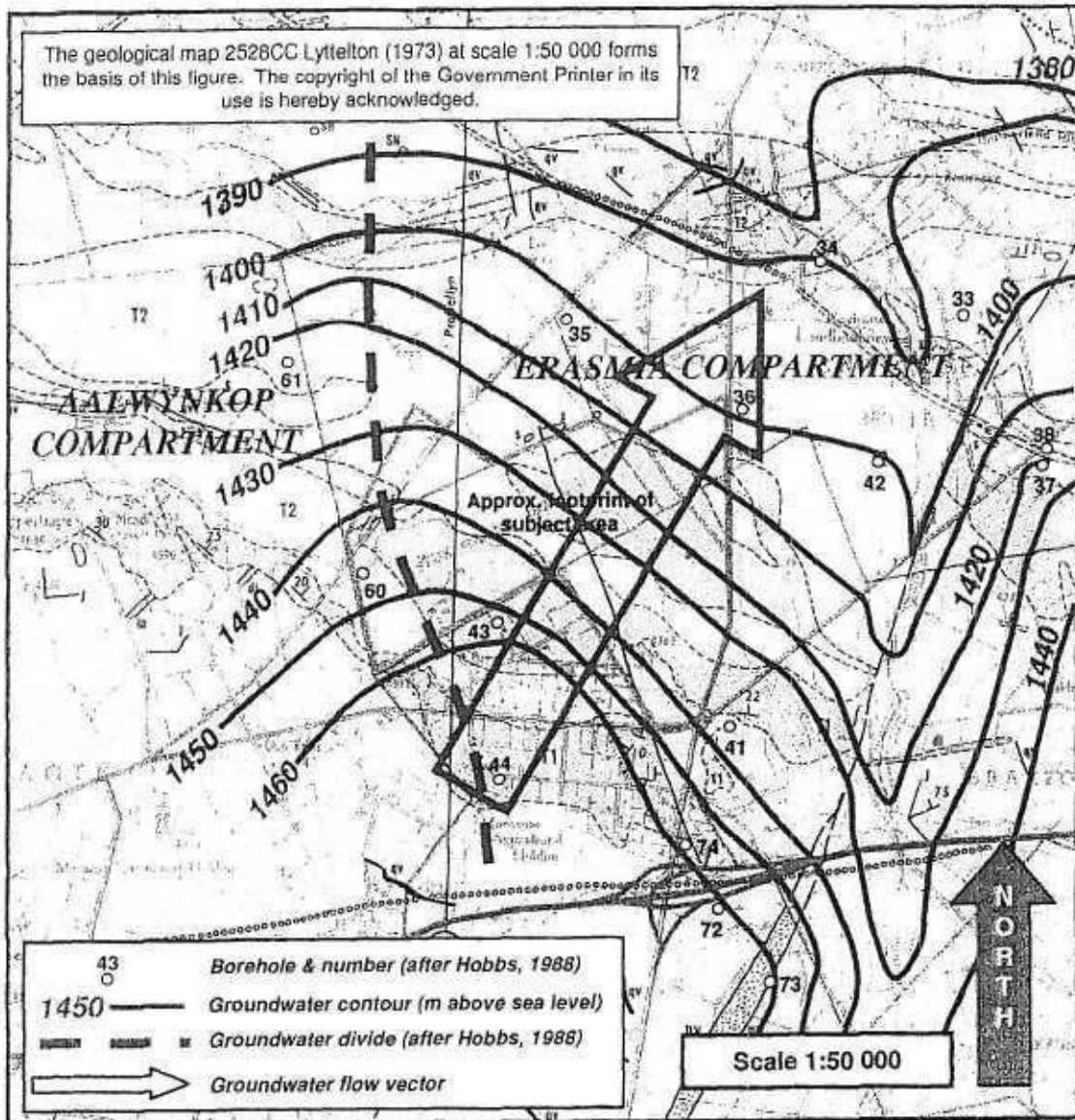


Figure 3. Hydrogeological map of the subject area.

#### 4.3 Groundwater Flow Pattern

The groundwater flow pattern in the subject area is shown by the vector in Figure 3. This indicates that groundwater drainage locally occurs from southwest to northeast, i.e. out of the granitic environment into the dolomitic system. It is also evident, however, that the western margin of the subject area coincides with the groundwater divide that forms the western boundary of the Erasmia compartment. Hobbs (1988) has shown that the regional groundwater flow pattern is centred on the Hennops River. Under these circumstances, the Erasmia compartment drains in a westerly direction, its "decant" position coinciding with the course of the Hennops River.

The groundwater contours across the subject area (Figure 3) describe a hydraulic gradient in the order of 0.020 (1:50). This is slightly shallower than, but similar to, the surface gradient of 0.024 (1:42).

#### 4.4 Water Level Fluctuation

An indication of the possible magnitude of groundwater level fluctuation in the region must be inferred from DWAF monitoring data. The latter are sourced from monitoring boreholes, and the closer such borehole is to the subject area, the more representative its record will be. The nearest DWAF exploration borehole to the subject area is G37842 located in the Zwartkop Nature Reserve close to the intersection of the Hennops River and the R55 road. The position of this borehole has been documented in a number of similar reports to this, e.g. Hobbs (2003 & 2004b).

Borehole G37842 was visited on 30 August 2003 when it was found to be infested by bees, rendering access for water level purposes impossible. Nevertheless, the record for monitoring station G37842 is reproduced, together with the coincident rainfall record, in Figure 4. The rainfall record is associated with the Wierda Park gauging station no. 0513232 8. The water level record indicates a difference of 4.52m between the shallowest (-7.35 m) and deepest (-11.87 m) values in the period June 1986 to July 1996. It also indicates a remarkable constancy of water level in the period June 1986 to January 1993.

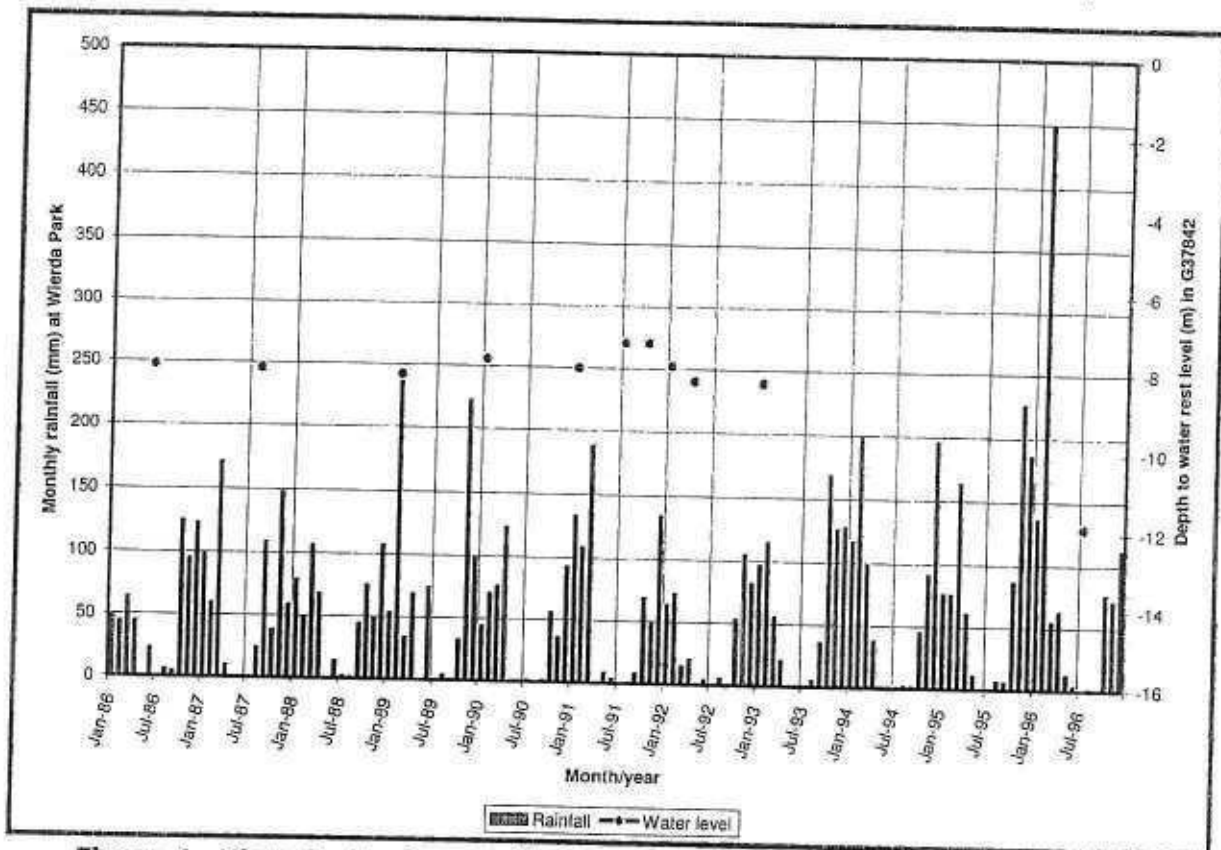


Figure 4. Historical hydrograph of DWAF monitoring borehole G37842.

Although the irregularity of water level measurements militates against a rigorous correlation with the monthly rainfall pattern, it would appear that the rainfall in the period January 1986 to January 1993 did not exhibit any major deviations, i.e. excessively wet or dry periods. The average annual rainfall in this period amounted to 623 mm, which is some 85 mm below the long term average value of 708 mm recorded in the period January 1974 to December 2001.



It is also evident that the greater water level depth measured in July 1996 followed an exceptionally wet summer. These circumstances are anomalous in that the opposite response in water level might be expected. As a consequence, not too much significance is afforded this value under circumstances where researching the reason for this anomalous response is beyond the scope of this report.

An additional indication of the magnitude of groundwater rest level fluctuation in the Erasmia compartment is provided by Hobbs (2004a). From a comparison of *circa* 1972 groundwater rest level data reported by Temperley (1978) with 1986 data reported by Hobbs (1988), it is apparent that no change in this parameter was recorded in this 16-year period for three localities to the north-northeast of the subject area.

Within the framework of these discussions, it is considered reasonable to conclude that the natural groundwater level fluctuation in the Erasmia compartment and, therefore, in the vicinity of subject area, did not experience a vertical variation of greater than about 5 m in the 24-year period from 1972 to 1996. Further, it is reasonable to presume that the subsequent period to the present has not witnessed a markedly different response pattern.

#### **4.5 Groundwater Use**

A survey of groundwater use in the subject and surrounding area was not within the brief of this report. Nevertheless, groundwater use in the subject area and surrounds is probably limited to domestic water supply, garden irrigation and limited stock watering applications associated with land use activities that are characteristic of small holdings. The conversion of the subject area from agricultural farm land to residential land use will no doubt mitigate even these small scale water uses.

### **5. CONCLUSION**

It is concluded that the dolomitic groundwater rest level in the vicinity of the site has not experienced a natural fluctuation of more than 8 m in the past two decades. These circumstances can be expected to continue for as long as no "new" large scale groundwater abstraction (e.g. for irrigation purposes) is developed in proximity to the subject area.

### **6. RECOMMENDATION**

It is recommended that the routine evaluation of groundwater level monitoring data collected by the DWAF in the subject area should form part of the **risk management plan** that is implemented for the envisaged residential development. Since the DWAF does not routinely evaluate these data, it will be necessary to source this service from a reputable and experienced groundwater scientist. The principal focus in this regard should be directed at borehole G37813. As a consequence, the developers must take every precaution to secure the continued existence of this DWAF monitoring station.

### **7. REFERENCES**

**Hobbs, P.J., 1988.** *Hydrogeology of the Verwoerdburg Dolomite Aquifer.* Rep. No. Gh3502. Directorate Geohydrology. Department of Water Affairs & Forestry. Pretoria.



**Hobbs, P.J., 2003.** *Assessment of Groundwater Levels in the vicinity of the proposed Eldo Meadows Residential Development, Eldoraigne X53, Zwartkop 356 JR, Centurion.* Hobbs Consulting for Porta Property Development (Jhb) (Pty) Ltd, Helderkruijn.

**Hobbs, P.J., 2004a.** *Intermediate Groundwater Reserve Determination for Quaternary Catchments A21A and A21B.* Project No. 2002-316. Department of Water Affairs & Forestry. Pretoria.

**Hobbs, P.J., 2004b.** *Assessment of the Groundwater Environment in the vicinity of Portion 169 of the farm Zwartkop 356 JR, Centurion, Gauteng Province.* Hobbs Consulting for RGM Properties cc, Laudium.

**Vegter, J.R., 2001.** *Groundwater Development in South Africa and an Introduction to the Hydrogeology of Groundwater Regions.* Rep. No. TT134/00. Water Research Commission. Pretoria.

**PJ Hobbs** (Pr.Sci.Nat.)  
**GROUNDWATER SCIENTIST**

**ANNEXURE A**  
**SITE-SPECIFIC GROUNDWATER REST LEVEL DATA**

BOREHOLE ID [after Dolomite Technology drawing no. 0020-03(C)]	DEPTH TO GROUNDWATER REST LEVEL (m below surface)	LITHOLOGY INTERSECTED	
		Dolomite	Syenite
6319	25	Y	N
6107	4	N	Y
4902	9	Y	N
4611	17	Y	Y
5016	10	N	Y
4719	6.1	Y	N
4923	5	Y	N
60	9	Y	Y
4931	5	Y	N
4837	4	Y	N
105G60	6.1	Y	N
3538	10	Y	N
3631	10	Y	Y
3916	25	Y	N
1631	16	Y	N
3805	11	N	Y
2603	46	Y	Y
2005	26.1	Y	N
2610	43	N	Y
2611	44	N	Y
80G26	6.1	Y	N
2828	27	N	Y
23	18.6	Y	N
2140	4	Y	N
2334	8	Y	N
1631	16	Y	N
1236	8	Y	N
634	6	Y	N
1423	16	Y	Y
823	36	N	Y
328	12	Y	Y
219	22	N	Y
C207	18	Y	N
C316	13	Y	N
Minimum	4		
Mean	15.9		
Median	11.5		
Maximum	46		

Note: Borehole ID numbers as per Dolomite Technology drawing no. 0020-03(C).

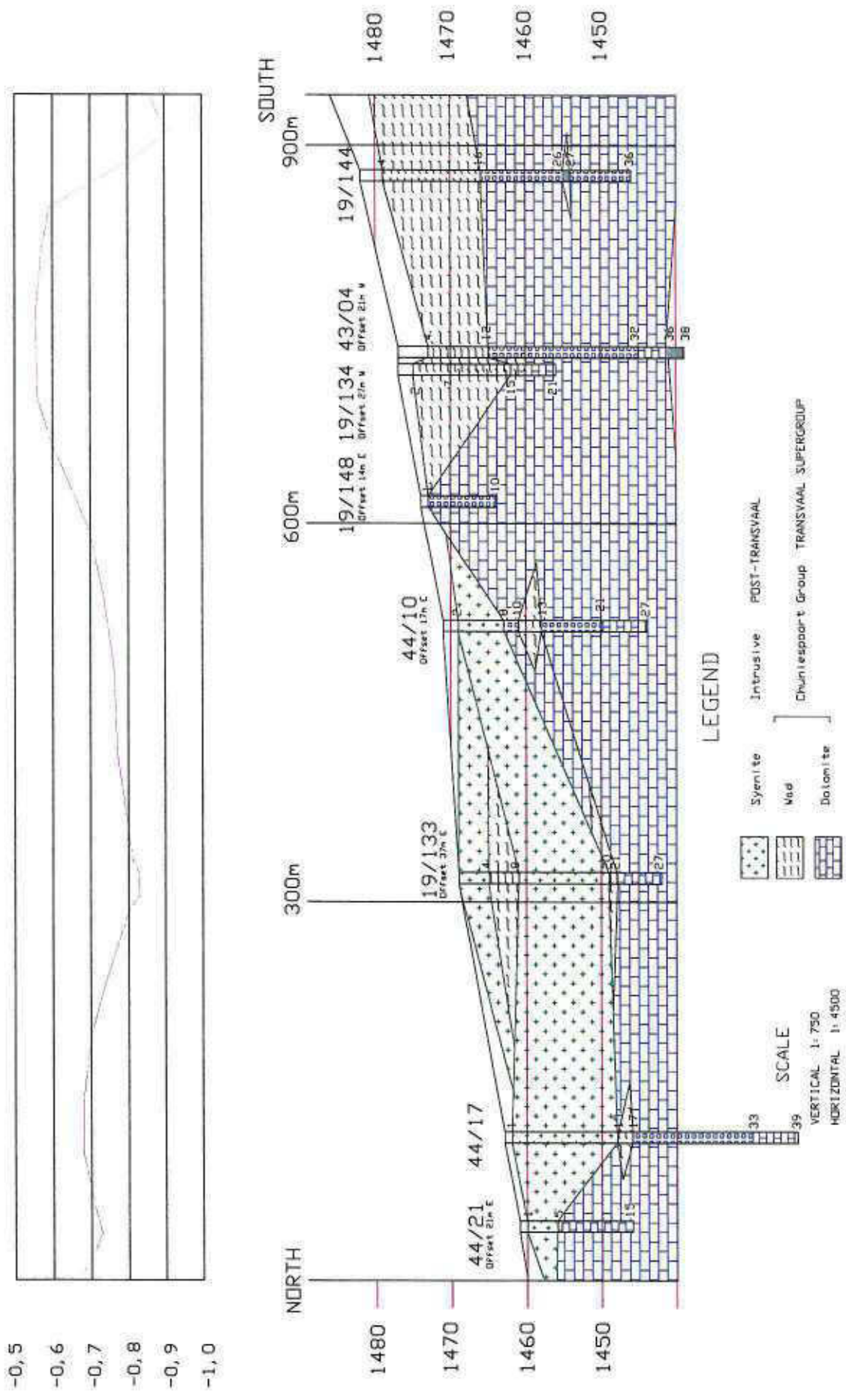
## APPENDIX F

1

### IDEALISED CROSS-SECTIONS

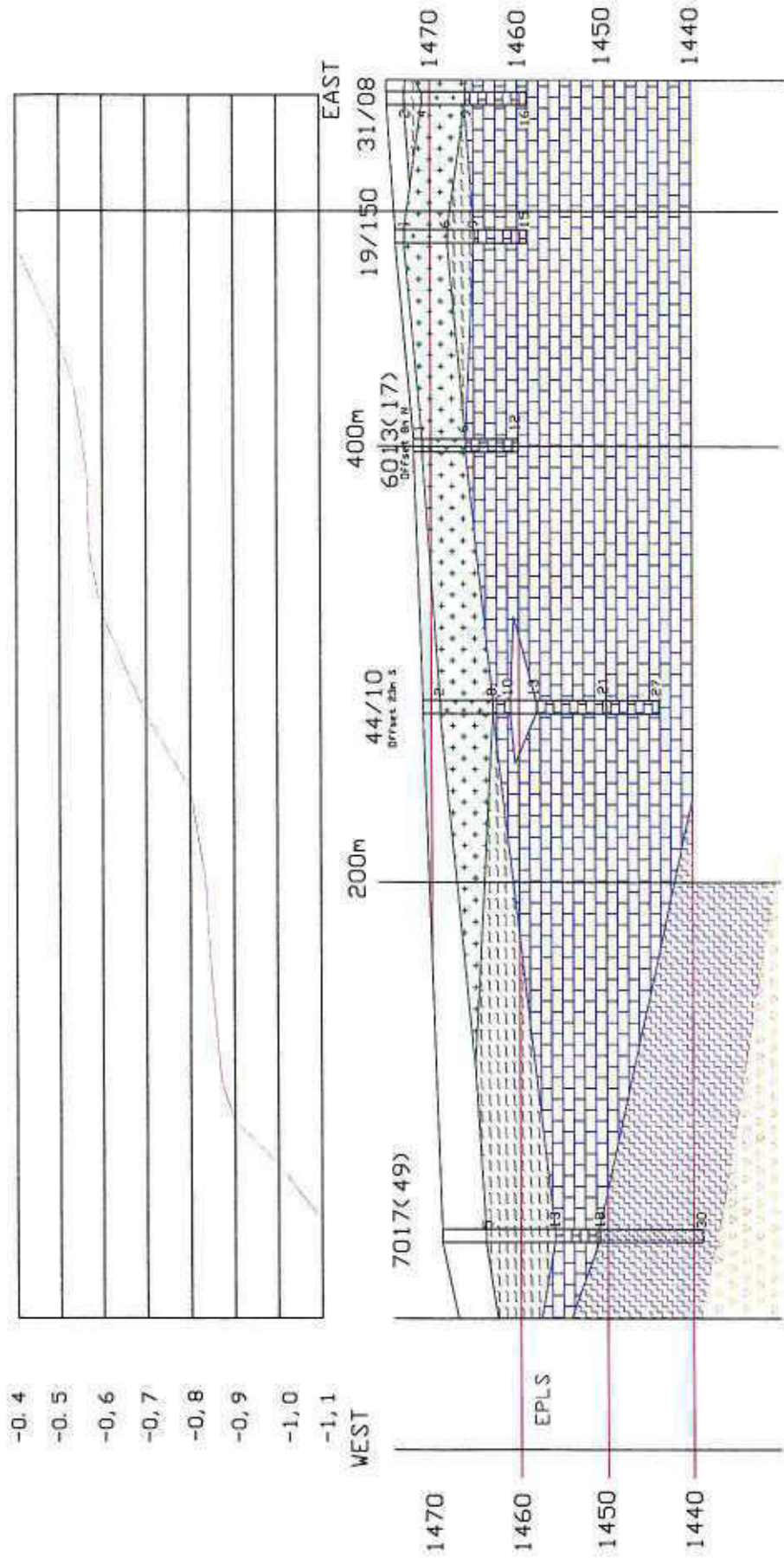
# IDEALISED CROSS-SECTION MONAVONI EXTENSIONS 43 & 44

A' A



# IDEALISED CROSS-SECTION MONAVONI EXTENSIONS 43 & 44

B' End of  
Ext 44



## LEGEND

- Syenite
- Vad
- Dolomite
- Quartzite
- Granite
- Intrusive
- POST-TRANSVAAL
- Chuniespoort Group
- TRANSVAAL SUPERGROUP
- Black Reef Formation
- TRANSVAAL SUPERGROUP
- BASEMENT GRANITE

## SCALE

VERTICAL 1:750  
HORIZONTAL 1:3000

EPLS=Electrical power line servitude



APPENDIX G

PRECAUTIONARY MEASURES

## GENERAL PRECAUTIONARY MEASURES

General measures to be implemented on all dolomitic sites (minimum requirements - NHBRC Standards)

### 1. Wet services of entire development and individual stands

- a. All wet services should be of good quality in order to ensure low maintenance.
- b. Piping materials selected should also be appropriate to local subsurface conditions. If clay pipes are utilized in areas of shallow dolomite, a higher standard of pipe bedding is recommended e.g. stabilized bedding or over-excavation and re-compaction with an approved material (minimum specification to be G7 material) in layers of 150 mm thickness, compacted to 93% mod AASHTO. Some soils may have low pH values, which will render the use of ferrous material for underground services unsuitable. Chapter II in 'A Technical Guide to Good House Construction' NBRI of the CSIR (July 1984) should be consulted concerning the potential corrosion of pipes.
- c. The NHBRC<sup>1</sup> makes the following recommendations: Water piping materials shall be one or more of the following:
  - \* High impact PVC pipes with vitualic joints.
  - \* Other flexible (as defined in SABS 0102, Part 1) water pipes with flexible, self anchoring connections.  
Pipes having a diameter of less than 75 mm.
  - \* HDPE type IV.
  - \* Polypropylene.  
Pipes should be flexible, while joints should be minimised.
- d. Water pipes entering buildings should either be fitted with flexible couplings or kinked with a Z to allow opportunity for relative movement. A flexible connection at the junction with all outlet pipes should be used, which includes WC pan connections.
- e. Pressure release systems tend to leak after a couple of years. This leaking water must flow directly into the storm- or sewerage water system.
- f. Water reticulation to houses should be kept at a minimum depth of 500 mm up to the structure and above ground wherever possible along the structure.
- g. As many services as possible should be placed within a single trench.
- h. Encasement of pipes in concrete or soilcrete should be avoided. Preferably place pipes in sleeves. If this cannot be achieved, care must be taken to ensure that differential movement can still be accommodated without the pipe breaking.
- i. All storm water, sewerage and water pipes and channels must be watertight. All laid wet services should be tested for leakage on installation using the air test (see NBRI Info Sheet X/BOU 2-34) for water pipes, and the water test for sewerage pipes.

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<sup>1</sup> National Home Builders Registration Council

- j. Placement of wet services below the footprint of structures must be avoided. No plumbing and drainage pipes should be placed under floor slabs, as far as practicable. Where this situation is unavoidable, reasons must be cited and the pipes must be placed in a sleeve to permit monitoring.
- k. Where practical, pipes running parallel to structures should be kept at a distance of at least 5 m from the structure.
- l. Each stand should have a rodding-eye or some similar access to the sewer connection in addition to the inspection eye.
- m. Each stand/unit should have a water meter at a suitable location so that testing of the stand/unit specific water supply is possible. Water leakage testing must be undertaken regularly, as set out in the risk management system.
- n. The roots of trees planted in close proximity to the line of water-bearing services often cause leaks in or malfunctioning of the services. Care should therefore be taken to avoid the unfortunate positioning of trees and other plants.
- o. Residents should be informed of where services traverse their garden so that accidental puncturing of pipes can be avoided.

## 2. Entire development

- a. The design of wet services should be governed by the need to create low maintenance systems. Wherever possible keep services above ground to facilitate detection of leaks, maintenance and repair.
- b. The stability of the centre-line of all bulk water services should be considered.
- c. Piping used in mains and communication pipes should be flexible, while joints should be minimised and, where required, self anchoring type (i.e. not reliant on thrust blocks for their anchorage at fittings, except at valves and end caps).
- d. The relevant provision of SABS 1200 DB, L, LB, LC, LD and LE shall be observed in the installation of all underground services.
- e. Water mains shall be laid only in road reserves.
- f. Provision for future connections shall be made in order to minimise the cutting into pipes to provide such connections.
- g. Water pipe entries into the building shall be in accordance with those of the JSD's code of practice <sup>2</sup>.
- h. The use of pre-manufactured, unjointed manholes are preferred. The manhole should be placed on a properly prepared foundation.
- i. Use flexible couplings on either side of manholes.
- j. Water-borne sewerage reticulation must be installed. French drains are unacceptable.
- k. A detailed sanitation and water reticulation plan should be drawn up for the development

---

<sup>2</sup> JSD Code of Practice reference

according to the local geological setting and engineering geological characteristics. The plan must be incorporated into the services management system of the local authority.

### 3. Storm water drainage

- a. No accumulation of surface water is to be permitted and the entire development must be properly drained.
- b. A minimum gradient of 1:150 should be maintained along storm-water systems.
- c. Brick and pre-cast concrete walls must be so designed as to provide drainage ports at ground level permitting passage of maximum probable volumes of water.
- d. When courtyards are designed the free flow of surface water should be ensured. Where gutter downpipes are to be found in such a courtyard, a lined canal should permit passage of water into a drain or onto the lawn away from the structure. The courtyard should preferably be paved and no garden beds should be created at gutter discharge points. Lawns must be graded in such a way to facilitate drainage.
- e. In order to deal with rainwater run-off from the roofs of structures the following is recommended:
  - Down-pipes should discharge into a lined or pre-cast furrow. This furrow should remove the water from the structure. The storm water should be trained, without ponding, off the property and into the municipal storm water system.
  - If no guttering is to be utilized (not recommended), then a sealed surface with a width of 1,5m should be cast along those walls of the structure where water will be discharged from the roof. Roof water will cascade off this sloping roof onto the apron into a lined or pre-cast furrow. The storm water should be drained, without ponding, off the property and into the municipal storm water system.
  - The ground immediately against the buildings shall be shaped to fall in excess of 75 mm over the first 1,5 m beyond the perimeter of the building, from where it shall drain freely away from housing units. Apron slabs, where provided, shall have the same fall.
- f. All ponds, watercourses and road surfaces shall be rendered impervious.
- g. No trees shall be planted within 1,5 times their eventual height from the line of storm water services.
- h. The storm water drainage system shall incorporate measures to ensure water tightness of conduits and other compartments. Whenever possible, storm water should be channeled in lined, surface canals.
- i. Concrete non-pressure pipes should be of the spigot and socket type with rubber ring seals. Joints in box culverts, channels etc should be sealed.
- j. Storm water drainage conduits shall be constructed at gradients that will not permit the deposition of silt, or sand, of the type present in the catchment area

#### 4. Trenching

- a. Trenches and excavation works should be opened and closed as rapidly as possible. Avoid leaving trenches open over weekends or holidays. All trenches and excavation works must be properly backfilled and compacted according to specifications given in subclause 5.2.4 of SABS 1200 DA, but specifically to ground surface to prevent them acting as French drains. Once services/cables are installed and backfilling is completed, it must be ensured that ground surface is graded to match the slope of the surrounding area. No rocks in the top layer.
- b. Berms should be constructed on the up-slope side of trenches to prevent the inflow of water during storms.
- c. The fall of trenches shall be away from buildings. Wherever practical, service trenches shall not be excavated along the length of housing units within the first 3 m beyond the perimeter of such units.
- d. No ponding of surface water is to be permitted over, in, or in the vicinity of trenches and excavations.

#### 5. Roads

- a. Ensure that roadways are in fact placed below the site level so as to facilitate drainage. If the road network is the sole storm water system, in a township, care must be taken that the roads are surfaced.
- b. Ponding of surface water on or next to roads that are not tarred should be avoided.
- c. Roadways which have a gradient of less than 1:80 shall be surfaced/sealed.
- d. The velocity of the 1 in 20 year storm water, flowing along unsurfaced roadways shall not exceed 1,5 m/s.

#### 6. Swimming pools

The following minimum requirements must exist:

##### *Construction:*

- a. The design, construction and use of the swimming pool should at all times be to the satisfaction of the local city engineer, who should be aware of the requirements of swimming pools in dolomitic areas.
- b. The swimming pool must be designed as an *independent unit, which will not give way or distort*. The sides or floor of the pool should not crack in the event of any ground movement underneath or nearby the swimming pool.



- c. The swimming pool may be constructed from concrete, metal or any other suitable material on condition that the design conforms to condition (7a) above.
- d. All water pipes, pumps and connections should be installed either in the open, on the surface, or in service canals where these may be inspected or repaired without access problems.
- e. The swimming pool should be built so as to prevent any rain water flowing into or towards the pool.

*Maintenance and responsibilities*

- f. All back wash water must be discharged *directly* into the main storm water line.
- g. Any abnormal loss of water from the pool as well as any noticeable ground movement (cracks forming in the ground or in the pool) must be reported by the stand owner to the Home Owners Association or Body Corporate and the local council.
- h. It is important to note that the responsibility of checking pipes to and from the pool, the handling of run-off water from the pool as well as the repairing of cracks in the pool and replacing of leaking pipes lies solely with the stand owner. Negligence could result in instability.

**APPENDIX H**

EXAMPLE OF DOLOMITE RISK MANAGMENT PLAN

**GENERALISED DOLOMITE RISK MANAGEMENT PLAN FOR MONAVONI EXTENSIONS 43 and 44,  
CENTURION (TSHWANE METRO), GAUTENG.**

**1 INTRODUCTION**

Urban development is generally expected to have a negative impact on the metastable conditions prevalent in a karst (dolomitic) environment. Consequently the appropriate design of the development is of importance in ensuring long-term safety and stability. The dolomite stability investigation assists in the appropriate selection of water precautionary measures through the risk characterization of the site. Although appropriate design and the implementation of precautionary measures form the cornerstones of a sustainable development, it is vitally important that the concepts laid out in the water precautionary measures should form part of a risk management system. Such a system should incorporate steps to mitigate risk before, during and after construction.

The results of the investigation enable the consultant to recommend suitable design concepts and the most appropriate water precautionary measures for the development. The consultant must advise the developer on the implementation of water precautionary measures prior to the commencement of construction. Such measures must include the handling of storm water during construction. It is not appropriate for an entire suite of general precautionary measures to be selected, trusting that the developer and engineer will know to implement those measures which are most suitable and eliminate any that are not locally applicable.

The consultant will then also be in a position to design an appropriate risk management plan. It is thus important that the recommendations made by the consultant receive sufficient attention. This plan should, at least, consist of the following: precautionary and remedial measures, monitoring (of structures and infrastructure, as well as ground surface), maintenance, the identification of unacceptable practices, vigilance, emergency procedures and rehabilitation, the assimilation of data (into a databank), continual reassessment and associated responsibilities and governance.

## 2 MANAGEMENT AT TOWNSHIP LEVEL

During construction it is the responsibility of the developer to ensure that a risk management plan is designed and implemented. Once the development is complete, it becomes the responsibility of that owner (Owners' Association [HOA] or other appointed body [OAB]). For this reason it is very important that a risk management plan exists and has been implemented so that the owners/tenants will be in the position to take over meaningful responsibility. The owner must know if there was any ground movement or suggestions of instability observed during the construction phase. Any potential problem areas identified at the development phase must be highlighted to the HOA/OAB management.

### 2.1 Precautionary measures

All precautionary measures recommended in the dolomite stability report and any additional measures recommended by the infrastructure (services) engineer during construction must form part of a document representing the foundation of the Risk Management databank.

Precautionary measures must be adhered to throughout the development. Where remedial action is recommended as a precautionary measure, this must be undertaken immediately. Remedial action implies the improvement or remedying of an existing ground condition that may, or may not, exist as a result of poor storm water management but which has not resulted as yet in sinkhole or doline formation. For example, the re-landscaping of an area to promote proper drainage, and/or the compaction of soil to render the ground less pervious may be deemed necessary.

Owners/tenants must be made aware of their responsibility in contributing to the overall stability of the development by their continued implementation of the recommended precautionary measures at individual stand/unit level.

### 2.2 Responsible Persons

Responsible individuals must be identified by the managing agent for various tasks that need to

be implemented regarding the Risk Management Plan (RMP). Responsibilities include ensuring the monitoring program takes place and information so obtained is properly recorded in the databank. Details of the responsibilities (job descriptions) must be unambiguously indicated to each individual and a record maintained of these responsibilities.

An important appointment is the individual involved in implementing emergency procedures. This person should be properly versed in the procedures to be followed if and when some form of instability occurs. Telephone numbers of various contact persons must be obtained and maintained at an accessible locality.

Services to be contact include

- i) City Emergency services.
- ii) Tshwane Engineer (Centurion division).
- iii) Engineer involved in infrastructure design.
- iv) Engineering geologist involved in stability report (if necessary).

### **2.3 Monitoring**

Certain procedures must be attended to as part of the monitoring schedule (i.e. the frequency of various tasks and the manner in which they will be undertaken). A responsible person must be assigned with the task of co-ordinating this programme.

#### *Storm Water Management Plan*

The following should be addressed:

- 1) Storm water should not pond anywhere on the property for lengthy periods.
- 2) An appointed person must appraise the surface drainage of the development immediately after a heavy downpour. Areas of surface ponding must be noted and action must be undertaken to ensure similar problems do not occur in the future. The location of the ponding, the remedial action and date thereof must be recorded and retained in the databank. This process should be undertaken at the beginning of each wet season.
- 3) Surface drainage should preferably take place in open, lined channels that discharge into the storm water canal on the eastern side of the development. Debris in the channels should be cleared before each wet season.



As a crucial part of the Risk Management System, attention must be given to the surface drainage on the entire development. All storm water run-off should drain off the land into the municipal storm water system which in turn must flow into the regional storm water system.

#### *Regional Storm Water Management Plan*

The storm water must be integrated into a Regional Storm Water Management Plan, which pertains to the area outside the boundaries of the development. This plan must form part of a Regional Risk Management Strategy (Tshwane Local Council). All concepts of the development's Risk Management Plan must be meshed with those of the Regional Risk Management Strategy.

Monitoring comprises two parts:

- i) ***Infrastructure monitoring:*** This entails the inspection of water-bearing bulk services, communal buildings, roads and public open spaces within the township.
- ii) ***Ground-surface monitoring:*** This entails the inspection of the ground-surface as it is disturbed and affected by man's activities.

Monitoring practices may differ from stability zone to stability zone within a development. Some higher risk zones may have more stringent precautionary measures imposed on them and might need to be monitored on a more frequent basis. This could be monthly, quarterly or yearly.

#### ***i) Infrastructure Monitoring***

##### *Seasonal interval basis*

- a) Visual checks for debris in open storm water channels at the start of the rainy season and after heavy storms.
- b) Visual checks for water flowing out of storm water pipes (where practical) at the start of the rainy season and after heavy storms. Observation positions should be indicated on the services plan.
- c) Examine buildings for cracks at the start of the rainy season.

##### *On a short interval basis (monthly)*

- d) Visual checks done for outside dripping taps and pressure valves (in parks and open spaces).
- e) Visual checks for damp areas.
- f) Visual checks for water flowing out of sewer manholes.
- g) Visual check for over-wetting of gardens.
- h) Visual check for blocked drainage ports in perimeter walls.

*On an intermediate interval basis (annually or less frequently as warranted)*

In many instances visual inspections may not be sufficient. It may be necessary to undertake regular air and water tests on services.

- Sewer lines should be inspected using CCTV after the first year of service and then every 4-5 years thereafter. All records of such tests must be contained in the databank.
- Water pipes with a valve where the pipe joins the building will allow testing without too much difficulty. Water meter readings taken when the valve is closed should give an indication if large leaks have developed.

## **ii) *Ground-surface Monitoring***

Ground-surface monitoring may be undertaken visually on a regular basis.

- a) Any signs of cracking either in structures or in the ground surface are indicative of some of movement. These cracks are often the precursor to more serious instability. The cause of cracking should be sought without delay. Cracks should be measured at the same place each time. A pencil line across a crack will ensure the same point is measured repeatedly. Dates and amount of movement must be recorded.
- b) Areas of unnaturally vibrant growth may be indicative of excessive moisture in the soil from leaking, buried wet services.
- c) A plan indicating the positions of the appropriate sewer inspection manholes must be available in the databank.

## **2.4 Maintenance**

An Infrastructure Maintenance Plan must take cognisance of the type of materials used in the installation of services (e.g. type piping used and trench backfill specifications). High risk zones

should receive priority for the repair of any infrastructure. It is important to establish the location of all piping. This should be superimposed on the stability zonation to permit the prioritization of maintenance programmes. It is essential that a copy of this information is always present in the HOA/OAB maintenance (manager's) office and within the databank.

Details of all maintenance tasks, such as routine replacement, repair after damage or instability, the contractor responsible etc must be recorded. These records must be lodged in the databank.

All maintenance should be done pro-actively, i.e. consider when pipes will have to be replaced/considered for replacement before instability is triggered, rather than reactively. This method should go a long way to ensuring stability. All excavated trenches should be inspected and profiled for the identification of potentially poor conditions, which may require immediate investigation.

## **2.5 Education and vigilance**

Environment awareness and understanding should be fostered among all employees. This campaign must be led by management with new employees being briefed. As part of this campaign, people should understand what impact the concentrated infiltration of surface water may have on the stability of the area. This will lead to better vigilance and the timeous reporting of problems. The correct channel of reporting any incident must be clearly understood by all employees. Any responsible person involved in emergency procedures must be readily available.

## **2.6 Emergency Reaction Plan**

A responsible person must be appointed to manage any emergency situation. The person must know, for example, where to cut off the water supply if the rupturing of piping caused, or resulted from, the instability. It must be established when evacuation of a building is justified. Funds should be set aside for these eventualities.

An emergency procedure should include the following

- i) An area within 20m surrounding the sinkhole (or doline) should be evacuated immediately.
- ii) The Tshwane Emergency services (fire services) should be contacted immediately.
- iii) The sinkhole (or doline) must be cordoned off to prevent unsuspecting people getting too close to the sinkhole.
- iv) The Engineers department of the Tshwane Metro must be informed of the sinkhole immediately.
- v) A professional team consisting of an engineering geologist, geotechnical and structural engineers must be appointed to investigate the sinkhole. This should be done as soon as possible to prevent further damage to the affected area.

## **2.6 Rehabilitation**

Rehabilitation or the repairing of damaged land may be required. These activities have the stabilization of the environment as their common goal, and should be undertaken as soon as possible to prevent further damage to the affected area. A maintenance team or a responsible person should be familiar with the practices for the rehabilitation of a sinkhole. It may be prudent to appoint a professional team to manage major rehabilitation.

## **2.7 Databank**

A databank, be it in electronic or hard copy form, is an important part of a risk management system because it allows for meaningful management even when the persons responsible for the initiation of the project, who carry intimate knowledge of the site, no longer form part of the management of the development. This databank must be the responsibility of management. A maintenance manager, if appointed, would be the ideal custodian of the information.

A databank should contain the following:

- the dolomite stability and geotechnical report
- relevant reports and correspondence from Geoscience and Local Authorities
- layout plans with location of all services (water, sewer and storm water). Valve positions must also be indicated
- the zonation map
- records of inspection and testing
- records of maintenance (detailing when, how and what was done)
- a register of damaged structures
- a record of sinkhole and doline occurrences (with rehabilitation taken)

## **2.8 Reassessment**

In order to ensure that the Risk Management Plan is functioning and fully addresses all presently known issues as well as possible future issues, reassessment of the entire Risk Management Plan on a five-yearly basis will be essential. This exercise should involve the evaluation of the present Plan in context of the requirements of the report. Notes should be made of weaknesses in the Plan as well as necessary additions, which may have become evident in the five-year period.

## **3. MANAGEMENT AT LOCAL COUNCIL LEVEL**

A local authority (Tshwane Metro) should have a Risk Management Strategy. The Strategy must give consideration to aspects such as increased run-off from additional developments, stormwater system capacity, contingency plans etc. The strategy must be flexible enough to incorporate the individual risk management plans for various developments.

Inspectors will need to be appointed to undertake the work originating from the requirements of the management system. Maintenance checks of infrastructure, the inspection of buildings, and the detection and repair/remediation of leaking services are amongst the tasks that will need to be undertaken. The inspector should put the findings on record and ensure that it is entered into a database. Inspectors should be aware or educated as to what to look for (ponding of water, cracks in the ground) so that appropriate action can be taken. Inspectors



should be aware of the procedures to be followed in the event of an emergency (in the event of sinkhole formation), and should know who to contact and when evacuation is necessary. A member or members at the local authority should be aware of the methods used in the backfilling of sinkholes. Should sinkholes develop, monitoring of any backfilled sinkholes should then be set in place.



E Shedden (Pr Sci Nat)

**RELLY MILNER AND SHEDDEN**

**OCTOBER 2009**

**APPENDIX I**

DRAFT SANS 1936-1; PART 1, TABLES 1 & 2

Table 1 --- Permissible land usage based on inherent risk class, dolomite area designations and footprint investigations

1	2	3	4	5	6	7	8	9	10
Land usage		Inherent risk class determined in accordance with the requirements of SANS 1936-2							
Designation	Description	1	2	3	4	5	6	7	8
<b>Agricultural, recreational and private and public open spaces</b>									
<b>Dolomite area designation and footprint investigation</b>									
A1	Agriculture that requires intensive irrigation excluding flood irrigation.		D2			D3			D3/D4
A2	Agriculture that requires limited irrigation Botanical gardens, sports fields driving ranges, golf courses, parkland and public open spaces.		D2			D3			D3/D4
A3	Agriculture that does not require irrigation in any form or the storage of water. Parkland and public open spaces that are not irrigated and grazing pastures.					D1/D2			
<b>Commercial and miscellaneous non-residential usages</b>									
C1	Places of detention, police stations, hospitals, hostels, hotels and institutional homes for the handicapped or aged with populations not exceeding those calculated in accordance with Regulation A21 of the National Building Regulations.			D3 + FPI					D4
C2	Railway stations, shops, wholesale stores, offices.	D2 + FPI			D3 + FPI				D4
C3	Places of worship, theatrical, indoor sports or public assembly venues, other institutional land uses, such as universities, schools, colleges, libraries, exhibition halls and museums.	D2 + FPI			D3 + FPI				D4
C4	High rise commercial developments with populations not exceeding those calculated in accordance with Regulation A21 of the National Building Regulations.	D2 + FPI			D3 + FPI				D4

Table 1 (continued)

1	2		3							
	Land usage	Description	1	2	3	4	5	6	7	8
C5	Light (dry) industrial developments, dry manufacturing, commercial uses such as warehousing, packaging, etc.		D2 + FPI				D3 + FPI			D4
C6	Fuel depots, processing plants or any other areas for the storage of liquids.		D2 + FPI/ D3 + FPI			D3 + FPI			D4	
C7	Outdoor storage facilities, stock yards, container depots, etc.		D2 + FPI			D3 + FPI				D4
C8	Waste sites, cemeteries, slimes dams, etc.		D2 + FPI	D32 + FPI in dry areas with deep groundwater levels.					D4	
C9	Parking areas		D2/D3				D3			D4
C10	Parking garages		D2/D3			D3 + FPI			D4	
<b>Low rise dwelling units</b>										
RL1	≤ 3 storeys with 80 to 120 units per hectare evenly distributed and a population not exceeding 600 people per hectare.		D2 + FPI /D3 + FPI					D4		
RL2	≤ 3 storeys with 40 to 80 units per hectare evenly distributed and a population not exceeding 400 people per hectare.		D2 + FPI /D3 + FPI			D3 + FPI			D4	
RL3	≤ 3 storeys with less than 40 units per hectare evenly distributed, and a population of ≤ 200 people per hectare.		D2 + FPI			D3 + FPI			D4	

Table 1 (concluded)

1		2		3							
Land usage		Inherent risk class determined in accordance with the requirements of SANS 1936-2									
Designation	Description	1	2	3	4	5	6	7	8		
<b>Dwelling houses</b>											
RN1	26 to 60 dwelling houses per hectare with stands larger than 150 m <sup>2</sup> , and a population of ≤ 300 people per hectare.	D2/D3	D3	D4	D4			D4			
RN2	10 to 25 dwelling houses per hectare with stands no smaller than 300 m <sup>2</sup> , and a population of ≤ 200 people per hectare.	D2/D3	D3	D4	D3			D4			
RN3	2 to 10 stands per hectare with 1 000 to 4 000 m <sup>2</sup> stands, and a population of ≤ 60 people per hectare.	D2/D3		D3		D3 + FPI/D4		D4			
RN4	Small holdings, <2 stands per hectare with stands >4 000 m <sup>2</sup> , and a population of ≤ 25 people per hectare.	D2/D3		D3		D3 + FPI/D4		D4 <sup>a</sup>			
<b>High rise dwelling units</b>											
RH1	> 3 Storeys with a population of ≤ 1 500 people per hectare.	D2 + FPI /D3 + FPI				D4					
RH2	> 3 Storeys with a coverage ratio of ≤ 0,4, no higher than 10 storeys, and a population of ≤ 800 people per hectare.	D2 + FPI /D3 + FPI		D3 + FPI (preferably with basement)		D3 + FPI/D4 (preferably with basement)		D4			
RH3	> 3 Storeys with a coverage ratio of ≤ 0,3, no higher than 10 storeys, and a population of ≤ 600 people per hectare.	D2 + FPI		D3 + FPI (preferably with basement)		D3 + FPI/D4 (preferably with basement)		D4			
FPI = a footprint investigation conducted in accordance with the requirements of SANS 1936-2.											
NOTE 1 D1, D2, D3 and D4 have the meanings assigned in table 3.											
NOTE 2 In D4 areas, establish footprint of inherent risk class 1 to 5 conditions in inherent risk class 6 to 8 areas.											
<sup>a</sup> Regulation A21 is reproduced in SANS 10400-A.											



Table 2 — Permissible infrastructure type based on inherent risk class and dolomite area designations

1		2	3	4	5	6	7	8	
Infrastructure type		Inherent risk class determined in accordance with the requirements of SANS 1936-2							
Designation	Description	1	2	3	4	5	6	7	8
<b>Dolomite area designation</b>									
11	Primary and secondary roads, railway lines, power lines.	D2	D3						
12	Bulk pipelines, including water, sewer, fuel and gas lines.	D2	D3						
13	Reservoirs and public swimming pools.	D3				D3/D4	D3/D4	D4	
14	Attenuation and retention ponds for stormwater management and artificial lakes.	D3	D3/D4			D4			
15	Dams	D3	D4						
16	Runways	D3							

Table 3 — Dolomite area designations

1	2
Dolomite area designation	Description
D1	No precautionary measures are required to support development.
D2	Only general precautionary measures that are intended to prevent the concentrated ingress of water into the ground in accordance with the requirements of SANS 1936-3, are required to support development.
D3	Precautionary measures in addition to those pertaining to the prevention of concentrated ingress of water into the ground are required to support development in accordance with the relevant requirements of SANS 1936-3.
D4	No precautionary measures can reduce the development risk to acceptable limits so as to support development, or the required precautionary measures are impractical to implement.

NOTE Dolomite area designations indicate the levels of precautionary measures required to support development. They relate to the precautionary measures required to improve the development risk associated with a parcel of land that has a particular inherent risk class to an acceptable level. In other words, they indicate what needs to be done to a parcel of land to support development.

### 4.3 Repair of sinkholes

4.3.1 Sinkholes, where they occur on land other than agricultural or undeveloped areas other than recreational areas and public accessible spaces, shall be repaired in accordance with the requirements of SANS 2001-BE4 under the direction of a competent person.

**Table 2 — Permissible infrastructure type based on inherent risk class and dolomite area designations**

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Infrastructure type		Inherent risk class determined in accordance with the requirements of SANS 1936-2							
Designation	Description	1	2	3	4	5	6	7	8
<b>Dolomite area designation</b>									
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12	Bulk pipelines, including water, sewer, fuel and gas lines.	D2	D3						
13	Reservoirs and public swimming pools.	D3				D3/ D4	D3/ D4	D4	
14	Attenuation and retention ponds for stormwater management and artificial lakes.	D3	D3/D4			D4			
15	Dams	D3	D4						
16	Runways	D3							

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**12 November 2009**

Tshwane Metropolitan Municipality  
Department Roads and Stormwater: Geology Section  
Centurion Offices  
P O Box 14013  
Lyttelton  
0140

**Attention: The Deputy Manager: Infrastructure Planning and Management**  
Hannes Claasen

*By Fax: 012 358 3361*

**The Deputy Manager Regional Spatial Planning**  
Lettie van der Berg

*By Fax: 012 358 3592*

Dear Sir / Madam,

### **PROPOSED TOWNSHIPS OF MONAVONI EXTENSIONS 43 AND 44**

The firm, Relly, Milner and Shedden Consulting Earth Scientists (RMS) submitted their report: "A dolomite stability investigation for a proposed Townships of Monavoni Extensions 43 and 44 on Portion 1 of Stukgrond 382-JR, Centurion (Tshwane Metro), Gauteng", dated October 2009, on behalf of their client M & T development, to this office for comment on 30 October 2009. This office acts as Agent to your Municipality in auditing the geoscientific work and emanating recommendations.

The purpose of this investigation was to collate existing borehole information from various phases of exploratory drilling over the past 5 years and then to assess the dolomite stability of the site.

Monavoni Extension 43 and 44 occupy a rectangular area of approximately 50ha. The Extensions are bounded by a farm portion in the north, by various holdings in the west and south and by the proposed extension to Mona Avenue in the east. The entire site is undeveloped farmland previously used for cattle grazing.

A composite residual gravity map covering the Greater Monavoni Area was used. The composite map made up of a number of separate surveys undertaken between 2004 and 2006. A total of fifty-nine rotary percussion boreholes were drilled in and immediately adjacent to Extension 43 and 44. Twenty –nine of these boreholes were drilled during the current investigation.

Groundwater strikes occurred at depths of between 25m and 35m below the surface in three of the boreholes drilled during the current investigation (BH's 43/04, 44/14, 44/17), Rest water levels were recorded at depths between 7m and 10m in 11 of the new boreholes. No groundwater strikes were recorded in the previously drilled boreholes nor were any rest water levels recorded. A report by P.Hobbs ( 2004) of the larger area states that the groundwater rest level is unlikely to experience a natural fluctuation of more then 8m, and a maximum fluctuation of about 5m has taken place over the past 25 years. Natural fluctuations of between 5 and 8m should not effect the stability of the site. The potential for significant dewatering is relatively low as the area is not intensely farmed. Dewatering is not assessed as a significant threat to the overall stability of the site.

Having reviewed the report, we submit that:

a) RMS has classified the site into 5 zones, namely:

- **Zone A: Inherent Risk Class (IRC) 1;** this zone is an elongated area in the northern half of Extension 44. Boreholes intersect residual syenite overlying syenite bedrock. Dolomite bedrock is intersected below 25m in BH 44/14. Four boreholes were terminated in solid syenite bedrock which occurs at depths of between 6m and 18m. There is no restriction on the type of development that may be considered, most types will require additional exploratory work.
- **Zone B: (IRC) 3a;** this zone occupies an elongated area immediately south of Zone A and along the eastern boundary and a small portion on the south western corner of the site. In the northern zone portion and south eastern portion, residual syenite is intersected between 6m and 15m overlying a 2m wad layer which in turn overlies dolomite bedrock. The south western corner is characterised by intrusive syenite at depth. The overburden ranges from 13m of chert rubble to shale and quartzite of the black reef formation. Commercial and restricted residential development may be considered provided the



appropriate requirements of the draft SANS 1936 document are implemented including footprint investigations.

- **Zone C: (IRC) 3b;** this zone is located in the central portion of the site and a pocket occurs in the northern section. The syenite layer encountered in these boreholes is about 2m up to 7m thick. Waddy layers occur between the syenite and dolomite bedrock. In the northern pocket no dolomite bedrock is intersected. Most types of development considered suitable for this zone will require footprint investigations for all structures.
- **Zone D: (IRC) 5;** this zone occurs along the western boundary and a small portion in the extreme north east. Boreholes intersect dolomite at shallow depths. Any development will require footprint investigations for all structures.
- **Zone E: (IRC) 6/7;** this zones comprises two elongate portions in the southern and central portion of the site. Boreholes intersect fairly thick layers of wad , dolomite bedrock is intersected below depths ranging from 6m to 17m. Significant dewatering could increase the risk of doline development as a rest level recorded in BH 43/04 indicates ground water to occur within wad-rich residual dolomite. Residential development should not be considered unless additional exploratory work, including detailed footprint investigations, confirms the presence of more favourable ground.

This Office is broadly in agreement with the risk assessment of the site. BH's 44/13 and 6521(39), however, should rather be incorporated into Zone D, IRC5.

b) RMS has recommended the following development potential for the site:

- **Zone A: Inherent Risk Class (IRC) 1;** No restrictions are placed on the types of development that may be considered on IRC 1 land provided spatial framework requirements are met. NHBRC D2.
- **Zone B: (IRC) 3a;** certain restrictions are placed on types of residential development. Full title residential (RN3-4) on stands of 1000m<sup>2</sup> or greater is permissible (SANS 1936- draft), multi-storey low-rise ( $\leq 3$  storeys [RL2-3]) and high –rise ( $> 3$  but  $<10$  [RH2-3]) residential development may be considered provided footprint investigations are undertaken. Most forms of commercial, retail and /or industrial development are permissible (C1 to C10) but all require footprint investigations. NHBRC D3.
- **Zone C: (IRC) 3b;** Normal residential development of not less than 1000m<sup>2</sup> stands and high-rise ( $> 3$  but  $<10$  [RH2-3]) and low rise ( $\leq 3$  storeys [RL2-3]) residential development may be considered provided footprint investigations are undertaken for all muti-storey structures. Commercial, retail and /or industrial development may be considered (C1 to C10) but all require footprint investigations. NHBRC D3.
- **Zone D: (IRC) 5;** Normal residential development of not less than 1000m<sup>2</sup> stands and high rise ( $> 3$  but  $<10$  [RH2-3]) residential development may be considered provided footprint investigations are undertaken for all muti-storey structures. Commercial, retail and /or industrial development may be considered. NHBRC D3.



- **Zone E: (IRC) 6/7;** Residential development is not recommended unless additional exploratory work, including detailed footprint investigations, confirms the presence of more favourable ground. This zone is best suited for commercial, retail and industrial development. Exploratory work is required to ensure suitable founding conditions.

The residential development types as set out by SANS: 1936:1 2009- draft is as follows:

- RN3- Normal residential: 2 to 10 stands per hectare with 1000 to 4000m<sup>2</sup> stands, and a population of ≤ 60 people per hectare.
- RN4- normal residential; Small holdings, <2 stands per hectare with stands >4000m<sup>2</sup>, and a population of ≤ 25 people per hectare.
- RL2- Low rise residential: ≤3 storeys with 40 to 80 units per hectare evenly distributed and a population not exceeding 400 people per hectare.
- RL3- Low rise residential: ≤3 storeys with less than 40 units per hectare evenly distributed and a population not exceeding 200 people per hectare.
- RH2- high rise residential: > 3 Storeys with a coverage ratio of ≤ 0,4 , no higher than 10 storeys, and a population of ≤ 800 people per hectare.
- RH3- high rise residential: > 3 Storeys with a coverage ratio of ≤ 0,3 , no higher than 10 storeys, and a population of ≤ 600 people per hectare.

The development potential recommendations and NHBRC designations are supported, however it must be noted that some development types in Zone A: IRC 1 would be D3, rather than D2 and would require footprint investigations. Foot print investigations will be required for normal residential stands (>1000m<sup>2</sup>) in Zone D, IRC 5.

- b) The implementation of the NHBRC precautionary measures, as attached in Appendix G of the report, is essential.
- c) A Risk Management Plan, as attached in Appendix H of the report, must be drawn up for the specific site and implemented.

This Office supports the proposed Townships of Monavoni Extensions 43 & 44, conditional to the following:

- d) A site development plan must be submitted to this Office for Co-signing.
- e) All footprint investigations must be submitted to this Office.
- f) Any residential development must be enrolled with the NHBRC.
- g) The application of stringent water precautionary measures for this development is essential. The Competent Person must certify those measures implemented.

- h) The Builder must inform the professional team when the service/foundation trenches are open for inspection takes place. The results of these inspections and quality control must be recorded in a construction report (copy to the Local Authority and this Office).
- i) The professional team involved, including RMS, shall carefully consider the appropriate water precautionary measures and then ensure and finally certify that these have been implemented.
- j) Wet services may not be laid below structures. The Builder must certify that they have been placed as such.
- k) The engineer must incorporate guttering, downpipes, channels and adequate paving around the houses, which should always be functional. All stormwater must be discharged in the municipal stormwater system. Roof water may thus not cascade off the apron and directly into the soil. The stand should be landscaped in a way that the stormwater is channeled around the building. The site must be assessed after a heavy rainstorm to check that this water flows off the site properly.
- l) The Local Authority must implement a risk management system. Commenting on the suitability of stands within its jurisdiction is based on the premise that this system will be implemented.

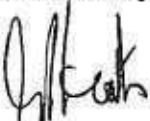
This letter reflects the Council for Geoscience's view and approach to development on dolomite at this time, as reflected by the above date. These comments may not be viewed as open-ended. If a property changes ownership or land-use changes are made, the comment may in part or wholly no longer apply. This Office should be informed of such changes and the Competent Person responsible for the dolomite stability investigation should be given the opportunity to indicate the influence such changes could have on the overall stability.

For any further queries, please do not hesitate to contact this office.

Yours faithfully,

If you have any further queries, please do not hesitate to contact this office.

Yours faithfully,



**G J HEATH**

**ENGINEERING GEOSCIENCE UNIT**

**CC: Relly, Milner and Shedden**  
P O Box 32107  
Glenstantia

# Annexure J



## Council for Geoscience

Private Bag X112 Pretoria 0001 SOUTH AFRICA 280 Pretoria Street Silverton Pretoria  
Reception: +27 (0)12 841 1911 Internet: <http://www.geoscience.org.za>

**Our Reference:** F3761.1  
Monavoni Ext 43 and 44  
**Your Reference:** 091124mana43  
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**Fax:** 0866769546  
**No. of Pages:** 5

**12 November 2009**

Tshwane Metropolitan Municipality  
Department Roads and Stormwater: Geology Section  
Centurion Offices  
P O Box 14013  
Lyttelton  
0140

**Attention: The Deputy Manager: Infrastructure Planning and Management**  
Hannes Claasen

*By Fax:* 012 358 3361

**The Deputy Manager Regional Spatial Planning**  
Lettie van der Berg

*By Fax:* 012 358 3592

Dear Sir / Madam,

### **PROPOSED TOWNSHIPS OF MONAVONI EXTENSIONS 43 AND 44**

The firm, Relly, Milner and Shedden Consulting Earth Scientists (RMS) submitted their report: "A dolomite stability investigation for a proposed Townships of Monavoni Extensions 43 and 44 on Portion 1 of Stukgrond 382-JR, Centurion (Tshwane Metro), Gauteng", dated October 2009, on behalf of their client M & T development, to this office for comment on 30 October 2009. This office acts as Agent to your Municipality in auditing the geoscientific work and emanating recommendations.

The purpose of this investigation was to collate existing borehole information from various phases of exploratory drilling over the past 5 years and then to assess the dolomite stability of the site.

Monavoni Extension 43 and 44 occupy a rectangular area of approximately 50ha. The Extensions are bounded by a farm portion in the north, by various holdings in the west and south and by the proposed extension to Mona Avenue in the east. The entire site is undeveloped farmland previously used for cattle grazing.

A composite residual gravity map covering the Greater Monavoni Area was used. The composite map made up of a number of separate surveys undertaken between 2004 and 2006. A total of fifty-nine rotary percussion boreholes were drilled in and immediately adjacent to Extension 43 and 44. Twenty-nine of these boreholes were drilled during the current investigation.

Groundwater strikes occurred at depths of between 25m and 35m below the surface in three of the boreholes drilled during the current investigation (BH's 43/04, 44/14, 44/17). Rest water levels were recorded at depths between 7m and 10m in 11 of the new boreholes. No groundwater strikes were recorded in the previously drilled boreholes nor were any rest water levels recorded. A report by P.Hobbs ( 2004) of the larger area states that the groundwater rest level is unlikely to experience a natural fluctuation of more than 8m, and a maximum fluctuation of about 5m has taken place over the past 25 years. Natural fluctuations of between 5 and 8m should not effect the stability of the site. The potential for significant dewatering is relatively low as the area is not intensely farmed. Dewatering is not assessed as a significant threat to the overall stability of the site.

Having reviewed the report, we submit that:

a) RMS has classified the site into 5 zones, namely:

- **Zone A: Inherent Risk Class (IRC) 1;** this zone is an elongated area in the northern half of Extension 44. Boreholes intersect residual syenite overlying syenite bedrock. Dolomite bedrock is intersected below 25m in BH 44/14. Four boreholes were terminated in solid syenite bedrock which occurs at depths of between 6m and 18m. There is no restriction on the type of development that may be considered, most types will require additional exploratory work.
- **Zone B: (IRC) 3a;** this zone occupies an elongated area immediately south of Zone A and along the eastern boundary and a small portion on the south western corner of the site. In the northern zone portion and south eastern portion, residual syenite is intersected between 6m and 15m overlying a 2m wad layer which in turn overlies dolomite bedrock. The south western corner is characterised by intrusive syenite at depth. The overburden ranges from 13m of chert rubble to shale and quartzite of the black reef formation. Commercial and restricted residential development may be considered provided the



appropriate requirements of the draft SANS 1936 document are implemented including footprint investigations.

- **Zone C: (IRC) 3b;** this zone is located in the central portion of the site and a pocket occurs in the northern section. The syenite layer encountered in these boreholes is about 2m up to 7m thick. Waddy layers occur between the syenite and dolomite bedrock. In the northern pocket no dolomite bedrock is intersected. Most types of development considered suitable for this zone will require footprint investigations for all structures.
- **Zone D: (IRC) 5;** this zone occurs along the western boundary and a small portion in the extreme north east. Boreholes intersect dolomite at shallow depths. Any development will require footprint investigations for all structures.
- **Zone E: (IRC) 6/7;** this zones comprises two elongate portions in the southern and central portion of the site. Boreholes intersect fairly thick layers of wad , dolomite bedrock is intersected below depths ranging from 6m to 17m. Significant dewatering could increase the risk of doline development as a rest level recorded in BH 43/04 indicates ground water to occur within wad-rich residual dolomite. Residential development should not be considered unless additional exploratory work, including detailed footprint investigations, confirms the presence of more favourable ground.

This Office is broadly in agreement with the risk assessment of the site. BH's 44/13 and 6521(39), however, should rather be incorporated into Zone D, IRC5.

b) RMS has recommended the following development potential for the site:

- **Zone A: Inherent Risk Class (IRC) 1;** No restrictions are placed on the types of development that may be considered on IRC 1 land provided spatial framework requirements are met. NHBRC D2.
- **Zone B: (IRC) 3a;** certain restrictions are placed on types of residential development. Full title residential (RN3-4) on stands of 1000m<sup>2</sup> or greater is permissible (SANS 1936- draft), multi-storey low-rise ( $\leq 3$  storeys [RL2-3]) and high –rise ( $> 3$  but  $<10$  [RH2-3]) residential development may be considered provided footprint investigations are undertaken. Most forms of commercial, retail and /or industrial development are permissible (C1 to C10) but all require footprint investigations. NHBRC D3.
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The residential development types as set out by SANS: 1936:1 2009- draft is as follows:

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- RH3- high rise residential: > 3 Storeys with a coverage ratio of ≤ 0,3 , no higher than 10 storeys, and a population of ≤ 600 people per hectare.

The development potential recommendations and NHBRC designations are supported, however it must be noted that some development types in Zone A: IRC 1 would be D3, rather than D2 and would require footprint investigations. Foot print investigations will be required for normal residential stands (>1000m<sup>2</sup>) in Zone D, IRC 5.

- b) The implementation of the NHBRC precautionary measures, as attached in Appendix G of the report, is essential.
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This Office supports the proposed Townships of Monavoni Extensions 43 & 44, conditional to the following:

- d) A site development plan must be submitted to this Office for Co-signing.
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Yours faithfully,

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Yours faithfully,



**G J HEATH**

**ENGINEERING GEOSCIENCE UNIT**

**CC:            Relly, Milner and Shedden**  
                 P O Box 32107  
                 Glenstantia

0010

*By Fax:* 012 998 6890

**ATTENTION: Mr Ed Shedden**

# Annexure K



# GALAGO ENVIRONMENTAL



**Fauna and Flora Specialists**

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Email: [Vanessam@lantic.net](mailto:Vanessam@lantic.net)

## *Flora and Fauna Habitat Assessment*

*of*

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**MONAVONI EXTENSION 44**

---

**January 2009**

**GDACE reference number:**

**Report Compiled and edited by:** Ms. Vanessa Marais of Galago Environmental  
**Report authors:** Dr. I.L. Rautenbach (Pri.Sci. Nat: Ph.D, T.H.E.D.),  
Mr. W.D. Haacke (Pri. Sci. Nat: M.Sc), Mr. R.F.  
Geyser, Mrs. P. Lemmer (Cert. Sci. Nat: B.Sc.)'  
**Report verified/reviewed by:** Dr. I.L. Rautenbach (Pri.Sci. Nat.)

## EXECUTIVE SUMMARY

Galago Environmental CC was appointed to undertake a mammal, bird, reptile, amphibian and plant survey for Monavoni Extension 44 on Part of Portion 1 of the farm Stukgrond 382 JR (elsewhere referred to as the study site), scheduled for residential development.

The study site lies in the quarter degree grid square 2528CC (Centurion). Mucina and Rutherford (2006) classified the area as Carletonville Dolomite Grassland. The 35.26 ha study site lies in the north-western corner of the farm Stukgrond 382-JR, on the corner of Monument Drive and Mimosa Avenue. It consists of a northern and a southern portion. The strip of land in-between is probably reserved for a road. The northern portion borders on Monavoni X 50 and the southern portion borders on Monavoni X 43. Corners of both sections culminate against Amsterdam Road to the northwest. A continuous ditch bisects the northern section. Two power lines parallel to Monument Drive form the southwestern border of the southern portion and a model aeroplane airstrip is located near Amsterdam Road.

Four **plant communities** were identified on or within 200 meters of the study site:

- Natural primary grassland;
- Mixed alien and indigenous vegetation;
- Old cultivated fields; and
- Rocky outcrop vegetation.

From the **vegetation** study it was found that no Red-listed plant species were found. The Natural primary grassland (including the Rocky outcrop) on the site was deemed sensitive. The Orange-listed *Hypoxis hemerocallidea* (African potato) was found sparsely scattered in the Natural primary grassland and the Rocky outcrop vegetation habitats. Corridors of Natural primary grassland that have not been disturbed by services trenches should be excluded in all the planned new townships of Monavoni and on the neighbouring sites that are to be developed together with these sites. These corridors should be connected to the rocky outcrop on the study site and on the other portions that are being developed and to the *Acacia karroo* vegetation in the eastern part of Monavoni to facilitate connectivity. These areas must be properly managed throughout the lifespan of the project in terms of fire, eradication of exotics etc. to ensure continuous biodiversity.

The **mammals** study found that most, if not all the terrestrial species listed as potential occupants of the site, will be displaced as a result of the proposed development. This will have no effect on the global conservation status of most of the species. However, the loss of the three Red Listed species is regrettable, although when expressing the magnitude of the loss in statistical terms it would most probably be negligible.

The **avifauna** study found that although the habitat on the study site could still favour White-bellied Korhaan, it is doubtful if they will make use of the open grassland due to the human presence. The open grassland habitat on site offers suboptimal habitat for the Melodious Lark. This species has however been removed from GDACE's list of priority species.

The development should not have a negative affect on any of the other Red Data bird species listed above due to the high level of human disturbance on site. In addition, there is a lack of sufficient breeding, foraging and breeding habitat for the mentioned Red Data bird species.

The **herpetological** study found that the site appears suitable for a relatively limited number of amphibian and reptile species. A specimen of the Striped Harlequin Snake (*Homoroselaps dorsalis*), a Red Data Species, has been recorded from the farm Swartkop 383 JR (Jacobsen, 1995), in this quarter degree grid cell. This proves the presence of this species in this area but it is practically impossible to confirm this record as occurring on this site. As this snake tends to live underground in burrows or tunnels, where it feeds exclusively on Thread Snakes (*Leptotyphlops* spp.), it is usually only found accidentally when dead termitaria are destroyed. To attempt to confirm the presence of this species in an area, it would be necessary to destroy a large number of dead termitaria, which would reduce the suitability of the area for the survival of this snake and other reptiles. Since it appears that this species occurs in relatively low densities it is impossible to suggest conservation measures.

Mitigation proposed is that corridors of natural vegetation be conserved and that connectivity be established between the rocky outcrop, natural grassland and the Acacia karoo vegetation to the east. Numerous specific mitigation measures are recommended for the construction phase of the proposed development.

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# 1. INTRODUCTION

Galago Environmental CC was appointed to undertake a mammal, bird, reptile, amphibian and plant survey for Monavoni Extension 44 on Part of Portion 1 of the farm Stukgrond 382 JR (elsewhere referred to as the study site), scheduled for residential development.

The objective was to determine which species might still reside on the site. Special attention had to be given to the habitat requirements of all the Red Data species, which may occur in the area. This survey focuses on the current status of threatened vertebrate and plant species occurring, or which are likely to occur on the proposed development site, and a description of the available and sensitive habitats on the site.

## 2. OBJECTIVES OF THE HABITAT STUDY

- To assess the current status of the habitat component and current general conservation status of the property and offers recommendations about the preservation of the sensitive areas on the site;
- To list the perceptible flora of the site and to recommend steps to be taken should endangered, vulnerable or rare species be found;
- To provide lists of mammals, birds, reptiles, and amphibians which occur or might occur, and to identify species of conservation importance;
- To highlight potential impacts of the development on the fauna and flora of the study site; and
- To provide management recommendations to mitigate negative and enhance positive impacts should the proposed development be approved.

## 3. SCOPE OF STUDY

This report:

- Lists the more noticeable trees, shrubs, suffrutices, herbs, geophytes and grasses observed during the study;
- Indicates medicinal plants recorded and lists alien species;
- Comments on connectivity with natural vegetation on adjacent sites;
- Is a mammal, bird, reptile and amphibian survey based on sightings and literature, with comments on preferred habitats;
- Comments on ecological sensitive areas;
- Evaluates the conservation importance and significance of the site with special emphasis on the current status of resident threatened species;
- Offers recommendations to reduce or minimise impacts, should the proposed development be approved.

## 4. STUDY AREA

The study site lies in the quarter degree grid square 2528CC (Centurion). Mucina and Rutherford (2006) classified the area as Carletonville Dolomite Grassland, a species-rich grassland with shallow soil and slightly undulating plains on dolomite dissected by prominent rocky chert ridges. This grassland falls within a warm-temperate summer-rainfall region with high summer temperatures and severe frequent winter frosts.

This vegetation unit is considered vulnerable. Its conservation target is 24%. Small parts of this unit are conserved in statutory reserves and a few private conservation areas. Almost a quarter of the unit is already transformed by cultivation, urbanization, mining and the building of two dams.

The 35.26 ha study site lies in the north-western corner of the farm Stukgrond 382-JR, on the corner of Monument Drive and Mimosa Avenue. It consists of a northern and a southern portion. The strip of land in-between is probably reserved for a road. The northern portion borders on Monavoni X 50 and the southern portion borders on Monavoni X 43. Corners of both sections culminate against Amsterdam Road to the northwest. A continuous ditch bisects the northern section, the purpose of which is not apparent. Two power lines parallel to Monument Drive form the southwestern border of the southern portion and a model aeroplane airstrip is located near Amsterdam Road.

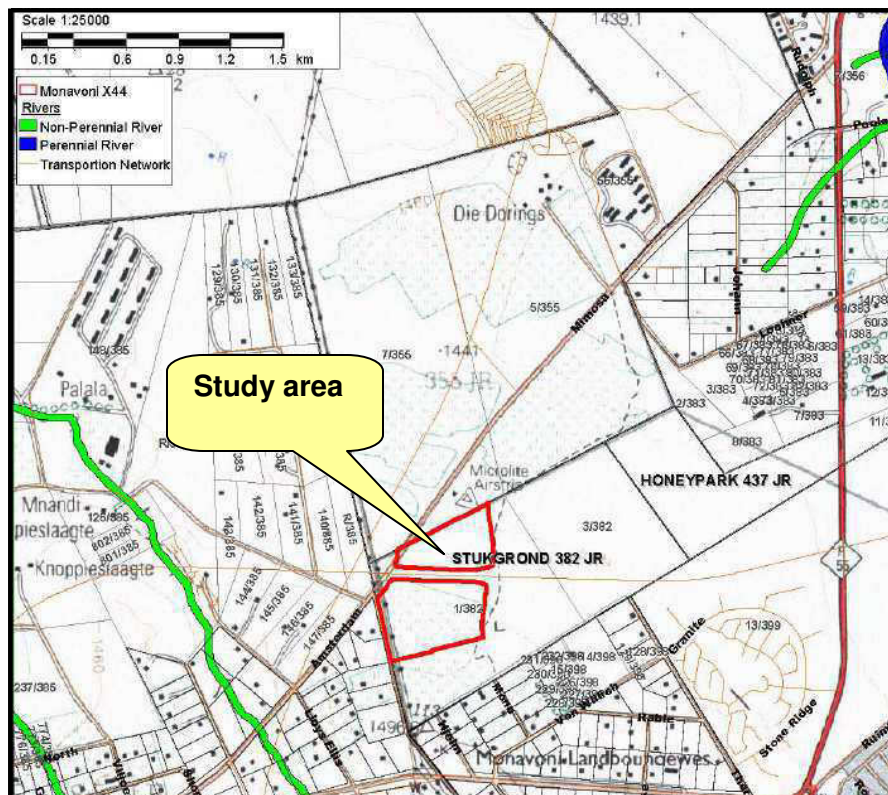


Figure 1: Locality map of the study area

The major portion of the site is undeveloped *albeit* ecologically disturbed. Aerial photo images suggest that portions of the site have been tilled in the distant past, but have been left fallow for a considerable period of time allowing a degree of ecological

succession to take place. It is clear that annual veld fires have taken its toll on the quality of the basal cover, and consequently on biodiversity. The site is not utilized at present.

The substrate is a reddish sandy soil, and termitaria have been recorded.

GPS coordinates 25 52'15" S, 28 05'07" E. Alt.= 1475 m

## **5. METHODS**

### **5.1 Vegetation survey**

Information about the Red Data species that occur in the area was obtained from GDACE. The Guidelines issued by GDACE to plant specialists were consulted to ascertain the habitat of the Red Data species concerned.

The PRECIS list of plants recorded in the 2528CC quarter degree grid square was obtained from SANBI. This list was consulted to verify the record of occurrence of the plant species seen in the study site. The vegetation map published in Mucina and Rutherford (2006) was consulted about the composition of Carltonville Dolomite Grassland. A desktop study of the habitats of the red-listed and orange-listed species known to occur in the area was done before the site visits.

The study area was first visited in February 2005, the vegetation communities identified and the plants in each vegetation community recorded. On 29 December 2007, the area was revisited to determine whether any changes took place since the previous site visit. On 11 December 2008, the present demarcation of the site was visited and the vegetation communities identified (see Figure 2). From each vegetation community one or more plots (depending on the size and composition of the vegetation community) were selected at random for detailed study. Each plot, which measured about 10m x 10m, was surveyed in a random crisscross fashion and the plants recorded. The entire site was searched in a random crisscross manner for the presence of the Red Data species known to occur in the quarter degree grid square. (The names of the Red- and Orange-listed species that occur in the quarter degree grid square appear in Appendix B.). Suitable habitat for red-listed species on the neighbouring properties was examined to a distance of 200 m from the boundaries of the site for the presence of the red-listed plants.

The adjoining agricultural holdings were not surveyed, as their habitat was clearly not suitable for any red-listed or orange listed species.

### **5.2 Fauna survey**

A site visit was conducted on 15 November 2008. During a four-hour visit the observed and derived presence of fauna associated with the recognised habitat types of the study site, were recorded. This was done with due regard to the well-recorded global distributions of Southern African fauna.

The 500 meters of adjoining properties were scanned for important fauna habitats.

### 5.2.1 Field Surveys

During the site visit mammals, birds, reptiles, and amphibians were identified by visual sightings through random transect walks. In addition, mammals were also identified by means of spoor, droppings or roosting sites. Possible burrows or reptile habitats (stumps or rocks) were inspected for any inhabitants. Amphibians were also identified by their vocalisations. No trapping or mist netting was conducted, as the terms of reference did not require such intensive work.

Birds were identified visually using a 10X42 Bushnell Legend binocular and a 20X-60X Pentax spotting scope and by call and where necessary verified from *Sasol Birds of Southern Africa* (Sinclair *et al.*, 2005) and *Southern African Bird Sounds* (Gibbon, 1991). All sightings of bird species on site were plotted on a PDA using Cyber Tracker as a database, which is connected to an external GPS mouse via blue tooth. Birds were also identified by means of their calls and other signs such as nests and feathers.

Three criteria were used to assess the probability of occurrence of Red Data and other bird species on the study site that will most probably make use of the site and surrounding area for breeding or feeding purposes. These criteria include known distribution range, habitat preference and the presence of suitable habitat on site as well as the presence of food.

### 5.2.2 Desktop Surveys

As the majority of mammals, reptiles and amphibians are secretive, nocturnal and/or poikilothermic or seasonal, distributional ranges and the presence of suitable habitats were used to deduce the presence or absence of these species based on authoritative tomes, scientific literature, field guides, atlases and databases. This can be done irrespective of season.

The probability of occurrences of **mammal** species was based on their respective geographical distributional ranges and the suitability of on-site habitat. In other words, *high* probability would be applicable to a species with a distributional range overlying the study site as well as the presence of prime habitat occurring on the study site. Another consideration for inclusion in this category is the inclination of a species to be common, i.e. normally occurring at high population densities.

*Medium* probability pertains to a mammal species with its distributional range peripherally overlapping the study site, or required habitat on the site being sub-optimal. The size of the site as it relates to its likelihood to sustain a viable breeding population, as well as its geographical isolation is also taken into consideration. Species categorised as *medium* normally do not occur at high population numbers, but cannot be deemed as rare. A *low* probability of occurrence will mean that the species' distributional range is peripheral to the study site and habitat is sub-optimal. Furthermore, some mammals categorised as *low* are generally deemed rare.

The occurrence of some key bird species was verified according to the distribution record obtained during the Southern African Bird Atlas period from 1981 to 1993 (Harrison *et al* 1997) as well as records from 1974 to 1987 according to Tarboton *et al* (1987).

The occurrence and historic distribution of these birds, including all Red Data bird species for the 2528CC quarter-degree grid cell were all verified according to Harrison *et al* (1997) and Tarboton *et al* (1987). The reporting rate was scored between 0 – 100% and is calculated as follows: Total number of cards on which a species was reported during the Southern African Bird Atlas period X 100 ÷ total number of cards for a particular quarter degree grid cell. The colour codes for each species are represented as follows: YELLOW = VERY LOW, LIGHT ORANGE = LOW, DARK ORANGE = MEDIUM AND RED = HIGH with reference to the specific habitat systems found on site. It is important to note that a quarter-degree grid cell covers a large area. A quarter-degree square, for example 2528CC, covers an area of ±27 X 25 kilometres (±693 km<sup>2</sup>) and it is possible that suitable habitat will exist for a certain Red Data species within this general and surrounding area. However, the specific habitat found on site will not suit the particular Red Data species although it was recorded for the quarter-degree grid cell. For example, Cape Vulture occurs along the Magaliesberg but will not favour the habitat found within the Pretoria CBD, which are both in the same quarter-degree grid cell. Red Data bird species were categorised according to Barnes (2000).

The biodiversity index gives an indication of which habitat will hold the richest bird diversity on site. This is calculated on the sum of the probability of occurrence: 5 = present on site, 4 = not observed on site but has a high probability of occurring on site, 3 = medium, 2 = low, 1 = very low and 0 = not likely to occur, of bird species within a specific habitat system on site.

Based on the impressions gathered during the visit and records in the Transvaal Museum, as well as the documentation of the herpetofauna of the then Transvaal by Dr N. H. G. Jacobsen (Unpublished Ph.D. thesis, University of Pretoria, 1989) and his internal report for the Gauteng Province (1995), as well as the "Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland" (Minter, et al, 2004) the following list of species which may occur on this site was compiled. The latest taxonomic nomenclature is being used. The vegetation type was analysed according to the standard handbook by Mucina and Rutherford (eds) (2006).

### 5.2.3 Specific Requirements

During the visit the site was surveyed and assessed for the potential occurrence of Red Data or wetland-associated species such as:

- Juliana's golden mole (*Neamblosomus juliana*)
- Rough-haired golden mole (*Chrysospalax villosus*)
- African marsh rat (*Dasymys incomtus*)
- Angoni vlei rat (*Otomys angoniensis*)
- Vlei rat (*Otomys irroratus*)
- African clawless otter (*Aonyx capensis*)
- Spotted-necked otter (*Lutra maculicollis*)
- Marsh mongoose (*Atilax paludinosus*)
- Forest shrew (*Myosorex varius*)



- White tailed rat (*Mystromys albicaudatus*)
- Highveld golden mole (*Amblysomus septentrionalis*)
- Giant Bullfrogs (*Pyxicephalus adspersus*);
- Cape Vulture (*Gyps coprotheres*)
- Blue Crane (*Anthropoides paradiseus*)
- Lesser Kestrel (*Falco naumanni*)
- African Grass-Owl (*Tyto capensis*)
- African Marsh-Harrier (*Circus ranivorus*)
- White-backed Night-Heron (*Gorsachius leuconotus*)
- White-bellied Korhaan (*Eupodotis senegalensis*)
- Martial Eagle (*Polemaetus bellicosus*)
- African Finfoot (*Podica senegalensis*)
- Lesser Flamingo (*Phoenicopterus minor*)
- Secretarybird (*Sagittarius serpentarius*)
- Black Stork (*Ciconia nigra*)
- Half-collared Kingfisher (*Alcedo semitorquata*)
- Greater Flamingo (*Phoenicopterus ruber*)

#### 5.2.4 Participating Specialists

This investigation was conducted by the following:

Specialists	Aspect Investigated	Qualifications	Prof. Registration	Date of Field Survey
Rautenbach, I.L.	Mammalogy review	Ph.D., T.H.E.D.	Pr. Nat. Sci.	15 November 2008
Haacke, W.D.	Herpetology	M.Sc. (Zoology)	Pr. Nat. Sci.	15 November 2008
Lemmer, P.	Botany	B.Sc. (Botany)	Cert. Sci. Nat.	11 December 2008
Geyser, R.	Avifauna		Pending	15 November 2008
Marais, V.	Environmental Impacts and maps	BL Landscape Architecture		15 November 2008

## 6. RESULTS

### 6.1 Vegetation survey:

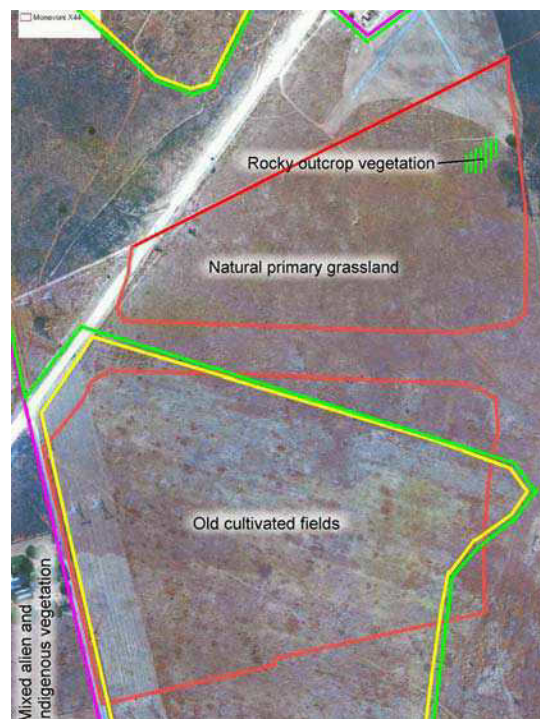
#### 6.1.1 Vegetation communities

Four plant communities were identified on or within 200 meters of the study site:

- Natural primary grassland;
- Mixed alien and indigenous vegetation;
- Old cultivated fields; and
- Rocky outcrop vegetation.

Tables 3 to 5 list the trees, shrubs, geophytes, herbs and grasses actually found on each of the surveyed areas on the site.

The vegetation of the adjacent agricultural smallholdings consisted of mixed alien and indigenous vegetation and was not surveyed.



**Figure 2: Vegetation communities**

#### 6.1.2 Medicinal plants

The names of known medicinal plants are marked with numbers to footnotes in Tables 3 to 5 and the footnotes themselves appear at the end of the last table. Of the 141 plant species recorded on the site, 28 species with medicinal properties were found. Their distribution in the various vegetation communities is as follows:

**Table 1:** Number of medicinal species in the various vegetation communities

VEGETATION COMMUNITY	TOTAL NO OF SPECIES IN VEGETATION COMMUNITY	NO OF MEDICINAL SPECIES IN VEGETATION COMMUNITY
Natural primary grassland	105	21
Mixed alien and indigenous vegetation	Not surveyed	
Old cultivated fields	34	4
Rocky outcrop vegetation	52	14

### 6.1.3 Alien plants

Alien plants are not listed separately, but are included in the lists as they form part of each particular vegetation group. Their names are marked with an asterisk in Tables 3 to 5. Two alien plant species, one of which was a Category 1 Declared weed, were recorded on the study site. The number of alien species in each vegetation community is reflected in table 2.

**Table 2:** Number of Alien species in each vegetation community

VEGETATION COMMUNITY	NO. OF ALIEN SPECIES	CAT 1	NOT DECLARED
Natural primary grassland	1	1	0
Mixed alien and indigenous vegetation	Not surveyed		
Old cultivated fields	2	1	1
Rocky outcrop vegetation	0	0	0

The alien plant name printed in **bold** in the plant table is that of a Category 1 Declared Weed and the removal of these plants is **compulsory** in terms of the regulations formulated under “The Conservation of Agricultural Resources Act” (Act No. 43 of 1983), as amended.

### 6.1.4 Orange-listed species

The habitat of the Natural primary grassland and the Rocky outcrop vegetation was suitable for the Orange-listed *Hypoxis hemerocallidea* (African potato). This species was found sparsely scattered in these two vegetation communities. These plants should be relocated to a safe, suitable area approved by GDACE.

### 6.1.5 Red-listed species

The habitat of the site was not suitable for any of the Red-listed species known to occur within 5 km of the study site. (See Appendix B for a list of the Red- and Orange-listed species known to occur in the quarter degree grid square.)

## 6.1.6 Natural primary grassland

### 6.1.6.1 Compositional aspects and connectivity

The Natural primary grassland comprised the northern part of the site and was dominated by *Themeda triandra* (Red grass). Connectivity with natural grassland on neighbouring portions existed to the north and east of the site. However, these neighbouring portions are also currently being considered for development.

The species diversity of the Natural primary grassland was high. Of the 105 species recorded, 104 were indigenous species, the life forms of which were as follows:

LIFE FORM	NUMBER OF SPECIES
Annual & perennial herbaceous species	48
Tree species	1
Shrubs and dwarf shrubs	3
Grasses	26
Geophytes	21
Sedges	3
Succulents	2
Total No of indigenous species	104

### 6.1.6.2 Red – and orange-listed species

The Orange-listed *Hypoxis hemerocallidea* (African potato) was found scattered in this vegetation community. The habitat was not suitable for the Red-listed legume species known to occur on subsurface dolomite within 5 km of the site.

### 6.1.6.3 Medicinal and alien species

Twenty-one of the 28 medicinal species recorded on the site were found in the Natural primary grassland. One alien species, the Category 1 Declared weed, *Campuloclinium macrocephalum* (Pom pom weed) occurred sparsely scattered in this vegetation community.

### 6.1.6.4 Sensitivity

Because this vegetation community was deemed natural primary grassland, it was considered sensitive.



**Photo 1: *Themeda triandra*-dominated Natural primary grassland on Monavoni 44**

**Table 3: Plants recorded in the Natural primary grassland**

SCIENTIFIC NAME	COMMON NAMES
<i>Albuca setosa</i>	Slymuintjie
<i>Antheophora pubescens</i>	Wool grass / Borseltjiegras
<i>Anthospermum rigidum subsp pumilum</i>	
<i>Aristida congesta subsp barbicollis</i>	Spreading three-awn grass / Witsteekgras
<i>Aristida diffusa subsp burkei</i>	Iron grass / Ystergras
<i>Aristida stipitata subsp graciliflora</i>	Long awned three-awn / Langnaaldsteekgras
<i>Babiana bainsii</i>	Bobbejaanuintjie
<i>Barleria macrostegia</i>	
<i>Bewisia biflora</i>	False love grass / Vals eragrostis
<i>Boophone disticha</i> <sup>1,2,3</sup>	Cape poison bulb / Seeroogblom, gifbol
<i>Brachiaria serrata</i>	Velvet grass / Fluweelgras
<i>Brachystelma barberae</i>	Platvoetaasblom
<i>Bulbostylis burchellii</i>	Biesie
<b><i>Campuloclinium macrocephalum</i>*</b>	<b>Pom pom weed / Pompombossie</b>
<i>Chaetacanthus costatus</i>	
<i>Chamaecrista capensis var. capensis</i>	
<i>Chamaecrista comosa var capricornia</i>	
<i>Chascanum hederaceum var hederaceum</i>	
<i>Clematis brachiata</i> <sup>2</sup>	Traveler's joy / Klimop
<i>Commelina livingstonii</i>	
<i>Crabbaea hirsuta</i> <sup>2,3</sup>	Prickle head
<i>Crassula lanceolata subsp transvaalensis</i>	
<i>Crinum graminicola</i>	Graslelie
<i>Cucumis hirsutus</i>	Wild cucumber / Suurkomkommer
<i>Cyanotis speciosa</i>	Doll's powder puff / Bloupoeierkwassie
<i>Cynodon dactylon</i>	Couch grass / Kweek
<i>Dicoma anomala subsp gerrardii</i> <sup>2</sup>	Maagbitterwortel
<i>Dicoma macrocephala</i>	
<i>Dimorphotheca spectabilis</i>	Blou bietou
<i>Drimia depressa</i>	
<i>Drimia sanguinea</i> <sup>1,2</sup>	Skanama / Slangkop
<i>Elephantorrhiza elephantina</i> <sup>1,2,3</sup>	Elephant's root / Olifantswortel
<i>Elionurus muticus</i>	

SCIENTIFIC NAME	COMMON NAMES
<i>Eragrostis capensis</i>	Heartseed love grass / Hartjiesgras
<i>Eragrostis chloromelas</i>	Curly leaf / Krulblaar
<i>Eragrostis lehmanniana</i> var <i>lehmanniana</i>	Lehmann's love grass / Knietjiesgras
<i>Eragrostis superba</i>	
<i>Eriosema burkei</i> var <i>burkei</i>	
<i>Eriospermum flagelliforme</i>	
<i>Euphorbia trichadenia</i> var <i>trichadenia</i>	Melkbol
<i>Eustachys paspaloides</i>	Fan grass / Bruin hoenderspoor
<i>Felicia muricata</i> subsp <i>muricata</i> <sup>1,2,3</sup>	White felicia
<i>Gazania krebsiana</i> subsp <i>serrulata</i> <sup>3</sup>	
<i>Gomphocarpus fruticosus</i> subsp. <i>fruticosus</i> <sup>1,2</sup>	Milkweed / Melkbos
<i>Helichrysum chionosphaerum</i>	
<i>Helichrysum nudifolium</i> var <i>nudifolium</i> <sup>1,2</sup>	Hottentot's tea / Hottentotstee
<i>Helichrysum rugulosum</i> <sup>2,3</sup>	
<i>Hermannia cordata</i>	
<i>Heteropogon contortus</i>	Spear grass / Assegaaigras
<i>Hibiscus microcarpus</i>	
<i>Hyparrhenia hirta</i>	Common thatching grass / Dekgras
<i>Hypericum lalandii</i>	Spindly hypericum / Laland se sintjanskruid
<i>Hyperthelia dissoluta</i>	Yellow thatching grass / Geeltamboekiegras
<i>Hypoxis hemerocallidea</i> <sup>1,2,3</sup>	Star flower / Gifbol
<i>Hypoxis obtusa</i>	
<i>Hypoxis rigidula</i> var <i>rigidula</i>	Silverleaved star flower / Wilde tulp
<i>Indigastrum burkeanum</i>	
<i>Ipomoea bathycolpos</i>	
<i>Ipomoea crassipes</i> <sup>2,3</sup>	Leafy-flowered Ipomoea / Wildewinde
<i>Ipomoea obscura</i> var <i>obscura</i>	Wild petunia / Wilde patat
<i>Ipomoea ommaneyi</i> <sup>2</sup>	Beespatat
<i>Justicia anagalloides</i>	
<i>Kohautia caespitosa</i> subsp <i>brachyloba</i>	
<i>Kohautia virgata</i>	
<i>Kyllinga alba</i>	
<i>Lactuca inermis</i>	Wild lettuce
<i>Ledebouria inquinata</i>	
<i>Ledebouria marginata</i>	
<i>Lotononis calycina</i>	Hairy lotononis
<i>Lotononis foliosa</i>	
<i>Macledium zeyheri</i> subsp <i>zeyheri</i> <sup>2,3</sup>	
<i>Mariscus uitehagensis</i>	
<i>Melinis nerviglumis</i>	Bristle leaf red top / Steekblaarblinkgras
<i>Melinis repens</i> subsp <i>repens</i>	Red top grass
<i>Microchloa caffra</i>	Pincushion grass / Elsgras
<i>Nidorella hottentotica</i>	
<i>Ornithogalum tenuifolium</i> subsp <i>tenuifolium</i>	Bosui
<i>Panicum natalense</i>	Natal panicum / Suurbuffelsgras
<i>Pentanisia angustifolia</i>	Wild verbena / Sooibrandbossie
<i>Pentarrhinum insipidum</i>	Donkieperske
<i>Peucedanum magalimontanum</i> <sup>2</sup>	Wild parsley / Wildepietersielie
<i>Pollichia campestris</i>	Waxberry / Teesuikerbossie
<i>Polygala hottentotta</i> <sup>2,3</sup>	Small purple broom
<i>Pygmaeothamnus zeyheri</i> var <i>zeyheri</i>	Sand apple / Goorappel



SCIENTIFIC NAME	COMMON NAMES
<i>Raphionacme hirsuta</i> <sup>2</sup>	Khadi root / Khadiwortel
<i>Scabiosa columbaria</i> <sup>1,2,3</sup>	Wild scabiosa / Bitterbos
<i>Schizachyrium sanguineum</i>	Red autumn grass / Rooi herfsgras
<i>Searsia lancea</i>	Karee / Karee
<i>Senecio coronatus</i>	Sybossie
<i>Setaria sphacelata</i> var <i>torta</i>	Creeping bristle grass / Kruipmannagras
<i>Sida dregei</i>	Spider-leg
<i>Solanum lichtensteinii</i>	Giant bitter apple / Bitterappel
<i>Sporobolus stapfianus</i>	Fibrous dropseed / Veselfynsaadgras
<i>Striga asiatica</i>	
<i>Striga bilabiata</i> subsp <i>bilabiata</i>	Small witch weed
<i>Tephrosia semiglabra</i>	
<i>Themeda triandra</i>	Red grass / Rooigras
<i>Thesium</i> sp	Besembossie
<i>Tolpis capensis</i>	
<i>Trachypogon spicatus</i>	Giant spear grass / Bokbaardgras
<i>Trichoneura grandiglumis</i>	Small rolling grass / Klein rolgras
<i>Tylosema esculentum</i>	Gemsbok bean / Gemsbokboontjie
<i>Vernonia oligocephala</i> <sup>1,2</sup>	Cape vernonia / Blounaaldetee bossie
<i>Wahlenbergia denticulata</i> var <i>transvaalensis</i>	
<i>Xysmalobium undulatum</i> var <i>undulatum</i> <sup>1,2</sup>	Uzara / Bitterwortel

### 6.1.7 Mixed alien and indigenous vegetation

The Mixed alien and indigenous vegetation community was confined to the Monavoni Agricultural Holdings that lay outside the boundaries of the site and this vegetation community was therefore not surveyed. The habitat was not suitable for any of the Red-listed or orange-listed species known to occur in the quarter-degree grid square. This vegetation community was not considered sensitive.

### 6.1.8 Old cultivated fields

#### 6.1.8.1 Compositional aspects and connectivity

The Old cultivated fields vegetation community comprised secondary grassland, well on its way to recovery and dominated by *Hyparrhenia hirta* (Common thatching grass). Geophytes and perennial herbaceous species occurred scattered throughout the vegetation community.

Connectivity with the natural grassland to the north and east existed, although these areas are also currently being considered for development. The species diversity was low. Of the 34 species recorded, 32 were indigenous species, the life forms of which were as follows:

LIFE FORM	NUMBER OF SPECIES
Annual & perennial herbaceous species	16
Grasses	13
Geophytes	2
Sedges	1
Total No of indigenous species	31

### 6.1.8.2 Red – and orange-listed species

The Orange-listed *Hypoxis hemerocallidea* (African potato) was found sparsely scattered over the entire vegetation community. These plants should be relocated to a safe, suitable area approved by GDACE. The habitat was not suitable for the Red-listed species known to occur within 5 km of the site.

### 6.1.8.3 Medicinal and alien species and sensitivity

Four medicinal species were recorded in this vegetation community. Two alien species were recorded, one of which was a Category 1 Declared weed. The Old cultivated fields vegetation community was not considered sensitive.



**Photo 2: Old cultivated fields of Monavoni 44 dominated by *Hyparrhenia hirta***

**Table 4:** Plants recorded in the Old cultivated fields

SCIENTIFIC NAME	COMMON NAMES
<i>Acalypha angustata</i>	Copper leaf / Katpisbossie
<i>Aristida congesta subsp barbicollis</i>	Spreading three-awn grass / Witsteekgras
<i>Aristida congesta subsp congesta</i>	Tassel three-awn grass / Katstertsteekgras
<i>Asparagus suaveolens</i>	Wild asparagus / Katdoring
<i>Barleria macrostegia</i>	
<i>Brachiaria serrata</i>	Velvet grass / Fluweelgras
<b><i>Campuloclinium macrocephalum</i>*</b>	<b>Pom pom weed / Pompombossie</b>
<i>Chaetacanthus costatus</i>	
<i>Chamaecrista capensis var. capensis</i>	
<i>Cleome monophylla</i>	
<i>Cynodon dactylon</i>	Couch grass / Kweek
<i>Cyperus esculentus var esculentus</i>	Yellow nutsedge / Geeluintjie
<i>Eragrostis barbinodis</i>	
<i>Eragrostis chloromelas</i>	Curly leaf / Krulblaar
<i>Eragrostis curvula</i>	Weeping love grass / Oulandsgras
<i>Eragrostis lehmanniana var lehmanniana</i>	Lehmann's love grass / Knietjiesgras
<i>Eragrostis rigidior</i>	Broadleaved curly leaf / Breëkrulgras
<i>Felicia muricata subsp muricata</i> <sup>1,2,3</sup>	White felicia
<i>Helichrysum nudifolium var nudifolium</i> <sup>1,2</sup>	Hottentot's tea / Hottentotstee
<i>Helichrysum paronychioides</i>	

SCIENTIFIC NAME	COMMON NAMES
<i>Helichrysum rugulosum</i> <sup>2,3</sup>	
<i>Hyparrhenia hirta</i>	Common thatching grass / Dekgras
<i>Melinis repens subsp repens</i>	Red top grass
<i>Monsonia angustifolia</i>	Crane's bill / Angelbossie
<i>Nemesia fruticans</i>	Wilde leebekkie
<i>Nidorella hottentotica</i>	
<i>Pentarrhinum insipidum</i>	Donkieperske
<i>Pogonarthria squarrosa</i>	Herring bone grass / Sekelgras
<i>Solanum panduriforme</i>	Poison apple / Gifappel
<i>Striga elegans</i>	Rooibloem
<i>Themeda triandra</i>	Red grass / Rooigras
<i>Tylosema esculentum</i>	Gemsbok bean / Gemsbokboontjie
<i>Vernonia oligocephala</i> <sup>1,2</sup>	Cape vernonia / Blounaldetee bossie
<i>Zinnia peruviana</i> *	Redstar zinnia / Wildejakobregop

## 6.1.9 Rocky outcrop vegetation

### 6.1.9.1 Functional aspects and connectivity

A small outcrop of rock with pristine vegetation occurred near the northern corner of the site. Connectivity with natural grassland existed in all directions. The 52 plant species recorded in this vegetation community were all indigenous species, the life forms of which were as follows:

LIFE FORM	NUMBER OF SPECIES
Annual & perennial herbaceous species	23
Tree species	1
Shrubs and dwarf shrubs	2
Grasses	12
Geophytes	12
Sedges	1
Succulents	1
Total No of indigenous species	52

### 6.1.9.2 Red – and orange-listed species

The Orange-listed *Hypoxis hemerocallidea* (African potato) did not occur in this small vegetation community. The habitat of the Rocky outcrop vegetation community was not suitable for the Red-listed legume species known to occur on subsurface dolomite in the area. The rocks of the outcrop were not of chert and therefore not suitable for the Red-listed fern species that is known to occur on chert within 5 km north of the site.

### 6.1.9.3 Medicinal and alien species and sensitivity

Fourteen of the 28 medicinal species recorded on the study site were found in this vegetation community. No alien species were recorded. The Rocky outcrop vegetation community was considered sensitive and should be excluded from development. It should be connected to areas of natural vegetation by means of suitable corridors.



**Photo 3: Rocky outcrop vegetation on Monavoni 44**

**Table 5: Plants recorded in the Rocky outcrop vegetation**

SCIENTIFIC NAME	COMMON NAMES
<i>Aloe greatheadii</i> var <i>davyana</i> <sup>1,2</sup>	Kleinaalwyn
<i>Anthospermum rigidum</i> subsp <i>rigidum</i>	
<i>Aristida congesta</i> subsp <i>congesta</i>	Tassel three-awn grass / Katstertsteekgras
<i>Aster harveyanus</i>	Bloublommetjie
<i>Bonatea speciosa</i> var <i>antennifera</i>	Terrestrial orchid / Grondorgidie
<i>Boophone disticha</i> <sup>1,2,3</sup>	Cape poison bulb / Seeroogblom, gifbol
<i>Brachiaria serrata</i>	Velvet grass / Fluweelgras
<i>Bulbostylis burchellii</i>	Biesie
<i>Chloris virgata</i>	Feathertop chloris / Witpluim chloris
<i>Commelina livingstonii</i>	
<i>Crabbaea angustifolia</i> <sup>2</sup>	
<i>Crabbaea hirsuta</i> <sup>2,3</sup>	Prickle head
<i>Dicoma anomala</i> subsp <i>anomala</i> <sup>1,2,3</sup>	Maagbitterwortel
<i>Dicoma macrocephala</i>	
<i>Diheteropogon amplexans</i>	Broadleaved bluestem / Breëblaar blougras
<i>Diospyros lycioides</i> subsp <i>guerkei</i>	Bushveld bluebush / Bosveldbloubos
<i>Drimia elata</i> <sup>2</sup>	Jeukbol
<i>Elionurus muticus</i>	
<i>Eriosema burkei</i> var <i>burkei</i>	
<i>Eulophia tuberculata</i>	
<i>Helichrysum dasymallum</i>	
<i>Helichrysum nudifolium</i> var <i>nudifolium</i> <sup>1,2</sup>	Hottentot's tea / Hottentotstee
<i>Helichrysum paronychioides</i>	
<i>Heteropogon contortus</i>	Spear grass / Assegaaigras
<i>Hyparrhenia hirta</i>	Common thatching grass / Dekgras
<i>Hypoxis hemerocallidea</i> <sup>1,2,3</sup>	Star flower / Gifbol
<i>Hypoxis obtusa</i>	
<i>Hypoxis rigidula</i> var <i>rigidula</i>	Silverleaved star flower / Wilde tulp
<i>Ipomoea obscura</i> var <i>obscura</i>	Wild petunia / Wilde patat
<i>Justicia anagalloides</i>	
<i>Ledebouria revoluta</i> <sup>3</sup>	Common ledebouria

SCIENTIFIC NAME	COMMON NAMES
<i>Macledium zeyheri subsp zeyheri</i> <sup>2,3</sup>	
<i>Melinis nerviglumis</i>	Bristle leaf red top / Steekblaarblinkgras
<i>Melinis repens subsp repens</i>	Red top grass
<i>Monsonia angustifolia</i>	Crane's bill / Angelbossie
<i>Neorautanenia ficifolius</i>	
<i>Nidorella hottentotica</i>	
<i>Panicum natalense</i>	Natal panicum / Suurbuffelsgras
<i>Pearsonia sessilifolia subsp sessilifolia</i>	Silwerertjietee
<i>Pentanisia angustifolia</i>	Wild verbena /Sooibrandbossie
<i>Pollichia campestris</i>	Waxberry / Teesuikerbossie
<i>Pygmaeothamnus chamaedendrum var chamaedendrum</i>	Sand apple / Goorappel
<i>Raphionacme hirsuta</i> <sup>2</sup>	Khadi root / Khadiwortel
<i>Scabiosa columbaria</i> <sup>1,2,3</sup>	Wild scabiosa / Bitterbos
<i>Schizachyrium sanguineum</i>	Red autumn grass / Rooi herfsgras
<i>Senecio coronatus</i>	Sybossie
<i>Senecio venosus</i>	Besembossie
<i>Sida dregei</i>	Spider-leg
<i>Tristachya biseriata</i>	Trident grass / Drieblomgras
<i>Triumfetta sonderi</i>	Maagbossie
<i>Vangueria infausta subsp infausta</i> <sup>2</sup>	Wild medlar / Wildemispel
<i>Xerophyta retinervis</i> <sup>1,2</sup>	Monkey's tail / Bobbejaanstert

<sup>1)</sup> Van Wyk, B-E., Van Oudtshoorn, B. & Gericke, N. 2002.

<sup>2)</sup> Watt, J.M. & Breyer-Brandwijk, M.G. 1962.

<sup>3)</sup> Pooley, E. 1998.

<sup>4)</sup> Van Wyk, B. & Van Wyk P. 1997.

## 6.2 Mammals:

The local occurrences of mammals are closely dependent on broadly defined habitat types, in particular terrestrial, arboreal (tree-living), rupicolous (rock-dwelling) and wetland-associated vegetation cover. It is thus possible to deduce the presence or absence of mammal species by evaluating the habitat types within the context of global distribution ranges. Sight records and information from residents or knowledgeable locals audit such deductions.

From a mammal habitat perspective, only one of the four major types is present on the site, namely terrestrial.

There are no randjies, a very small rocky outcrop and no bat caves on the site.

### **Observed and Expected Species Richness**

All large mammals have disappeared decades ago to benefit farming interests and latterly more intensive land-use practices. More recently many medium-sized mammals have thus also succumbed such as the black-backed jackal and aardvark.

Considering the absence of arboreal, rupicolous and wetland habitats, those mammals closely reliant on these were *a priori* excluded from the list of potential occurrences (Table 6). Range management was geared to cattle farming with little or no attention to wildlife conservation, hence the low species diversity relative to that of historical times.

Of the 28 mammal species expected to occur on the study site (Table 6), only three species were confirmed during the site visit (Table 7).

Table 6 lists the mammals that were observed or deduced to occupy the site, or to be occasional visitors. All feral mammal species expected to occur on the study site (e.g. house mice, house rats, dogs and cats) were omitted from the assessment since these species normally associate with human settlements.

All but three of the species of the resident diversity (Table 7) are generalists / opportunists with wide habitat tolerances and are thus common and widespread in SA.

The bats listed are very common, widespread and ecologically resilient. Given daytime roosts in the form of crevices in structures of civilization in the general area, these animals can be expected to hunt for aerial insects during summer dusks.

### **Mammal Habitat Assessment**

From a mammal perspective, the terrestrial habitat is in poor condition, due to intensive cattle grazing in the past. The study site has suffered from fires during the recent dry season, and basal cover was sprouting during the site visit. As such, it was low and presented poor refuge against predation. Fires are a catastrophic event in the seasonal cycles of small mammal populations and were curtailed for the sake of grazing prior to the removal of cattle herds. Prime terrestrial habitat for small terrestrial mammals is directly linked to good cover rather than the species composition of the vegetative ground cover. Seasonal fires are therefore concluded to have a severe impact on population densities, and possibly mammal diversity. A small rise on the northern section is rocky, but cannot be construed as a rupicolous habitat. The site is thus considered to be devoid of rocky ridges, woodlands or wetlands.

The 500 meters of adjoining properties on all sides (except the Monument Drive and small holdings beyond) are in a similar state of ecological disrepair and although there is a high degree of connectivity, the fact that only three Red Listed species are recognized on the site relegate this ecological mechanism to a low level of importance. Connectivity is in any case a hypothetical concept in this instance since adjoining areas are also scheduled for urban development.

**Table 6:** The mammals which were observed or deduced to occupy the site

	<b>SCIENTIFIC NAME</b>	<b>ENGLISH NAME</b>
√	<i>Lepus saxatilis</i>	Scrub hare
√	<i>Cryptomys hottentotus</i>	African mole rat
*	<i>Rhabdomys pumilio</i>	Four-striped grass mouse
*	<i>Mus minutoides</i>	Pygmy mouse
*	<i>Mastomys natalensis</i>	Natal multimammate mouse
*	<i>Mastomys coucha</i>	Southern multimammate mouse
*	<i>Aethomys ineptus</i>	Tete veld rat
*	<i>Tatera brantsii</i>	Highveld gerbil
?	<i>Saccostomus campestris</i>	Pouched mouse
?	<i>Dendromus melanotis</i>	Grey pygmy climbing mouse
?	<i>Dendromus mesomelas</i>	Brants' climbing mouse
?	<i>Dendromus mystacalis</i>	Chestnut climbing mouse



	SCIENTIFIC NAME	ENGLISH NAME
<b>DD?</b>	<i>Suncus lixus</i>	Greater dwarf shrew
<b>DD?</b>	<i>Suncus infinitesimus</i>	Least dwarf shrew
*	<i>Crocidura cyanea</i>	Reddish-grey musk shrew
*	<i>Crocidura hirta</i>	Lesser red musk shrew
<b>NT?</b>	<i>Atelerix frontalis</i>	Southern African hedgehog
*	<i>Neoromicia capensis</i>	Cape serotine bat
*	<i>Scotophilus dinganii</i>	African yellow house bat
*	<i>Scotophilus viridis</i>	Greenish yellow house bat
?	<i>Genetta genetta</i>	Small-spotted genet
?	<i>Genetta tigrina</i>	SA large-spotted genet
√	<i>Cynictis penicillata</i>	Yellow mongoose
*	<i>Galerella sanguinea</i>	Slender mongoose
?	<i>Canis mesomelas</i>	Black-backed jackal
?	<i>Ictonyx striatus</i>	Striped polecat
?	<i>Sylvicapra grimmia</i>	Common duiker
?	<i>Raphicerus campestris</i>	Steenbok

√ Definitely there or has a *high* probability to occur;

\* *Medium* probability to occur based on ecological and distributional parameters;

? *Low* probability to occur.

**Red Data species rankings as defined in Friedmann and Daly's S.A. Red Data Book / IUCN (World Conservation Union) (2004)** are indicated in the first column: **CR**= Critically Endangered, **En** = Endangered, **Vu** = Vulnerable, **LR/cd** = Lower risk conservation dependent, **LR/nt** = Lower Risk near threatened, **DD** = Data Deficient. All other species are deemed of **Least Concern**.

**Table 7:** Mammal species positively confirmed from the study site.

SCIENTIFIC NAME	ENGLISH NAME	OBSERVATION INDICATOR	HABITAT
<i>L. saxatilis</i>	Scrub hare	Faecal pellets	Short grass
<i>C. hottentotus</i>	African mole rat	Tunnel system	Wide tolerance
<i>C. penicillata</i>	Yellow mongoose	Grassland	Wide tolerance

All three species are widespread and common and justifiably called opportunistic generalists. With their proven wide habitat tolerance and/or reticent behaviour patterns, they display a remarkable ability to co-exist in the close proximity of human activities.

### **Threatened and Red Listed Mammal Species**

The two dwarf shrew species are listed as potential occupants. They have a tendency to use dead termite mounds as refuges, and these structures are used as a coarse indicator of their presence. Their assigned "Data Deficient" Red Listed conservation status is, however, indicative of a dearth of field data to ascertain their true global conservation status. Under natural conditions, hedgehogs have no problem with surviving and their "Near Threatened" conservation status is the direct result of human predation. Considering the extent of the site and surrounding undeveloped areas, some individuals must have managed to survive.

It is submitted that no other Endangered species could have survived the ravages of farming and urbanization: the white-tailed rat is extremely sensitive to habitat conditions which are not met on this site, while habitat requirements for rough-haired golden moles or any other golden moles are absent. Other Red Data or sensitive species are deemed

absent from the site since the site is too disturbed, falls outside the distributional ranges of some species, or does not offer suitable habitat(s).

## 6.2 Avifauna:

### ***Avifaunal Habitat Assessment:***

The study site is situated within the Dry Highveld Grassland Bioregion of the Grassland Biome and more specifically within the Carletonville Dolomite Grassland vegetation type according to Mucina and Rutherford (2006). Egoli Granite Grassland runs past the southern edge of the study site and the grassland on the study site can probably be described as a transition area between the two grassland vegetation types. Within this vegetation type one distinct bird habitat systems was identified.

### **Open grassland:**

The entire study site consists of open natural grassland (either primary or secondary) with a few scattered trees and shrubs. Open grassland is the most important habitat type for South Africa's threatened bird species in the region with a proportional importance of 27% (Barnes 2000). The highest diversity of threatened bird species occurs within this grassland habitat of which many are in the highest category of threat (Barnes 2000). The presence and abundance of bird species in this habitat will vary from season to season being lush and green in summer after summer rains and dry and brown or burnt during winter. The area will favour ground living bird species such as lapwings, francolins, pipits, long claws, larks and chats that either hunt for insects or breed on the ground, in burrows in the ground or between the grass. Weavers and widow-birds will make use of this area for feeding (seeds) during late summer and early winter when the grass is not burnt. Widow-birds and cisticolas will also breed in the tall grass during summer. Aerial feeding birds such as martins, swifts and swallows will hunt for insects over the grasslands.

### ***Observed and Expected Species Richness***

Of the 314 bird species recorded for the 2528CC q.d.g.c 101 (32.16%) are likely to occur on the study site and 24 (23.7.6%) of these bird species were actually observed on the study site (Table 8).

The bird species listed in Table 8 are in species order according to *Roberts - Birds of Southern Africa* VII th edition (Hockey *et al*, 2005). These were actually observed on site (**in bold**) or are likely to occur within the specific habitat found on site. This does not include overflying birds or rare vagrants. The reporting rate (%) is according to Harrison *et al*. (1997). The habitat preference, **OG = Open Grassland** is indicated next to the reporting rate with their possibility of occurrence in these specific habitats on site rated as 5 = present, 4 = High, 3 = Medium, 2 = Low, 1 = Very low, and 0 = Not likely to occur.

**Table 8:** Bird species observed and that are likely to occur on the study site.

SCIENTIFIC NAME	ENGLISH NAME	R RATE (%) * 2528CC	HABITAT PREFERENCE
			OG
<i>Peliperdix coqui</i>	Coqui Francolin	4	4
<i>Scleroptila levaillantoides</i>	Orange River Francolin	1	1
<b><i>Pternistis swainsonii</i></b>	<b>Swainson's Spurfowl</b>	21	5
<i>Coturnix coturnix</i>	Common Quail	1	4
<b><i>Numida meleagris</i></b>	<b>Helmeted Guineafowl</b>	53	5
<i>Jynx ruficollis</i>	Red-throated Wryneck	20	4
<i>Upupa africana</i>	African Hoopoe	76	4
<i>Merops apiaster</i>	European Bee-eater	12	4
<i>Colius striatus</i>	Speckled Mousebird	72	3
<i>Urocolius indicus</i>	Red-faced Mousebird	38	4
<b><i>Chrysococcyx caprius</i></b>	<b>Diderick Cuckoo</b>	26	5
<b><i>Cypsiurus parvus</i></b>	<b>African Palm-Swift</b>	23	5
<i>Apus affinis</i>	Little Swift	39	4
<b><i>Apus caffer</i></b>	<b>White-rumped Swift</b>	19	5
<i>Corythaixoides concolor</i>	Grey Go-away-bird	44	2
<i>Tyto alba</i>	Barn Owl	6	3
<i>Bubo africanus</i>	Spotted Eagle-Owl	4	3
<i>Columba livia</i>	Rock Dove	27	4
<i>Columba guinea</i>	Speckled Pigeon	42	4
<b><i>Streptopelia senegalensis</i></b>	<b>Laughing Dove</b>	94	5
<b><i>Streptopelia capicola</i></b>	<b>Cape Turtle-Dove</b>	81	4
<b><i>Streptopelia semitorquata</i></b>	<b>Red-eyed Dove</b>	32	5
<b><i>Afrotis afraoides</i></b>	<b>Northern Black Korhaan</b>	13	5
<i>Eupodotis senegalensis</i>	White-bellied Korhaan (VU)	<1	2
<i>Burhinus capensis</i>	Spotted Thick-knee	36	4
<i>Vanellus armatus</i>	Blacksmith Lapwing	39	3
<i>Vanellus senegallus</i>	African Wattled Lapwing	16	4
<b><i>Vanellus coronatus</i></b>	<b>Crowned Lapwing</b>	74	5
<i>Cursorius temminckii</i>	Temminck's Courser	<1	2
<i>Elanus caeruleus</i>	Black-shouldered Kite	47	4
<i>Milvus migrans</i>	Black Kite	14	2
<i>Buteo vulpinus</i>	Steppe Buzzard	5	4
<i>Falco naumanni</i>	Lesser Kestrel (VU)	1	2
<i>Falco rupicolus</i>	Rock Kestrel	<1	1
<i>Falco rupicoloides</i>	Greater Kestrel	5	4
<i>Falco amurensis</i>	Amur Falcon	1	4
<b><i>Ardea melanocephala</i></b>	<b>Black-headed Heron</b>	40	5
<b><i>Bubulcus ibis</i></b>	<b>Cattle Egret</b>	71	5
<b><i>Bostrychia hagedash</i></b>	<b>Hadedda Ibis</b>	86	4
<i>Ciconia ciconia</i>	White Stork	2	2
<i>Telophorus zeylonus</i>	Bokmakierie	64	4
<b><i>Corvus albus</i></b>	<b>Pied Crow</b>	64	5
<i>Lanius collurio</i>	Red-backed Shrike	1	1

SCIENTIFIC NAME	ENGLISH NAME	R RATE (%) <sup>*</sup>	HABITAT PREFERENCE
		2528CC	OG
<i>Lanius minor</i>	Lesser Grey Shrike	1	1
<b><i>Lanius collaris</i></b>	<b>Common Fiscal</b>	90	5
<b><i>Riparia cincta</i></b>	<b>Banded Martin</b>	1	5
<b><i>Hirundo rustica</i></b>	<b>Barn Swallow</b>	28	5
<i>Hirundo albigularis</i>	White-throated Swallow	22	4
<b><i>Hirundo cucullata</i></b>	<b>Greater Striped Swallow</b>	34	5
<i>Hirundo abyssinica</i>	Lesser Striped Swallow	20	4
<i>Hirundo spilodera</i>	South African Cliff-Swallow	10	4
<i>Hirundo fuligula</i>	Rock Martin	18	4
<i>Delichon urbicum</i>	Common House-Martin	5	1
<b><i>Pycnonotus tricolor</i></b>	<b>Dark-capped Bulbul</b>	89	4
<i>Cisticola tinniens</i>	Levaillant's Cisticola	10	2
<i>Cisticola fulvicapilla</i>	Neddicky	16	4
<b><i>Cisticola juncidis</i></b>	<b>Zitting Cisticola</b>	11	5
<b><i>Cisticola aridulus</i></b>	<b>Desert Cisticola</b>	3	5
<b><i>Cisticola textrix</i></b>	<b>Cloud Cisticola</b>	3	5
<i>Cisticola ayresii</i>	Wing-snapping Cisticola	1	3
<i>Prinia subflava</i>	Tawny-flanked Prinia	22	4
<b><i>Prinia flavicans</i></b>	<b>Black-chested Prinia</b>	22	5
<b><i>Mirafrā cheniana</i></b>	<b>Melodious Lark (NT)</b>	<1	5
<i>Mirafrā africana</i>	Rufous-naped Lark	21	4
<b><i>Mirafrā fasciolata</i></b>	<b>Eastern Clapper Lark</b>	5	5
<i>Chersomanes albofasciata</i>	Spike-heeled Lark	2	4
<i>Calandrella cinerea</i>	Red-capped Lark	4	3
<i>Saxicola torquatus</i>	African Stonechat	15	4
<i>Oenanthe pileata</i>	Capped Wheatear	3	4
<i>Cercomela familiaris</i>	Familiar Chat	2	2
<i>Myrmecocichla formicivora</i>	Ant-eating Chat	8	2
<i>Onychognathus morio</i>	Red-winged Starling	23	0
<b><i>Lamprotornis nitens</i></b>	<b>Cape Glossy Starling</b>	46	4
<i>Spreo bicolor</i>	Pied Starling	9	2
<i>Creatophora cinerea</i>	Wattled Starling	1	1
<i>Acridotheres tristis</i>	Common Myna (INT)	46	4
<i>Chalcomitra amethystina</i>	Amethyst Sunbird	32	3
<i>Cinnyris talatala</i>	White-bellied Sunbird	37	2
<i>Ploceus capensis</i>	Cape Weaver	22	2
<b><i>Ploceus velatus</i></b>	<b>Southern Masked-Weaver</b>	73	5
<i>Quelea quelea</i>	Red-billed Quelea	5	3
<i>Euplectes afer</i>	Yellow-crowned Bishop	5	4
<i>Euplectes orix</i>	Southern Red Bishop	38	4
<i>Euplectes albonotatus</i>	White-winged Widowbird	10	4
<b><i>Euplectes ardens</i></b>	<b>Red-collared Widowbird</b>	9	5
<i>Euplectes progne</i>	Long-tailed Widowbird	25	4
<i>Ortygospiza atricollis</i>	African Quailfinch	7	4

SCIENTIFIC NAME	ENGLISH NAME	R RATE (%) <sup>*</sup> 2528CC	HABITAT PREFERENCE
			OG
<i>Amadina erythrocephala</i>	Red-headed Finch	3	3
<i>Estrilda astrild</i>	Common Waxbill	10	4
<i>Vidua macroura</i>	Pin-tailed Whydah	18	4
<b><i>Passer melanurus</i></b>	<b>Cape Sparrow</b>	91	5
<i>Passer diffusus</i>	Southern Grey-headed Sparrow	24	4
<i>Motacilla capensis</i>	Cape Wagtail	70	3
<b><i>Macronyx capensis</i></b>	<b>Cape Longclaw</b>	19	5
<b><i>Anthus cinnamomeus</i></b>	<b>African Pipit</b>	14	5
<i>Anthus leucophrys</i>	Plain-backed Pipit	<1	2
<i>Anthus vaalensis</i>	Buffy Pipit	<1	2
<i>Crithagra mozambicus</i>	Yellow-fronted Canary	7	2
<i>Crithagra atrogularis</i>	Black-throated Canary	28	4
<i>Crithagra gularis</i>	Streaky-headed Seedeater	13	4
<i>Emberiza tahapisi</i>	Cinnamon-breasted Bunting	3	3
Biodiversity Index:			368

\*The reporting rate is calculated as follows: Total number of cards on which a species was reported X 100 ÷ total number of cards for a particular quarter degree grid cell. INT = Introduced or alien birds species to Southern Africa.

#### Red Data Species Categories for the birds (Barnes, 2000)

RE = Regionally extinct, CR = Critically Endangered EN = Endangered, VU = Vulnerable, NT = Near-threatened.

#### Threatened and Red Listed Bird Species

The following Red Data bird species were recorded for the 2528CC quarter degree grid cell (q.d.g.c) according to Harrison *et al.* (1997) and Tarboton *et al.* (1987) (Table 9).

**Table 9:** Red Data bird species recorded for the 2528CC q.d.g.c.

SCIENTIFIC NAME	ENGLISH NAME	R RATE (%) <sup>*</sup> 2528CC CENTURION
<i>Nettapus auritus</i>	African Pygmy-Goose (NT)	(T)
<i>Alcedo semitorquata</i>	Half-collared Kingfisher (NT)	1(T)
<i>Tyto capensis</i>	African Grass-Owl (VU)	2(Tb)
<i>Neotis denhami</i>	Denham's Bustard (VU)	(T)
<i>Eupodotis caerulescens</i>	Blue Korhaan (NT)	(Tb)
<i>Eupodotis senegalensis</i>	White-bellied Korhaan (VU)	<1(T)
<i>Anthropoides paradiseus</i>	Blue Crane (VU)	3(Tb)
<i>Podica senegalensis</i>	African Finfoot (VU)	<1(T)
<i>Crex crex</i>	Corn Crake (VU)	(T)
<i>Rostratula benghalensis</i>	Greater Painted-snipe (NT)	(T)
<i>Glareola nordmanni</i>	Black-winged Pratincole (NT)	(T)
<i>Gyps coprotheres</i>	Cape Vulture (VU)	<1(T)
<i>Aegypius tracheliotus</i>	Lappet-faced Vulture (VU)	(T)
<i>Circus ranivorus</i>	African Marsh-Harrier (VU)	<1(Tb)
<i>Circus macrourus</i>	Pallid Harrier (NT)	(T)
<i>Aquila ayresii</i>	Ayres's Hawk-Eagle (NT)	<1(T)

SCIENTIFIC NAME	ENGLISH NAME	R RATE (%)* 2528CC CENTURION
<i>Polemaetus bellicosus</i>	Martial Eagle (VU)	<1(T)
<i>Sagittarius serpentarius</i>	Secretarybird (NT)	(Tb)
<i>Falco naumanni</i>	Lesser Kestrel (VU)	1(T)
<i>Falco biarmicus</i>	Lanner Falcon (NT)	1(Tb)
<i>Gorsachius leuconotus</i>	White-backed Night-Heron (VU)	(T)
<i>Pelecanus onocrotalus</i>	Great White Pelican (NT)	(T)
<i>Pelecanus rufescens</i>	Pink-backed Pelican (VU)	(T)
<i>Mycteria ibis</i>	Yellow-billed Stork (NT)	<1(T)
<i>Ciconia nigra</i>	Black Stork (NT)	<1(T)
<i>Mirafra cheniana</i>	Melodious Lark (NT)	<1(T)
	<b>Very Low :</b>	<b>12</b>
	<b>Low :</b>	<b>2</b>
	<b>Medium :</b>	<b>0</b>
	<b>High :</b>	<b>0</b>
	<b>TOTAL :</b>	<b>14</b>
	<b>Tarboton :</b>	<b>20</b>
	<b>Tarboton breeding:</b>	<b>6</b>
		<b>26</b>

\*The reporting rate is calculated as follows: Total number of cards on which a species was reported X 100 ÷ total number of cards for a particular quarter degree grid cell.

**Red Data Species Categories for the birds** (Barnes, 2000)

**RE** = Regionally extinct, **CR** = Critically Endangered **EN** = Endangered, **VU** = Vulnerable, **NT** = Near-threatened.

Twenty-six Red Data bird species have been recorded within the 2528CC q.d.g.c (Table 9). Thirteen of these have disappeared from the area or were not recorded for this quarter degree grid cell during the time of the southern African Bird Atlas project. It is unlikely that they will ever be seen in this region again except maybe on rare occasions in protected areas. Six of these species used to breed within the said q.d.g.c (Tarboton, 1987) and only one, the African Grass-Owl, has been recorded as a breeding species for the q.d.g.c. during the period of the Southern African bird atlas project. This decline in breeding species is probably due to the large extent of development that took place during a short space of time. As with the African Grass-Owl, the Blue Crane also show a low reporting rate but the habitat on site and the level of disturbance will not favour Blue Crane. The rest of the Red Data species that have been recorded shows a very low reporting rate and will more than likely only move through the area on rare occasions.

### **Summary of the Red Data bird species**

Table 10 provides a list of the Red Data bird species recorded for the 2528CC q.d.g.c according to Harrison *et al.* (1997) and an indication of the likelihood of occurring on the study site based on habitat and food availability on site.



**Table 10:** Red Data bird species assessment for the 2528CC q.d.g.c .

SCIENTIFIC NAME	PRESENCE OF SUITABLE HABITAT	LIKELIHOOD OF OCCURRENCE ON STUDY SITE
<i>Alcedo semitorquata</i> (Half-collared Kingfisher) (NT)	None. Prefers clear fast-flowing rivers fringed with riparian growth.	Highly unlikely
<i>Tyto capensis</i> (African Grass-Owl) (VU)	None. Prefers rank moist grassland bordering vleis.	Highly unlikely
<i>Eupodotis senegalensis</i> (White-bellied Korhaan) (VU)	None. Prefers tall vegetation, typically fairly dense grassland in either open or lightly wooded regions and seems abundant in hilly areas (Barnes, 2000).	Unlikely
<i>Anthropoides paradiseus</i> (Blue Crane) (VU)	None. Prefers more open grassland and Karroid grassland. Might on occasion just move over the area.	Highly unlikely
<i>Podica senegalensis</i> (African Finfoot) (VU)	None. Prefers clear, perennial rivers and streams, lined with reeds, overhanging trees and shrubs.	Highly unlikely.
<i>Gyps coprotheres</i> (Cape Vulture) (VU)	None. Their presence is dependent on the availability of food otherwise they are only likely to move over the area on rare occasions.	Highly unlikely.
<i>Circus ranivorus</i> (African Marsh-Harrier) (VU)	None. Dependent on large permanent wetlands for breeding, roosting and foraging.	Highly unlikely
<i>Aquila ayresii</i> (Ayres's Hawk-Eagle) (NT)	None.	Highly unlikely
<i>Polemaetus bellicosus</i> (Martial Eagle) (VU)	None. It is found in flat country and rarely in suburbia. Rare visitor to the region.	Highly unlikely
<i>Falco naumanni</i> (Lesser Kestrel) (VU)	None. Palaearctic migrant. Prefers open country such as pristine open grassland and pastures for foraging purposes.	Unlikely. Only on rare occasions
<i>Falco biarmicus</i> (Lanner Falcon) (NT)	None.	Highly unlikely.
<i>Mycteria ibis</i> (Yellow-billed Stork) (NT)	None. Prefers extensive systems of wetland, notably pans, marshes, lakes and floodplains.	Highly unlikely
<i>Ciconia nigra</i> Black Stork (NT)	None. Prefers shallow waterbodies such as estuaries and rivers.	Highly unlikely
<i>Mirafra cheniana</i> Melodious Lark (NT)	<b>Yes:</b> Prefers dry open climax grassland dominated by <i>Themeda triandra</i> grass.	Observed on site

### 6.3 Reptiles and Amphibians:

During the inspection, the site was evaluated for the potential occurrence of Red Data and Near Threatened species, such as the Striped Harlequin Snake, Duerden's Stiletto Snake and the Giant Bullfrog. The two Red Data snake species have not been recorded in this quarter degree grid cell. As only a few active termitaria were noticed along the edge of the site, they are not expected to occur here. The Giant Bullfrog has been recorded from the adjacent quarter degree grid cell to the east, of which the edge is very close to this site (Minter *et al*, 2004). This frog is well known from the general area and although not verified, may very well be present on this site.

**Table 11:** The Reptiles and Amphibians that could occur on the site

SCIENTIFIC NAME	ENGLISH NAME	PROBABILITY OF OCCURRENCE
<b>CLASS: AMPHIBIA</b>	<b>AMPHIBIANS</b>	
<b>Order: ANURA</b>	<b>FROGS</b>	
<b>Family: Bufonidae</b>	<b>Toads</b>	
<i>Bufo gutturalis</i>	Guttural Toad	Low
<i>Bufo rangeri</i>	Ranger's Toad	Low
<b>CLASS: REPTILIA</b>	<b>REPTILES</b>	
<b>ORDER: SQUAMATA</b>	<b>SCALE-BEARING REPTILES</b>	
<b>Suborder: LACERTILIA</b>	<b>LIZARDS</b>	
<b>Family: Gekkonidae</b>	<b>Geckos</b>	
<i>Pachydactylus affinis</i>	Transvaal Thick-toed Gecko	Low
<i>Pachydactylus capensis</i>	Cape Thick-toed Gecko	Low
<b>Family: Agamidae</b>	<b>Agamids</b>	
<i>Agama aculeata distanti</i>	Distant's Ground Agama	Low
<b>Family: Scincidae</b>	<b>Skinks</b>	
<i>Panaspis wahlbergii</i>	Wahlberg's Snake-eyed Skink	Low
<i>Acontias percivali occidentalis</i>	Percival's Legless Skink	Low
<i>Trachylepis punctatissimus</i>	Speckled Skink	Medium
<b>Suborder: SERPENTES</b>	<b>SNAKES</b>	
<b>Family: Typhlopidae</b>	<b>Blind Snakes</b>	
<i>Typhlops bibronii</i>	Bibron's Blind Snake	Low
<b>Family: Leptotyphlopidae</b>	<b>Thread Snakes</b>	
<i>Leptotyphlops scutifrons</i>	Peters' Thread Snake	Medium
<i>Leptotyphlops incognitus</i>	?	Low
<b>Family: Atractaspididae</b>	<b>African Burrowing Snakes</b>	
<i>Atractaspis bibronii</i>	Bibron's Stiletto Snake	Low
<i>Aparallactus capensis</i>	Cape Centipede-eater	Low
<b>Family: Colubridae</b>	<b>Typical Snakes</b>	
<i>Lamprophis aurora</i>	Aurora Snake	Low
<i>Lamprophis capensis</i> (= <i>fuliginosus</i> )	Brown House Snake	Low
<i>Lycophidion capense</i>	Cape Wolf Snake	Low
<i>Prosymna sundevallii</i>	Sundevall's Shovel-snout	Medium

SCIENTIFIC NAME	ENGLISH NAME	PROBABILITY OF OCCURRENCE
<i>Dasypeltis scabra</i>	Rhombic Egg-eater	Low
<b>Family: Elapidae</b>	<b>Cobras, Mambas, other Elapids</b>	
<i>Hemachatus haemachatus</i>	Rinkhals	Low
<i>Homoroselaps dorsalis</i>	Striped Harlequin Snake	Low

## 7. FINDINGS AND POTENTIAL IMPLICATIONS

### 7.1 Flora

During the most recent visit, the study site was found to be unchanged except for a deep services trench that ran along the eastern boundary of the site. Division of the large area of Natural primary grassland into small townships without corridors of natural vegetation to facilitate connectivity will result in destruction of the natural plant species diversity of the area.

The habitat of the Natural primary grassland and the Rocky outcrop vegetation was suitable for the Orange-listed *Hypoxis hemerocallidea* (African potato). This species was found sparsely scattered in these two vegetation communities. These plants should be relocated to a safe, suitable area approved by GDACE.



**Photo 4: Services trench dug through part of the Rocky outcrop vegetation along the eastern boundary of the site**

## 7.2 Fauna

### 7.2.1 Mammals

The proposed development will not result in a loss of ecological sensitive and important habitat units, ecosystem function (e.g. reduction in water quality, soil pollution), loss of faunal habitat, nor of loss/displacement of threatened or protected fauna.

### 7.2.2 Avifauna

The open grassland on site offers ideal habitat conditions for Melodious Larks for both breeding and foraging purposes. Several displaying male Melodious Larks were observed on the study site.

#### **The Melodious Lark (*Mirafra cheniana*)**

The Melodious Lark is listed in the *Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland* (Barnes 2000) but has been removed from GDACE's list of priority species.

The Melodious Lark is a southern Africa endemic and is an uncommon resident bird species of which their numbers and range have been greatly reduced due to habitat destruction. It appears to be sensitive to overgrazing (Barnes 2000) and land-use changes in the grasslands may severely impact this species (Stattersfield *et al.* 1998).

This species has a very low reporting rate (<1%) for the 2528CC quarter degree square grid cell as well as most of the central Gauteng area according to Harrison *et al.* (1997). Despite the low reporting rate, several individual male Melodious Larks were observed displaying over the open grassland during this bird habitat survey.

Particular references were made to the possible occurrence of White-bellied Korhaan (*Eupodotis senegalensis*) on the study site:

#### **White-bellied Korhaan (*Eupodotis senegalensis*)**

Criteria for IUCN threatened category: A1c; A2c; C1. Status: Vulnerable

Habitat: According to Barnes (2000) it inhabits relatively tall vegetation, typically fairly dense grassland in either open or lightly wooded regions. It seems to be most abundant in hilly areas at the interface between the grassland and savanna biomes (Tarboton *et al.* 1987). They occur in low abundance in severely grazed and recently burnt sites (Barnes 2000).

Threats: Within Gauteng habitat loss through crop farming, overgrazing, burning and high human densities are the main reasons for the population decline of this species. Even where suitable habitat exists, it is often modified by inappropriate fire regimes and grazing practices (Barnes 2000). The genetic integrity of this species may be threatened because of severely fragmented distribution (Barnes 2000).

On site conclusion: The habitat on the study site is disturbed by human presence. Humans move over the area to the squatter camp that is situated to the north of the study site and a network of human track crisscross most parts of the study site. Although the habitat could still favour White-bellied Korhaan, it is doubtful if they will make use of the open grassland on site due to the human presence.

### 7.2.3 Reptiles and Amphibians

This study site was originally covered by Carletonville Dolomite Grassland (Mucina *et al*, 2006) on a fairly homogeneous clayey to stony substrate of the Timeball Hill Formation. Apart from a clump of trees on the northeastern border, hardly any woody plants occur. Dolomite does not weather in a way that provides cracks suitable as retreats for reptiles and amphibians. Therefore, this environment has a limited number of niches but conditions are improved in the areas where there is a presence of termitaria. Of those, once in moribund state, they will provide additional suitable retreats for small animals, including dry-land amphibians and reptiles. Species diversity and population densities are not expected to be high.



**Photo 5: View across open grassveld with termitaria and exposed rocks of the northern section of Monavoni x 44 towards the Microlite Airstrip**

Although the 'Near Threatened' Giant Bullfrog (*Pyxicephalus adspersus*) has been recorded from this quarter degree grid cell (Minter *et al*, 2004), the terrain on this site does not appear suitable as dispersal area as the substrate is not suitable for burrowing. Odd individuals from adjacent areas may occasionally occur but the terrain on the study site is not suitable to form shallow breeding ponds for the full lifecycle. The intensive development in the general area precludes the future presence of the Giant Bullfrog. The Striped Harlequin Snake (*Homoroselaps dorsalis*), a very rarely recorded species (Only 12 recorded for Gauteng, Jacobsen, 1995) and consequently a Red Data species, has been recorded from Farm Swartkop 383JR in this quarter degree grid cell.



## 8. LIMITATIONS, ASSUMPTIONS AND GAPS IN KNOWLEDGE

None

## 9. RECOMMENDED MITIGATION MEASURES

Mitigation measures proposed by the specialists

- Should hedgehogs be encountered during the construction and operational phase of the development, these should be relocated to natural grassland areas in the vicinity.
- The contractor must ensure that no fauna species are disturbed, trapped, hunted or killed during the construction phase. Conservation-orientated clauses should be built into contracts for construction personnel, complete with penalty clauses for non-compliance.
- It is important to note that the trenches for the water pipeline and even those for sewage lines do not need to be wide, which means that the environmental damage caused by the actual digging can be reduced to a minimum. However, while they are open their presence will mean that wildlife of any size may fall into them, from where it will be difficult to escape and death may be caused by drowning, excessive exposure to the sun or by being buried alive during the final construction work.
- Environmental damage caused by these trenches may be kept to a minimum by good forward planning and thereby reducing the actual length of time that they are open. Possible damage to wildlife is in direct proportion to the time that these trenches are open and may destroy amphibian and reptilian species.
- The design of the stormwater lines is not known. If large diameter cement pipes are used and the trenches are closed again, potential danger become reduced by filling in the trenches. Open stormwater channels are dangerous, as they will continuously contribute to wildlife destruction.



**Photo 6: Open trench across grassveld on farm Stukgrond which is a hazardous situation as far as small animals are concerned.**



The following mitigation measures were developed by GDACE (Directorate of Nature Conservation, GDACE, 2008) and are applicable to the study site.

- All areas designated as sensitive in a sensitivity mapping exercise (see *Sensitivity Mapping Rules for Biodiversity Assessments*) should be incorporated into an open space system and registered against the title deeds as a conservation servitude. Development should be located on the areas of lowest sensitivity.\*
- Development structures should be clustered as close as possible to existing development.\*
- An independent suitably qualified individual registered in accordance with the Natural Scientific Professions Act (No. 27 of 2003) should act as the environmental control officer.\*
- An appropriate management authority (e.g. the body corporate) that is contractually bound to implement the Environmental Management Plan (EMP) and Record Of Decision (ROD) during the operational phase of the development should be identified.\*
- An ecological management plan for the open space system should be compiled by a specialist registered in accordance with the Natural Scientific Professions Act (No. 27 of 2003) in the fields of Botanical / Ecological / Zoological Science. This ecological management plan should form part of the EMP.\*
- The ecological management plan should:
  - include a fire management programme to ensure persistence of grassland\*
  - include an ongoing monitoring and eradication programme for all non-indigenous species, with specific emphasis on invasive and weedy species\*
  - ensure the persistence of all Red and Orange List species\*
  - include a monitoring programme for all Red and Orange List species\*
  - facilitate/augment natural ecological processes\*
  - provide for the habitat and life history needs of important pollinators\*
  - minimize artificial edge effects (e.g. water runoff from developed areas & application of chemicals)\*
  - include management recommendations for neighbouring land, especially where correct management on adjacent land is crucial for the long-term persistence of sensitive species present on the development site\*
  - result in a report back to the Directorate of Nature Conservation on an annual basis\*
  - investigate and advise on appropriate legislative tools (e.g. the NEMA: Protected Areas Act 57 of 2003) for formally protecting the area (as well as adjacent land where it is crucial for the long-term persistence of sensitive species present on the development site)\*
- A copy of the ecological management plan should be provided to all neighbouring landowners.\*
- A funding mechanism that will cover the cost of implementing the ecological management plan should be established.\*
- All areas earmarked for development should be fenced off from the open space system prior to construction commencing (including site clearing and pegging). All construction-related impacts (including service roads, temporary housing, temporary ablution, disturbance of natural habitat, storing of equipment/building materials/vehicles or any other activity) should be contained within the fenced-off development areas. Access of vehicles to the open space system should be prevented and access of people should be controlled, both during the

construction and operational phases. Movement of all indigenous fauna should however be allowed (i.e. no solid walls, e.g. through the erection of palisade fencing), unless otherwise specified in another condition.\*

- Compacting of soil should be avoided in areas to be included in the open space system.\*
- Connectivity between the open space system and adjacent natural vegetation / open space systems should be ensured.\*
- Only species indigenous to South Africa should be used for landscaping / gardens within 200m of the open space system. Plant species indigenous to the natural vegetation of the area are preferred. As far as possible, plants naturally growing on the development site, but would otherwise be destroyed during clearing for development purposes, should be incorporated into landscaped areas. Forage and host plants required by pollinators should also be planted in landscaped areas.\*

#### **General mitigatory measures:**

- Where possible, trees naturally growing on the site should be retained as part of the landscaping, with specific emphasis on the following species: *Acacia erioloba*, *Boscia albitrunca*, *Combretum imberbe*, *Pittosporum viridiflorum*, *Prunus africana*, *Sclerocarya birrea* subsp. *caffra*. Measures to ensure that these trees survive the physical disturbance from the development should be implemented. A tree surgeon should be consulted in this regard. \*
- In order to minimize artificially generated surface storm water runoff, total sealing of paved areas such as parking lots, driveways, pavements and walkways should not be permitted. Permeable material should rather be utilized for these purposes.\*

#### **Red Listed Birds**

When Red Listed birds occur or potentially occur on site, the following mitigatory measures are recommended:

- Construction activities should be timed to coincide with the period when the Red Listed bird species that could potentially occur on site are unlikely to be breeding.\*

#### **Non-Sensitive Sites**

When sensitive areas are **not** present on the proposed development site, the following mitigatory measures are recommended:

- A rescue operation for medicinal plants should be undertaken. The Gauteng Directorate of Nature Conservation (Head: Bioregional Planning; Michele.Pfab@gauteng.gov.za) should be contacted with regard to the co-ordination of such an operation.\*
- A surface runoff and stormwater management plan should be compiled.\*

#### **Roads Pipelines / Powerlines**

- The appropriate agency should implement an ongoing monitoring and eradication programme for all invasive and weedy plant species growing within the servitude.\*
- Any post-development re-vegetation or landscaping exercise may only use species indigenous to South Africa. Plant species locally indigenous to the area

are preferred. As far as possible, plants naturally growing along the route, but would otherwise be destroyed during construction, should be used for re-vegetation / landscaping purposes.\*

- Where a road / railway / pipeline/ power line is to traverse a wetland, measures are required to ensure that the road / railway / pipeline/ power line has minimal effect on the flow of water through the wetland, e.g. by using a high level clear-span bridge or box culverts rather than pipes.\*
- Prior to construction, fences should be erected in such a manner to prevent access and damage to any sensitive areas identified in a sensitivity mapping exercise (see *Sensitivity Mapping Rules for Biodiversity Assessments*).\*
- Sealing of surfaces under a bridge or gabion construction should be avoided.\*

The following recommended mitigatory measures only apply to **roads**:

- Appropriate road design and traffic control measures are recommended to reduce air pollution and animal mortality.\*
- All storm water structures should be designed so as to block amphibian and reptile access to the road surface.\*
- Suitable terrestrial underpasses should be provided to facilitate safe movement of animals, specifically where roads traverse ridges or habitat suitable for any Red/Orange List amphibian/ reptile/ mammal species. The number and spacing of underpasses will need to be determined by a specialist registered in accordance with the Natural Scientific Professions Act (No. 27 of 2003) in the fields of Ecological / Zoological Science. All underpasses should be dressed with a layer of sand (minimum 10cm) and should be a minimum of 1.5m x 1.0m so as to facilitate maintenance access. Underpasses should be accessible to maintenance staff and should be cleared of accumulated material at least at the start of each rainy season.\*
- Where roads are associated with power lines and telephone lines (these provide an attraction for species that hunt from perches), road margins should be mowed and/or burned regularly to prevent the accumulation of grass cover that could provide refuge for small mammals.\*
- A comprehensive surface runoff and storm water management plan should be compiled, indicating how all surface runoff generated as a result of the road development (during both the construction and operational phases) will be managed (e.g. artificial wetlands / storm water and flood retention ponds) prior to entering any natural drainage system or wetland and how surface runoff will be retained outside of any demarcated buffer/flood zones and subsequently released to simulate natural hydrological conditions. This plan should form part of the EMP.\*

The following recommended mitigatory measures only apply to **power lines / telephone lines / communication masts / cell phone towers**:

- Where communication masts / cell phone towers / overhead lines (power lines or telephone lines) are to be constructed within/adjacent to urban open space systems or within rural areas, the Eskom-EWT strategic partnership should advise on appropriate mitigatory measures.\*
- The design (including mitigation measures) and location of any proposed power lines (whether new alignments or refurbishment/upgrading of existing lines) should be endorsed by the bird conservation experts of the Eskom-EWT strategic partnership.\*

## 10. CONCLUSIONS

### Flora:

No Red-listed plant species were found. The Natural primary grassland on the site was deemed sensitive. The Orange-listed *Hypoxis hemerocallidea* (African potato) was found sparsely scattered in the Natural primary grassland and the Rocky outcrop vegetation habitats. These plants should be relocated to a safe, suitable area approved by GDACE. Corridors of Natural primary grassland that have not been disturbed by services trenches should be excluded in all the planned new townships of Monavoni and on the neighbouring sites that are to be developed together with these sites. These corridors should be connected to the rocky outcrop on the study site and on the other portions that are being developed and to the *Acacia karroo* vegetation in the eastern part of Monavoni to facilitate connectivity. These areas must be properly managed throughout the lifespan of the project in terms of fire, eradication of exotics etc. to ensure continuous biodiversity.

### Mammals:

Most, if not all the terrestrial species listed as potential occupants of the site, will be displaced as a result of the proposed development. This will have no effect on the global conservation status of most of the species. However, the loss of the three Red Listed species is regrettable, although when expressing the magnitude of the loss in statistical terms it would most probably be negligible.

### Birds:

Although the habitat on the study site could still favour White-bellied Korhaan, it is doubtful if they will make use of the open grassland due to the human presence.

The open grassland habitat on site offers suboptimal habitat for the Melodious Larks. This species has however been removed from GDACE's list of priority species.

The proposed development should not have a negative affect on any of the other Red Data bird species listed above due to the high level of human disturbance on site. In addition, there is a lack of sufficient breeding, foraging and breeding habitat for the mentioned Red Data bird species.

### Reptiles and Amphibians:

The site appears suitable for a relatively limited number of amphibian and reptile species. A specimen of the Striped Harlequin Snake (*Homoroselaps dorsalis*), a Red Data Species, has been recorded from the farm Swartkop 383 JR (Jacobsen, 1995), in this quarter degree grid cell. This proves the presence of this species in this area but it is practically impossible to confirm this record as occurring on this site. As this snake tends to live underground in burrows or tunnels, where it feeds exclusively on Thread Snakes (*Leptotyphlops* spp.), it is usually only found accidentally when dead termitaria are destroyed. To attempt to confirm the presence of this species in an area, it would be necessary to destroy a large number of dead termitaria, which would reduce the suitability of the area for the survival of this snake and other reptiles. Since it appears that this species occurs in relatively low densities it is impossible to suggest conservation measures.

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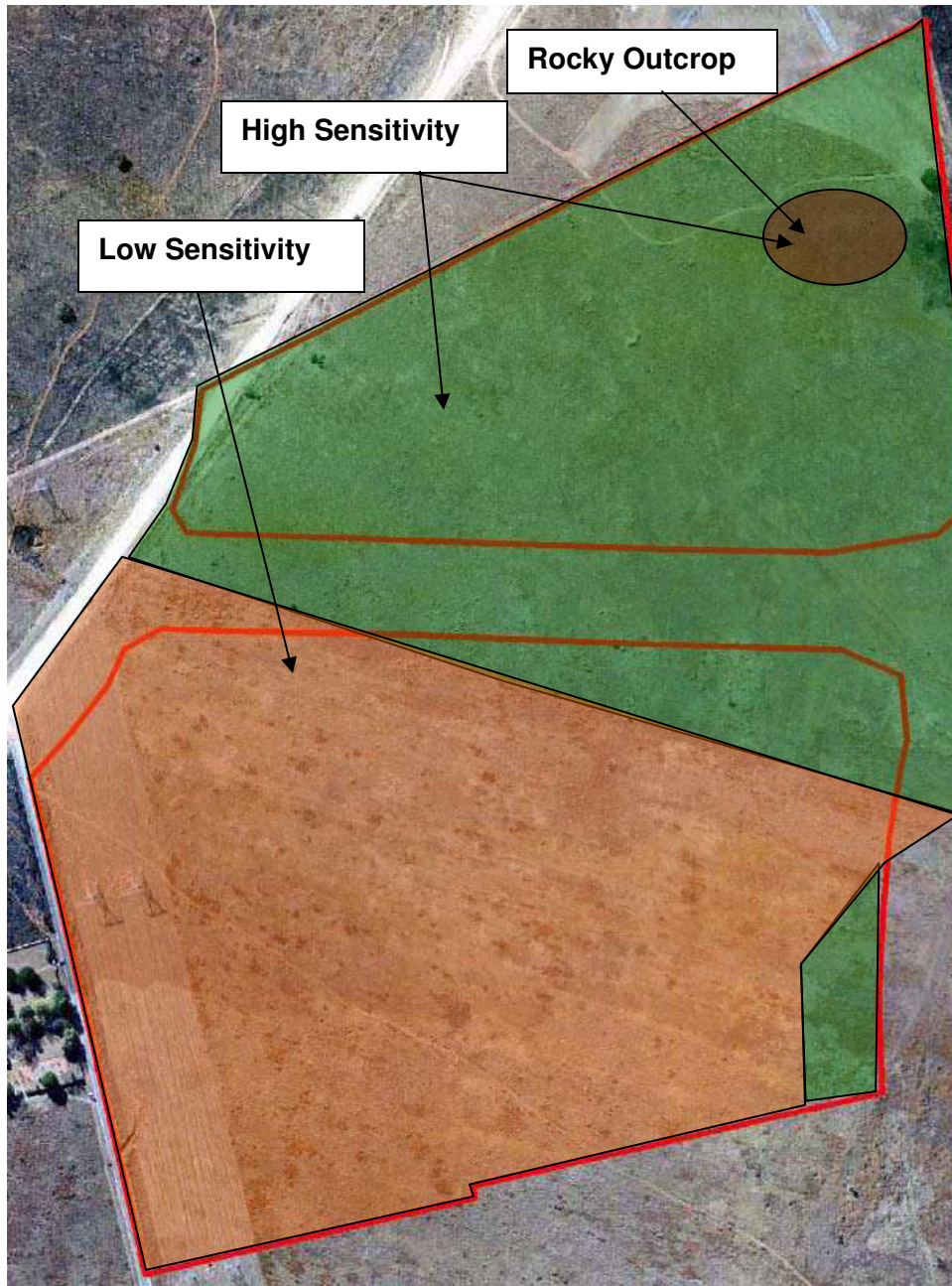
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# APPENDIX A

## *Sensitivity map*



## APPENDIX B

### *Red and Orange-listed\* plants of the 2528CC q.d.g.s.*

Species	Flowering season	Suitable habitat	Priority grouping	Conservation status	PRESENCE ON SITE
<i>Bonatea speciosa</i> var. <i>speciosa</i>	Jan-Mar	Savanna.	N/A	Declining <sup>2</sup>	Habitat not suitable
<i>Bowiea volubilis</i>	Sep-Apr	Shady places, steep rocky slopes and in open woodland, under large boulders in bush or low forest.	N/A	Declining <sup>2</sup>	Habitat not suitable
<i>Ceropegia decidua</i> subsp. <i>pretoriensis</i>	Nov-Apr	Direct sunshine or shaded situations, rocky outcrops of the quartzitic Magaliesberg mountain series, in pockets of soil among rocks, in shade of shrubs and low trees, can be seen twining around grass spikes.	A1	Vulnerable <sup>1</sup>	Habitat not suitable
<i>Cheilanthes deltoidea</i>	Feb-Jun	Sheltered rock crevices predominantly on granite or gneiss rock formations; on chert outcrops.	A2	Data Deficient <sup>1</sup>	Habitat not suitable
<i>Cleome conrathii</i>	Mar-May	On stony slopes, usually on sandy soil, open to closed deciduous woodland, quartzites, red sandy soil, all aspects, 1515m.	A3	Near Threatened <sup>1</sup>	Habitat not suitable
<i>Eucomis autumnalis</i> subsp. <i>clavata</i>	Nov-Apr	Open grassland, marshes.	N/A	Declining <sup>2</sup>	Habitat not suitable
<i>Habenaria barbertoni</i>	Feb-Mar	In grassland on rocky hillsides.	A2	Vulnerable <sup>1</sup>	Habitat not suitable
<i>Habenaria kraenzliniana</i>	Feb-Apr	Terrestrial in stony, grassy hillsides, recorded from 1000 to 1400m.	A3	Near Threatened <sup>1</sup>	Habitat not suitable
<i>Habenaria mossii</i>	Mar-Apr	Open grassland on dolomite or in black sandy soil.	A1	Endangered <sup>1</sup>	Habitat not suitable
<i>Holothrix randii</i>	Sep-Jan	Grassy slopes & rocky ledges.	B	Near Threatened <sup>2</sup>	Habitat not suitable
<i>Hypoxis hemerocallidea</i>	Sep-Mar	Grassland and mixed woodland.	N/A	Declining <sup>2</sup>	<b>FOUND</b>
<i>Melolobium subspicatum</i>	Oct-May	Grassland.	A1	Vulnerable <sup>1</sup>	Habitat not suitable

<sup>1</sup>) global status;

<sup>2</sup>) national status;

\* Orange listed plants have no priority grouping and are designated 'N/A'.

# Annexure L



**Lizelle Gregory**

**From:** GDACE Biodiversity Information (GDACE) [GDACE\_BiodiversityInfo@gauteng.gov.za]  
**Sent:** 29 September 2008 04:53 PM  
**To:** Lizelle Gregory  
**Subject:** RE: Gaut 002/08-09/N0588

With regard to the above project, specialist biodiversity studies are required to investigate the following aspects:

- \* Birds, with specific reference to White-bellied Korhaan.
- \* Reptiles, with specific reference to Striped Harlequin Snake.
- \* Vegetation

Should a wetland be located during site investigations, a wetland specialist study will also be required. Please note that this information is relevant solely for the study site specified in your request. Red List species information relevant to a wider geographic area can be obtained from Lorraine Mills (Lorraine.Mills@gauteng.gov.za). All specialist studies must comply with GDACE Requirements for Biodiversity Assessments. The most recent version of this document can be obtained by e-mailing GDACE\_BiodiversityInfo@gauteng.gov.za or can be downloaded from [www.gdace.gpg.gov.za](http://www.gdace.gpg.gov.za) <file://www.gdace.gpg.gov.za/>. Should the environmental consultant be of the opinion that any of the above specialist studies are unnecessary for the site/activity in question, then an ecologically-based motivation justifying why the studies are deemed unnecessary must be submitted to GDACE as part of the application. This submission will be evaluated and either accepted or returned to the applicant for the completion of the necessary studies. Please do not send follow up inquiries to this message as they will not be processed. For further queries please contact Michele Pfab (Michele.Pfab@gauteng.gov.za).

---

**From:** Lizelle Gregory [mailto:lizelleg@mweb.co.za]  
**Sent:** Fri 9/19/2008 11:23 AM  
**To:** GDACE Biodiversity Information (GDACE)  
**Subject:** FW: Gaut 002/08-09/N0588

To Whom It May Concern:

Please find attached the shapefile for the above mentioned project. If you could send us the relevant specialist studies that is required.

Kind Regards,  
 Willie Wilkins

**Disclaimer:**

This message may contain confidential information and is intended only for the individual named. If you are not the named addressee you should not disseminate, distribute or copy this e-mail. Please notify the sender immediately by e-mail if you have received this e-mail by mistake and delete this e-mail from your system. E-mail transmission cannot be guaranteed to be secured or error-free as information could be intercepted, corrupted, lost, destroyed, arrive late or incomplete, or contain viruses. The sender therefore does not accept liability for any errors or omissions in the content of this message, which arise as a result of e-mail transmission. The Gauteng Provincial Government does not take responsibility for Gauteng Provincial Government users' personal views. Gauteng Provincial Government services available online at: [www.gautengonline.gov.za](http://www.gautengonline.gov.za)

No virus found in this incoming message.  
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Version: 7.5.524 / Virus Database: 270.7.5/1696 - Release Date: 2008/09/28 01:30 PM

# Annexure M





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**RELLY, MILNER AND SHEDDEN**  
Consulting Earth Scientists

P.O. Box 32107  
GLENSTANTIA, 0010  
Tel: (012) 993 2049  
Fax: (012) 998 6890  
Cell: 082 551 6034

Our Ref:

08111gma

3 February 2009

M & T Development (Pty) Ltd  
PO Box 39727  
FAERIE GLEN  
0043

For attention: Mr PW Kruger

Dear Sir

**CAVES IN DOLOMITE ON PORTIONS OF HONEYPARK 437-JR, STUKGROND 382-JR AND SWARTKOP 383-JR, CENTURION (TSHWANE METRO).**

This letter is written in response to your request to provide information of the possible presence of caves on the above-mentioned site.

There are no known caves of significance on the site. This firm is involved in the assessment of the dolomite stability of portions of various farm (Honeypark 437-JR, Stukgrond 382-JR and Swartkop 383-JR) in the western part of Centurion (Tshwane Metro). The investigation consisted of collating and assessing the results from one hundred and sixty-eight percussion boreholes. The boreholes have been drilled by various consultants over a 4 year period. Limited field mapping of dolomite and syenite outcrops was undertaken by the writer over the site. No evidence of any caves, whether large or small, was observed during the fieldwork. The writer has been involved in dolomite investigations in this general region for the past 30 years and is unaware of any significant caves on or in the immediate vicinity of this site.

We trust the contents of the letter provides the information required but should any additional information be necessary please do not hesitate to contact us.

Yours faithfully

E Shedden (Pr Sci Nat)  
**RELLY MILNER AND SHEDDEN**

# Annexure N

**Heritage impact survey report for the  
PROPOSED DEVELOPMENT ON VARIOUS HOLDINGS OF  
THE MONAVONI AGRICULTURAL HOLDINGS AREA OF THE  
PRETORIA MAGISTERIAL DISTRICT, GAUTENG**

**THE PROJECT:**

Development of urban housing and a filling station.

**THIS REPORT:**

HERITAGE IMPACT SURVEY REPORT FOR THE PROPOSED DEVELOPMENT ON VARIOUS HOLDINGS OF THE MONAVONI AGRICULTURAL HOLDINGS AREA OF THE PRETORIA MAGISTERIAL DISTRICT, GAUTENG

**Report No:** 2009/JvS/005  
**Status:** Final  
**Revision No:** 0  
**Date:** January 2008

**Prepared for:**

Bokamoso Landscape Architects  
Representative: Ms L Gregory

Postal Address: P O Box 11375, MAROELANA, 0161  
Tel: 012 346 3810  
E-mail: Lizelleg@mweb.co.za

**Prepared by:**

J van Schalkwyk (D Litt et Phil), Heritage Consultant  
ASAPA Registration No.: 168  
Principal Investigator: Iron Age, Colonial Period, Industrial Heritage

Postal Address: 62 Coetzer Avenue, Monument Park, 0181  
Mobile: 076 790 6777  
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## EXECUTIVE SUMMARY

### **HERITAGE IMPACT SURVEY REPORT FOR THE PROPOSED DEVELOPMENT ON VARIOUS HOLDINGS OF THE MONAVONI AGRICULTURAL HOLDINGS AREA OF THE PRETORIA MAGISTERIAL DISTRICT, GAUTENG**

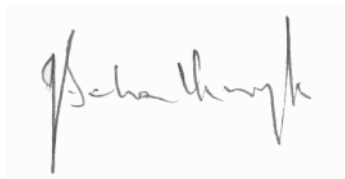
Development is planned for various Holdings in the Monavoni Agricultural Holdings on Portions of the farms Mooiplaats 355JR and Stukgrond 382JR southwest of Pretoria. This involves the building of a housing estate as well as a filling station.

An independent heritage consultant was appointed by **Bokamoso Landscape Architects** to conduct a survey to locate, identify, evaluate and document sites, objects and structures of cultural importance found within the boundaries of the area where the different types of development is to take place.

This HIA report forms part of the Environmental Impact Assessment (EIA) as required by the EIA Regulations in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) and was done in accordance with Section 38 of the National Heritage Resources Act, No. 25 of 1999 and is intended for submission to the South African Heritage Resources Agency (SAHRA).

Very few sites are known to occur in the larger region, mostly informal cemeteries. No sites, features or objects of cultural significance were identified in the study area during the survey. Based on what was found and its evaluation, it is recommended that any development can continue, on condition of acceptance of the following recommendations:

- If construction takes place and archaeological sites are exposed, it should immediately be reported to a museum, preferably one at which an archaeologist is available, so that an investigation and evaluation of the finds can be made.



J A van Schalkwyk  
Heritage Consultant

**TECHNICAL SUMMARY**

<b>Property details</b>						
Province	Gauteng					
Magisterial district	Pretoria					
Topo-cadastral map	2828CC					
Closest town	Pretoria					
Farm name & no.	Mooiplaats 355JR, Stukgrond 382JR					
Portions/Holdings	Various					
Average altitude						
Coordinates	Centre point					
	No	Latitude	Longitude	No	Latitude	Longitude
	1	S 25.86870	E 28.09085			

<b>Development criteria in terms of Section 38(1) of the NHR Act</b>	Yes/No
Construction of road, wall, power line, pipeline, canal or other linear form of development or barrier exceeding 300m in length	
Construction of bridge or similar structure exceeding 50m in length	
Development exceeding 5000 sq m	Yes
Development involving three or more existing erven or subdivisions	
Development involving three or more erven or divisions that have been consolidated within past five years	
Rezoning of site exceeding 10 000 sq m	Yes
Any other development category, public open space, squares, parks, recreation grounds	

<b>Development</b>	
Description	Development of urban housing and a filling station
Project name	Monavoni

<b>Land use</b>	
Previous land use	Agriculture
Current land use	Vacant

<b>Heritage sites assessment</b>		
<i>Site type</i>	<i>Site significance</i>	<i>Site grading (Section 7 of NHRA)</i>
None		
<b>Impact assessment</b>		
<i>Impact</i>	<i>Mitigation</i>	<i>Permits required</i>
None		None



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## **GLOSSARY OF TERMS AND ABBREVIATIONS**

**Study area:** Refers to the entire study area as indicated by the client in the accompanying Fig. 1.

**Stone Age:** The first and longest part of human history is the Stone Age, which began with the appearance of early humans between 3-2 million years ago. Stone Age people were hunters, gatherers and scavengers who did not live in permanently settled communities. Their stone tools preserve well and are found in most places in South Africa and elsewhere.

Early Stone Age	2 000 000 - 150 000 Before Present
Middle Stone Age	150 000 - 30 000 BP
Late Stone Age	30 000 - until c. AD 200

**Iron Age:** Period covering the last 1800 years, when new people brought a new way of life to southern Africa. They established settled villages, cultivated domestic crops such as sorghum, millet and beans, and they herded cattle as well as sheep and goats. These people, according to archaeological evidence, spoke early variations of the Bantu Language. Because they produced their own iron tools, archaeologists call this the Iron Age.

Early Iron Age	AD 200 - AD 900
Middle Iron Age	AD 900 - AD 1300
Late Iron Age	AD 1300 - AD 1830

**Historical Period:** Since the arrival of the white settlers - c. AD 1840 - in this part of the country

## **LIST OF ABBREVIATIONS**

<b>ADRC</b>	Archaeological Data Recording Centre
<b>ASAPA</b>	Association of Southern African Professional Archaeologists
<b>EIA</b>	Early Iron Age
<b>ESA</b>	Early Stone Age
<b>LIA</b>	Late Iron Age
<b>LSA</b>	Later Stone Age
<b>MSA</b>	Middle Stone Age
<b>NHRA</b>	National Heritage Resources Act
<b>PHRA</b>	Provincial Heritage Resources Agency
<b>SAHRA</b>	South African Heritage Resources Agency

## HERITAGE IMPACT SURVEY REPORT FOR THE PROPOSED DEVELOPMENT ON VARIOUS HOLDINGS OF THE MONAVONI AGRICULTURAL HOLDINGS AREA OF THE PRETORIA MAGISTERIAL DISTRICT, GAUTENG

### 1. INTRODUCTION

Development is planned for various Holdings in the Monavoni Agricultural Holdings on Portions of the farms Mooiplaats 355JR aand Stukgrond 382JR southwest of Pretoria. This involves the building of a housing estate as well as a filling station.

An independent heritage consultant was appointed by **Bokamoso Landscape Architects** to conduct a survey to locate, identify, evaluate and document sites, objects and structures of cultural importance found within the boundaries of the area where the different types of development is to take place.

This HIA report forms part of the Environmental Impact Assessment (EIA) as required by the EIA Regulations in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) and was done in accordance with Section 38 of the National Heritage Resources Act, No. 25 of 1999 and is intended for submission to the South African Heritage Resources Agency (SAHRA).

### 2. TERMS OF REFERENCE

The scope of work consisted of conducting a Phase 1 archaeological survey of the site in accordance with the requirements of Section 38(3) of the National Heritage Resources Act (Act 25 of 1999).

This include:

- Conducting a desk-top investigation of the area
- A visit to the proposed development site

The objectives were to

- Identify possible archaeological, cultural and historic sites within the proposed development areas;
- Evaluate the potential impacts of construction, operation and maintenance of the proposed development on archaeological, cultural and historical resources;
- Recommend mitigation measures to ameliorate any negative impacts on areas of archaeological, cultural or historical importance.

### 3. DEFINITIONS AND ASSUMPTIONS

The following aspects have a direct bearing on the survey and the resulting report:

- *Cultural resources* are all non-physical and physical human-made occurrences, as well as natural occurrences that are associated with human activity. These include all sites, structures and artefacts of importance, either individually or in groups, in the history, architecture and archaeology of human (cultural) development.

- The *significance* of the sites and artefacts are determined by means of their historical, social, aesthetic, technological and scientific value in relation to their uniqueness, condition of preservation and research potential. It must be kept in mind that the various aspects are not mutually exclusive, and that the evaluation of any site is done with reference to any number of these.
- Sites regarded as having low significance have already been recorded in full and require no further mitigation. Sites with medium to high significance require further mitigation.
- The latitude and longitude of archaeological sites are to be treated as sensitive information by the developer and should not be disclosed to members of the public.

## 4. STUDY APPROACH AND METHODOLOGY

### 4.1 Extent of the Study

This survey and impact assessment covers the area as presented in Section 5 and as illustrated in Figure 1 - 3.

### 4.2 Methodology

#### 4.2.1 Preliminary investigation

##### 4.2.1.1 Survey of the literature

A survey of the relevant literature was conducted with the aim of reviewing the previous research done and determining the potential of the area. In this regard, various anthropological, archaeological and historical sources were consulted - see the list of references below.

##### 4.2.1.2 Data bases

The *Heritage Atlas Database*, the *Environmental Potential Atlas* and the *National Archives of South Africa* were consulted.

##### 4.2.1.3 Other sources

Aerial photographs and topocadastral and other maps were also studied - see the list of references below.

#### 4.2.2 Field survey

The field survey was done according to generally accepted archaeological practices, and was aimed at locating all possible sites, objects and structures. The area that had to be investigated, was identified by **Bokamoso** by means of maps. The area was investigated by walking across it in a number of transects. Special attention was given to topographical occurrences such as trenches, holes, outcrops and clusters of trees were investigated.

#### 4.2.3 Documentation

All sites, objects and structures that are identified are documented according to the general minimum standards accepted by the archaeological profession. Coordinates of individual

localities are determined by means of the *Global Positioning System (GPS)*<sup>1</sup> and plotted on a map. This information is added to the description in order to facilitate the identification of each locality.

Map datum used: Hartebeeshoek 94 (WGS84).

#### 4.3 Limitations

In some areas the grass cover was high and very dense, which limited archaeological visibility to some extent.

### 5. DESCRIPTION OF THE AFFECTED ENVIRONMENT

#### 5.1 Site location

The study area covers various Portions of the farms Stukgrond 382JR and Mooiplaats 355JR, all in the Monavoni Agricultural Holdings area of the Pretoria magisterial district of Gauteng. For more detail please see the Technical Summary presented above.

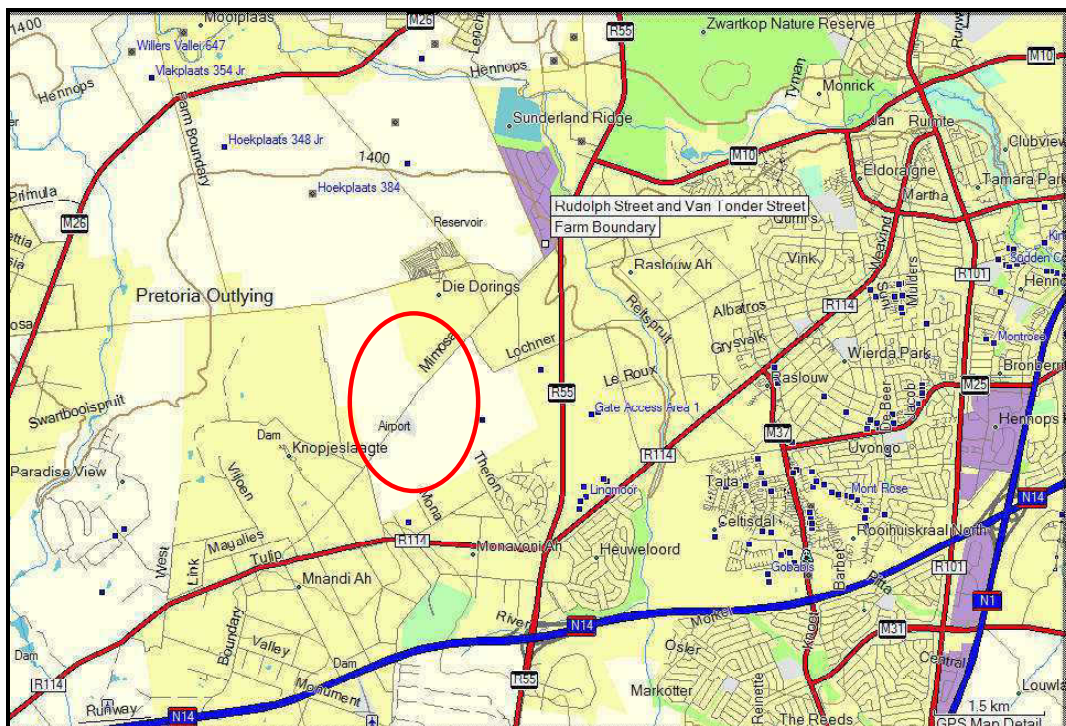


Fig. 1. Location of the study area indicated by the red oval.

<sup>1</sup> According to the manufacturer a certain deviation may be expected for each reading. Care was, however, taken to obtain as accurate a reading as possible, and then to correlate it with reference to the physical environment before plotting it on the map.

## 5.2 Site description

The geology is made up of dolomite and the original vegetation is classified as Rocky Highveld Grassland. Sections of the study area has been impacted on by the illegal dumping of building material. No features (e.g. hills, outcrops, streams or rock shelters) that usually drew people to settle in its vicinity, occurs in the study area.

## 5.3 Identified sites

### 5.3.1 Stone Age

No sites, features or objects dating to the Stone Age were identified.

### 5.3.2 Iron Age

No such sites, objects or features dating to the Iron Age were identified.

### 5.3.3 Historic period

No sites, objects or features dating to historic times were identified.

## 6. SITE SIGNIFICANCE AND ASSESSMENT

### 6.1 Statement of significance

According to the NHR Act, Section 2(vi), the **significance** of heritage sites and artefacts is determined by its aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technical value in relation to the uniqueness, condition of preservation and research potential. It must be kept in mind that the various aspects are not mutually exclusive, and that the evaluation of any site is done with reference to any number of these.

Sites regarded as having low significance are viewed as being recorded in full after identification and would require no further mitigation. Sites with a medium to high significance would require mitigation. Mitigation, in most cases the excavation of a site, is in essence destructive and therefore the impact can be viewed as high and as permanent.

**No sites, features or objects of cultural significance were identified in the study area.**

### 6.2 Impact assessment

Impact analysis of cultural heritage resources under threat of the proposed development, are based on the present understanding of the development.

- As no sites, features or object of cultural significance were identified in the study area, there would be no impact resulting from the proposed development.

## 7. IDENTIFICATION OF RISK SOURCES



A Heritage Impact Assessment is focused on two phases of a proposed development: **the construction and operation phases**. The following project actions may impact negatively on archaeological sites and other features of cultural importance. The actions are most likely to occur during the construction phase of a project.

#### Construction phase:

Possible Risks	Source of the risk
Actually identified risks	
- damage to sites	Construction work
Anticipated risks	
- looting of sites	Curious workers

#### Operation phase:

Possible Risks	Source of the risk
Actually identified risks	
- damage to sites	Not keeping to management plans
Anticipated risks	
- damage to sites	Unscheduled construction/developments
- looting of sites	Visitors removing objects as keepsakes

## 8. RECOMMENDED MANAGEMENT MEASURES

Heritage sites are fixed features in the environment, occurring within specific spatial confines. Any impact upon them is permanent and non-reversible. Those resources that cannot be avoided and that are directly impacted by the development can be excavated/recorded and a management plan can be developed for future action. Those sites that are not impacted on can be written into the management plan, whence they can be avoided or cared for in the future.

### 8.1 Objectives

- Protection of archaeological, historical and any other site or land considered being of cultural value within the project boundary against vandalism, destruction and theft.
- The preservation and appropriate management of new discoveries in accordance with the National Heritage Resources Act (Act No. 25 of 1999), should these be discovered during construction.

#### 8.2.1 Construction phase

General management objectives and commitments:

- To avoid disturbing sites of heritage importance; and
- To avoid disturbing burial sites.

The following shall apply:

- Known sites should be clearly marked in order that they can be avoided during construction activities.
- The contractors and workers should be notified that archaeological sites might be exposed during the construction work.

- Should any heritage artefacts be exposed during excavation, work on the area where the artefacts were discovered, shall cease immediately and the Environmental Control Officer shall be notified as soon as possible;
- All discoveries shall be reported immediately to a museum, preferably one at which an archaeologist is available, so that an investigation and evaluation of the finds can be made. Acting upon advice from these specialists, the Environmental Control Officer will advise the necessary actions to be taken;
- Under no circumstances shall any artefacts be removed, destroyed or interfered with by anyone on the site; and
- Contractors and workers shall be advised of the penalties associated with the unlawful removal of cultural, historical, archaeological or palaeontological artefacts, as set out in the National Heritage Resources Act (Act No. 25 of 1999), Section 51. (1).

## **9. RECOMMENDATIONS**

A survey was conducted to locate, identify, evaluate and document sites, features and objects of cultural significance found within the boundaries of an area in which it is proposed to develop a housing estate as well as a filling station.

Very few sites are known to occur in the larger region, mostly informal cemeteries. No sites, features or objects of cultural significance were identified in the study area during the survey. Based on what was found and its evaluation, it is recommended that any development can continue, on condition of acceptance of the following recommendations:

- If construction takes place and archaeological sites are exposed, it should immediately be reported to a museum, preferably one at which an archaeologist is available, so that an investigation and evaluation of the finds can be made.

## 10. REFERENCES

### 10.1 Data bases

Chief Surveyor General

Environmental Potential Atlas, Department of Environmental Affairs and Tourism.

Heritage Atlas Database, Pretoria.

National Archives of South Africa

### 10.2 Literature

Acocks, J.P.H. 1975. *Veld Types of South Africa*. Memoirs of the Botanical Survey of South Africa, No. 40. Pretoria: Botanical Research Institute.

Holm, S.E. 1966. *Bibliography of South African Pre- and Protohistoric archaeology*. Pretoria: J.L. van Schaik.

Horn, A.C. 1998. *Tshwane, Pretoria, Phelindaba: Structure-agency interaction and the transformation of a South African Region up to 1994, with prospects for the immediate future*. Unpublished D.Phil. Pretoria: University of Pretoria.

### 10.3 Maps

1: 50 000 Topocadastral maps – 2528CC

## APPENDIX 1: CONVENTIONS USED TO ASSESS THE IMPACT OF PROJECTS ON HERITAGE RESOURCES

### Significance

According to the NHRA, Section 2(vi) the **significance** of a heritage sites and artefacts is determined by it aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technical value in relation to the uniqueness, condition of preservation and research potential. It must be kept in mind that the various aspects are not mutually exclusive, and that the evaluation of any site is done with reference to any number of these.

Matrix used for assessing the significance of each identified site/feature

<b>1. Historic value</b>				
Is it important in the community, or pattern of history				
Does it have strong or special association with the life or work of a person, group or organisation of importance in history				
Does it have significance relating to the history of slavery				
<b>2. Aesthetic value</b>				
It is important in exhibiting particular aesthetic characteristics valued by a community or cultural group				
<b>3. Scientific value</b>				
Does it have potential to yield information that will contribute to an understanding of natural or cultural heritage				
Is it important in demonstrating a high degree of creative or technical achievement at a particular period				
<b>4. Social value</b>				
Does it have strong or special association with a particular community or cultural group for social, cultural or spiritual reasons				
<b>5. Rarity</b>				
Does it possess uncommon, rare or endangered aspects of natural or cultural heritage				
<b>6. Representivity</b>				
Is it important in demonstrating the principal characteristics of a particular class of natural or cultural places or objects				
Importance in demonstrating the principal characteristics of a range of landscapes or environments, the attributes of which identify it as being characteristic of its class				
Importance in demonstrating the principal characteristics of human activities (including way of life, philosophy, custom, process, land-use, function, design or technique) in the environment of the nation, province, region or locality.				
<b>7. Sphere of Significance</b>		High	Medium	Low
International				
National				
Provincial				
Regional				
Local				
Specific community				
<b>8. Significance rating of feature</b>				
1.	Low			
2.	Medium			
3.	High			

**Significance of impact:**

- low where the impact will not have an influence on or require to be significantly accommodated in the project design
- medium where the impact could have an influence which will require modification of the project design or alternative mitigation
- high where it would have a “no-go” implication on the project regardless of any mitigation

**Certainty of prediction:**

- Definite: More than 90% sure of a particular fact. Substantial supportive data to verify assessment
- Probable: More than 70% sure of a particular fact, or of the likelihood of that impact occurring
- Possible: Only more than 40% sure of a particular fact, or of the likelihood of an impact occurring
- Unsure: Less than 40% sure of a particular fact, or the likelihood of an impact occurring

**Recommended management action:**

For each impact, the recommended practically attainable mitigation actions which would result in a measurable reduction of the impact, must be identified. This is expressed according to the following:

- 1 = no further investigation/action necessary
- 2 = controlled sampling and/or mapping of the site necessary
- 3 = preserve site if possible, otherwise extensive salvage excavation and/or mapping necessary
- 4 = preserve site at all costs

**Legal requirements:**

Identify and list the specific legislation and permit requirements which potentially could be infringed upon by the proposed project, if mitigation is necessary.

## APPENDIX 2. RELEVANT LEGISLATION

All archaeological and palaeontological sites, and meteorites are protected by the National Heritage Resources Act (Act no 25 of 1999) as stated in Section 35:

(1) Subject to the provisions of section 8, the protection of archaeological and palaeontological sites and material and meteorites is the responsibility of a provincial heritage resources authority: Provided that the protection of any wreck in the territorial waters and the maritime cultural zone shall be the responsibility of SAHRA.

(2) Subject to the provisions of subsection (8)(a), all archaeological objects, palaeontological material and meteorites are the property of the State. The responsible heritage authority must, on behalf of the State, at its discretion ensure that such objects are lodged with a museum or other public institution that has a collection policy acceptable to the heritage resources authority and may in so doing establish such terms and conditions as it sees fit for the conservation of such objects.

(3) Any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.

(4) No person may, without a permit issued by the responsible heritage resources authority-

- (a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;
- (b) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;
- (c) trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or
- (d) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.

In terms of cemeteries and graves the following (Section 36):

(1) Where it is not the responsibility of any other authority, SAHRA must conserve and generally care for burial grounds and graves protected in terms of this section, and it may make such arrangements for their conservation as it sees fit.

(2) SAHRA must identify and record the graves of victims of conflict and any other graves which it deems to be of cultural significance and may erect memorials associated with the grave referred to in subsection (1), and must maintain such memorials.

(3) No person may, without a permit issued by SAHRA or a provincial heritage resources authority-

- (a) destroy, damage, alter, exhume or remove from its original position or otherwise disturb the grave of a victim of conflict, or any burial ground or part thereof which contains such graves;
- (b) destroy, damage, alter, exhume, remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority; or
- (c) bring onto or use at a burial ground or grave referred to in paragraph (a) or (b) any excavation equipment, or any equipment which assists in the detection or recovery of metals.

(4) SAHRA or a provincial heritage resources authority may not issue a permit for the destruction or damage of any burial ground or grave referred to in subsection (3)(a) unless it is satisfied that the applicant has made satisfactory arrangements for the exhumation and re-interment of the contents of such graves, at the cost of the applicant and in accordance with any regulations made by the responsible heritage resources authority.



The National Heritage Resources Act (Act no 25 of 1999) stipulates the assessment criteria and grading of archaeological sites. The following categories are distinguished in Section 7 of the Act:

- **Grade I:** Heritage resources with qualities so exceptional that they are of special national significance;
- **Grade II:** Heritage resources which, although forming part of the national estate, can be considered to have special qualities which make them significant within the context of a province or a region; and
- **Grade III:** Other heritage resources worthy of conservation, and which prescribes heritage resources assessment criteria, consistent with the criteria set out in section 3(3), which must be used by a heritage resources authority or a local authority to assess the intrinsic, comparative and contextual significance of a heritage resource and the relative benefits and costs of its protection, so that the appropriate level of grading of the resource and the consequent responsibility for its management may be allocated in terms of section 8.

Presenting archaeological sites as part of tourism attraction requires, in terms 44 of the Act, a Conservation Management Plan as well as a permit from SAHRA.

(1) Heritage resources authorities and local authorities must, wherever appropriate, co-ordinate and promote the presentation and use of places of cultural significance and heritage resources which form part of the national estate and for which they are responsible in terms of section 5 for public enjoyment, education, research and tourism, including-

- (a) the erection of explanatory plaques and interpretive facilities, including interpretive centres and visitor facilities;
- (b) the training and provision of guides;
- (c) the mounting of exhibitions;
- (d) the erection of memorials; and
- (e) any other means necessary for the effective presentation of the national estate.

(2) Where a heritage resource which is formally protected in terms of Part I of this Chapter is to be presented, the person wishing to undertake such presentation must, at least 60 days prior to the institution of interpretive measures or manufacture of associated material, consult with the heritage resources authority which is responsible for the protection of such heritage resource regarding the contents of interpretive material or programmes.

(3) A person may only erect a plaque or other permanent display or structure associated with such presentation in the vicinity of a place protected in terms of this Act in consultation with the heritage resources authority responsible for the protection of the place.

**APPENDIX 3: SURVEY RESULTS**

See Appendix 1 for an explanation of the conventions used in assessing the cultural remains.  
Map datum used: Hartebeeshoek 94 (WGS84).

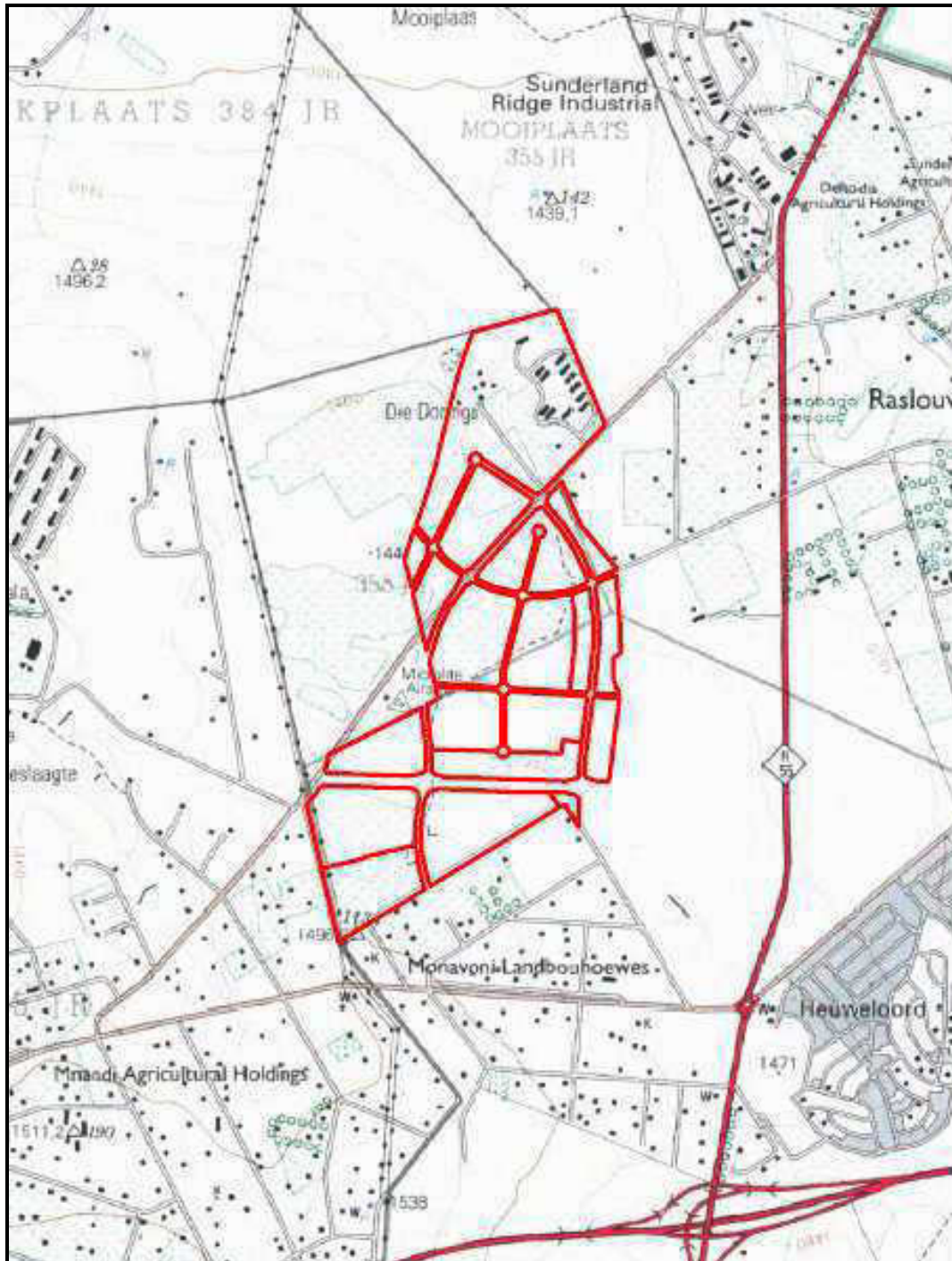


Fig. 2. The study area, showing the location of the identified sites.  
Map 2528CC: Chief Directorate Survey and Mapping.

Sites identified: Nil

**APPENDIX 4: ILLUSTRATIONS**



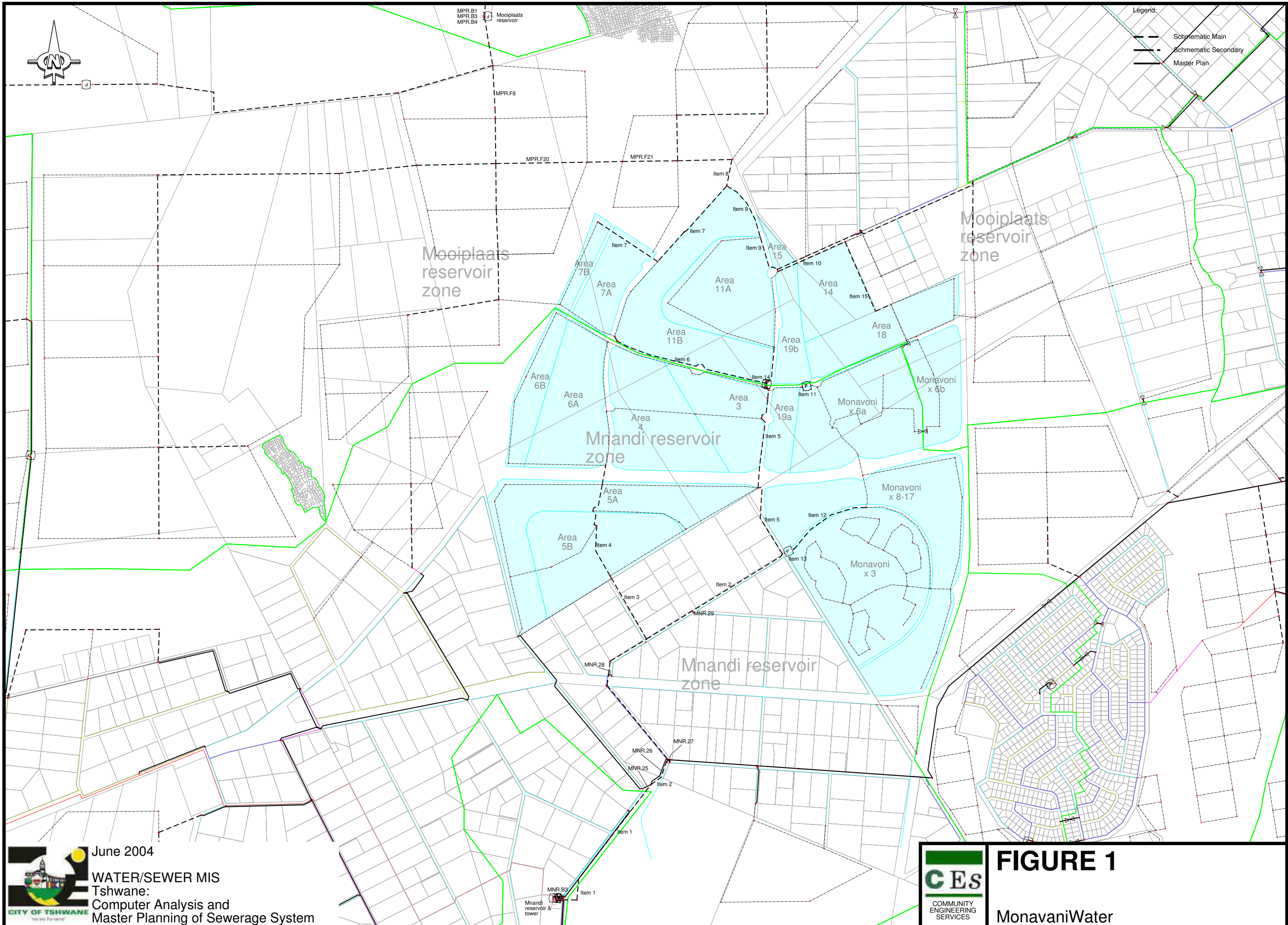
Fig. 3. View over the site, looking east.



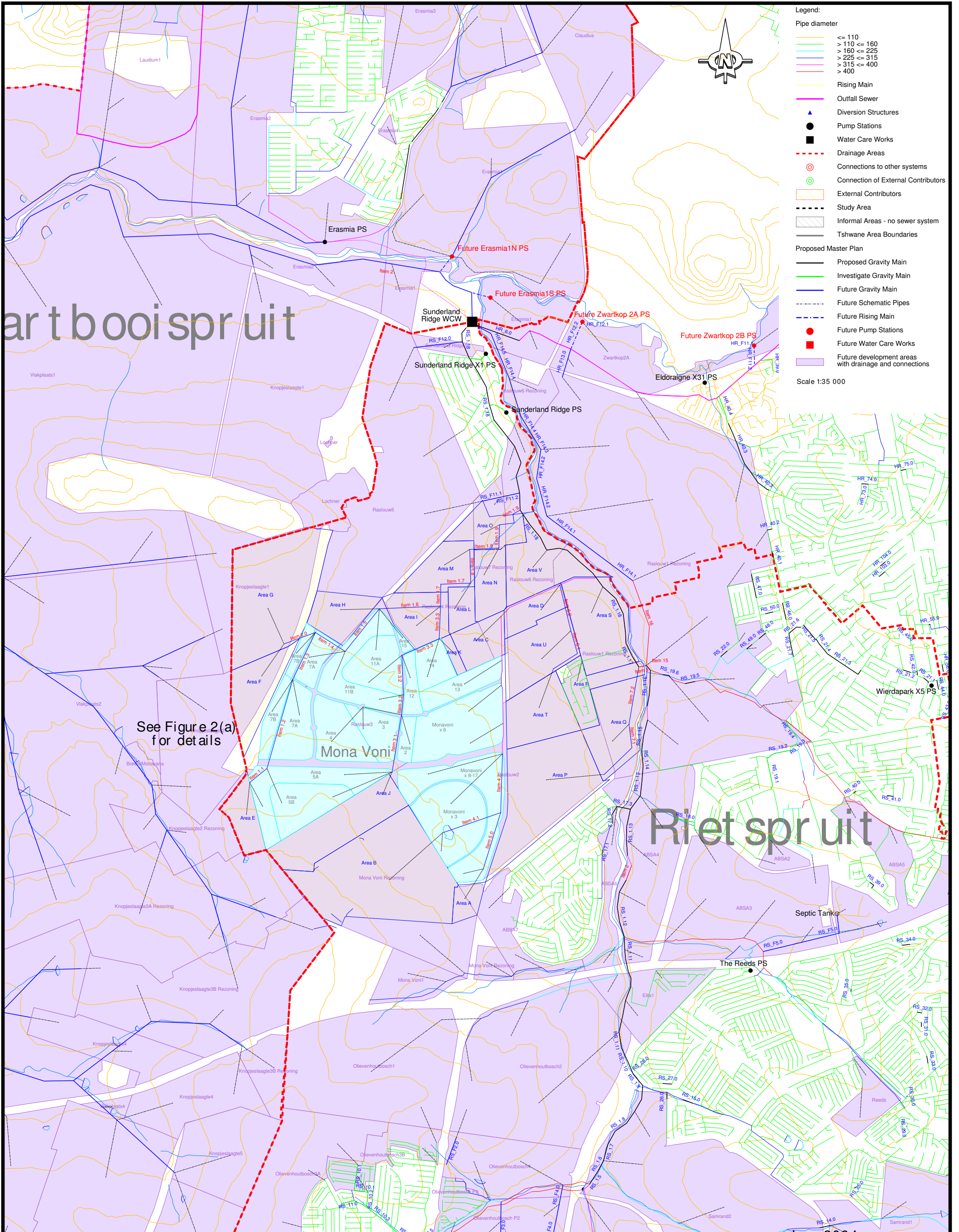
Fig. 4. View across the site looking north,

# Annexure O









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See Figure 2(a) for details

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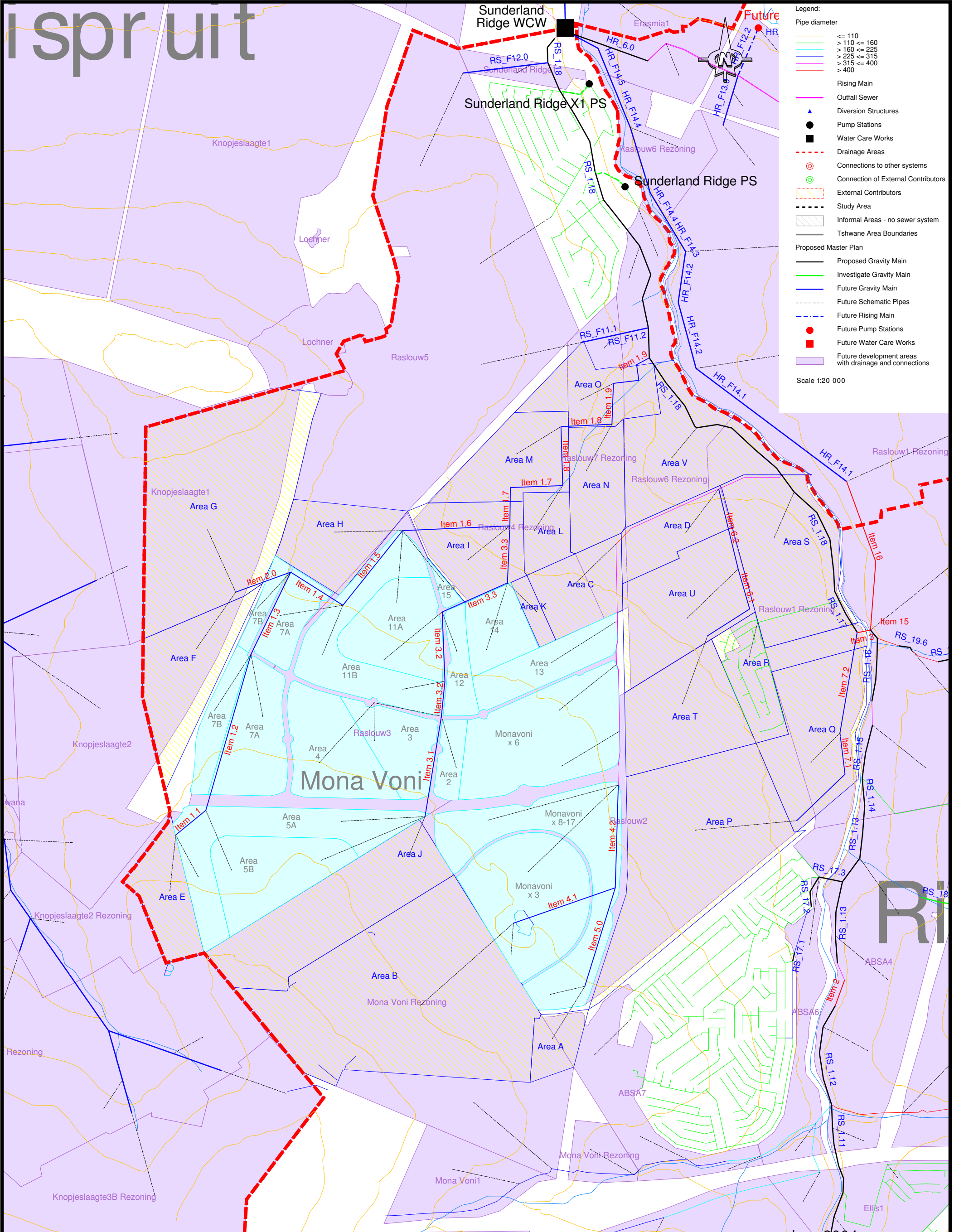
**FIGURE 2**  
**Required Works - Monavoni**

June 2004

**WATER/ SEWER MIS**  
**Tshwane:**  
**Computer Analysis and**  
**Master Planning of Sewerage System**







**FIGURE 2a**  
**Detail - Monavoni**

June 2004

**WATER/ SEWER MIS**  
**Tshwane:**  
**Computer Analysis and**  
**Master Planning of Sewerage System**



30 March 2006



The Director : Water & Sanitation  
Tshwane Metropolitan Municipal Council  
P O Box 6338  
**PRETORIA**  
0001

**Attention: Mr André Lochner**

Dear Sir

## **DEVELOPMENT OF PROPOSED TOWNSHIP MONAVONI**

The request by Dekker & Gelderblom with regards to accommodation of the proposed development in the Centurion sewer network, refers.

This document should be read in conjunction with:

- Computer Analysis and Master Planning - Centurion Sewer System (CEs - June 2004)
- Ad-hoc Water Report - Development of Monavoni (CEs - 16 August 2005)

### **1. SEWER NETWORK**

#### **1.1 *Drainage area***

The proposed development was taken into consideration for the recently completed (June 2005) master plan.

The development falls within the existing Rietspruit drainage area as indicated on Figure 2, showing the master plan items required for this drainage area.

The development is outside the Tshwane sewer priority area and the developer will have to install certain link services and make pro rata contributions for services provided by other developers.

#### **1.2 *Sewer flow***

The estimated future PDDWF calculated in the master planning study for the proposed development was 3620 kl/d.

For this re-analysis, the PDDWF for the proposed development was calculated at 6726 kl/d.

Directors:  
L C Geustyn  
F J Haupt  
J E Kock  
L H Matlala



The following table indicates the anticipated flows for the sub-drainage system which drains towards the proposed development.

Development name		Anticipated Land use	Area (ha)	No. of Units	PDDWF (kl/d)	IPDWF (l/s)
Mona Voni Rezoning	Area A	MD Residential	9.9	99	78	1.5
Mona Voni Rezoning	Area B	MD Residential	128.1	1281	1013	18.7
Raslouw4 Rezoning	Area C	Industrial	21.4	107	245	4.2
Raslouw6 Rezoning	Area D	Mixed Landuse	18.3	146	164	2.5
Knopjeslaagte2 Rezoning	Area E	Business/Commercial	19.8	99	226	4.1
Knopjeslaagte2	Area F	Business/Commercial	34.6	173	395	7.5
Knopjeslaagte1	Area G	MD Residential	102.8	1028	813	15.7
Raslouw5	Area H	Industrial	25.1	126	287	5.1
Raslouw4 Rezoning	Area I	Industrial	29.4	147	336	5.8
Mona Voni Rezoning	Area J	MD Residential	54.6	546	432	8.0
Raslouw4 Rezoning	Area K	Industrial	4.3	21	49	0.8
Raslouw4 Rezoning	Area L	Industrial	11.7	59	134	2.3
Raslouw4 Rezoning	Area M	Industrial	28.4	142	325	5.6
Raslouw7 Rezoning	Area N	Mixed Landuse	22.0	176	197	3.5
Raslouw7 Rezoning	Area O	Mixed Landuse	23.5	188	210	3.7
Raslouw2	Area P	MD Residential	87.9	527	576	11.4
Raslouw1 Rezoning	Area Q	HD Residential	44.0	881	506	7.9
Raslouw2	Area R	MD Residential	25.7	154	168	3.3
Raslouw1 Rezoning	Area S	HD Residential	52.9	1057	607	9.5
Raslouw2	Area T	MD Residential	38.2	229	250	4.9
Raslouw6 Rezoning	Area U	Mixed Landuse	42.8	343	383	5.9
Raslouw6 Rezoning	Area V	Mixed Landuse	46.2	369	413	6.4
Monavani	Area 2	Cluster housing up to 40 units per hectare	7.1	282	183	2.9
Monavani	Area 3	Cluster housing up to 40 units per hectare	18.3	458	298	4.8
Monavani	Area 4	Cluster housing up to 40 units per hectare	29.0	726	472	7.6
Monavani	Area 5A	Cluster housing up to 40 units per hectare	36.0	900	585	9.4
Monavani	Area 5B	Cluster housing up to 20 units per hectare	29.7	447	407	6.7
Monavani	Area 7A	Cluster housing up to 40 units per hectare	25.5	637	414	6.7
Monavani	Area 7B	Cluster housing up to 40 units per hectare	11.6	463	301	4.8
Monavani	Area 7A1	Cluster housing up to 40 units per hectare	12.5	500	325	5.2
Monavani	Area 7B1	Cluster housing up to 60 units per hectare	4.9	293	172	2.7
Monavani	Area 11A	Cluster housing up to 20 units per hectare	26.6	399	363	6.0
Monavani	Area 11B	Cluster housing up to 40 units per hectare	33.2	830	540	8.7
Monavani	Area 12	Cluster housing up to 40 units per hectare	9.2	369	240	3.9
Monavani	Area 13	Cluster housing up to 20 units per hectare	19.3	290	264	4.3
Monavani	Area 14	Cluster housing up to 20 units per hectare	15.1	227	207	3.4
Monavani	Area 15	Cluster housing up to 40 units per hectare	1.8	72	47	0.8
Monavani	Area MV3	Large sized erf up to 1 500m <sup>2</sup>	46.6	327	402	8.0
Monavani	Area MV6	Cluster housing up to 20 units per hectare	50.5	757	689	11.3

## 1.3 Sewer Master Plan

Adjustments to the proposed master plan items are required to accommodate the development and other developments. The development will have a pro rata effect on the required items downstream of its connections as indicated.

Item	Description				IPDWF	Cost*
Item 1.1	200	mm Ø x	227	m new pipe	9 l/s	R 79,000
Item 1.2	200	mm Ø x	949	m new pipe	13 l/s	R 311,000
Item 1.3	200	mm Ø x	533	m new pipe	24 l/s	R 177,000
Item 1.4	250	mm Ø x	362	m new pipe	47 l/s	R 152,000
Item 1.5	300	mm Ø x	559	m new pipe	54 l/s	R 292,000
Item 1.6	300	mm Ø x	627	m new pipe	62 l/s	R 327,000
Item 1.7	375	mm Ø x	530	m new pipe	112 l/s	R 329,000
Item 1.8	450	mm Ø x	643	m new pipe	118 l/s	R 487,000
Item 1.9	450	mm Ø x	565	m new pipe	124 l/s	R 429,000
Item 2.0	250	mm Ø x	342	m new pipe	22 l/s	R 144,000
Item 3.1	160	mm Ø x	594	m new pipe	15 l/s	R 167,000
Item 3.2	250	mm Ø x	611	m new pipe	36 l/s	R 252,000
Item 3.3	250	mm Ø x	751	m new pipe	47 l/s	R 309,000
Item 4.1	200	mm Ø x	630	m new pipe	24 l/s	R 208,000
Item 4.2	250	mm Ø x	602	m new pipe	31 l/s	R 249,000
Item 5.0	160	mm Ø x	603	m new pipe	7 l/s	R 169,000
Item 6.1	160	mm Ø x	535	m new pipe	6 l/s	R 151,000
Item 6.2	160	mm Ø x	481	m new pipe	11 l/s	R 136,000
Item 7.1	160	mm Ø x	634	m new pipe	12 l/s	R 178,000
Item 7.2	200	mm Ø x	597	m new pipe	19 l/s	R 198,000
Item 3	900	mm Ø x	75	m parallel pipe	2023 l/s	R 46,000
RS_1.17	1,050	mm Ø x	389	m parallel pipe	2054 l/s	R 496,000
RS_1.18	1,200	mm Ø x	4000	m parallel pipe	2462 l/s	R 9,071,000

The Sunderland Ridge WCW is already operating beyond capacity and needs to be upgraded to accommodate this development.

(\* Excluding P & G Contingencies, Fees & VAT - Year 2005/06 Rand Value).

As an alternative to the implementation of Items 3, RS\_1.17 and RS\_1.18, the following items can be installed.

Item	Description				IPDWF	Cost*
Item 15	New diversion structure (65% - 35%)				1,287 l/s	R 100,000
Item 16	1,050	mm Ø x	900	m new pipe	1,287 l/s	R 2,172,600
HR_F14.1	1,050	mm Ø x	1,100	m new pipe	1,307 l/s	R 2,655,400
HR_F14.2	825	mm Ø x	700	m new pipe	1,326 l/s	R 1,220,100
HR_F14.3	1,050	mm Ø x	200	m new pipe	1,345 l/s	R 482,800
HR_F14.4	1,050	mm Ø x	900	m new pipe	1,351 l/s	R 2,172,600
HR_F14.5	1,050	mm Ø x	400	m new pipe	1,352 l/s	R 965,600

#### 1.4 Accommodation of the development in the present sewer system

Accommodation of the development in the present system, in the context of the sewer master plan, will require implementation of the following master plan items:

Item	Description			IPDWF	Cost*
Item 1.1	200	mm Ø x	227 m new pipe	9 l/s	R 79,000
Item 1.2	200	mm Ø x	949 m new pipe	13 l/s	R 311,000
Item 1.3	200	mm Ø x	533 m new pipe	24 l/s	R 177,000
Item 1.4	250	mm Ø x	362 m new pipe	47 l/s	R 152,000
Item 1.5	300	mm Ø x	559 m new pipe	54 l/s	R 292,000
Item 1.6	300	mm Ø x	627 m new pipe	62 l/s	R 327,000
Item 1.7	375	mm Ø x	530 m new pipe	112 l/s	R 329,000
Item 1.8	450	mm Ø x	643 m new pipe	118 l/s	R 487,000
Item 1.9	450	mm Ø x	565 m new pipe	124 l/s	R 429,000
Item 2.0	250	mm Ø x	342 m new pipe	22 l/s	R 144,000
Item 3.1	160	mm Ø x	594 m new pipe	15 l/s	R 167,000
Item 3.2	250	mm Ø x	611 m new pipe	36 l/s	R 252,000
Item 3.3	250	mm Ø x	751 m new pipe	47 l/s	R 309,000
Item 4.1	200	mm Ø x	630 m new pipe	24 l/s	R 208,000
Item 4.2	250	mm Ø x	602 m new pipe	31 l/s	R 249,000
Item 5.0	160	mm Ø x	603 m new pipe	7 l/s	R 169,000
Item 6.1	160	mm Ø x	535 m new pipe	6 l/s	R 151,000
Item 6.2	160	mm Ø x	481 m new pipe	11 l/s	R 136,000
Item 7.1	160	mm Ø x	634 m new pipe	12 l/s	R 178,000
Item 7.2	200	mm Ø x	597 m new pipe	19 l/s	R 198,000

Pipe sizes should be such that the Instantaneous Peak Dry Weather Flow (IPDWF) can be accommodated in the pipeline whilst flowing 70% or less full, the remaining 30% of the flow area is for the accommodation of stormwater ingress. The above IPDWF'S and the future pipe sizes as proposed in the June 2004 report were calculated with cognizance of all potential upstream future developments. Note that pipes in future development areas are still indicated schematically.

The Sunderland Ridge WCW is already operating beyond capacity and needs to be upgraded to accommodate this and other future developments. According to information, a phased upgrading is currently in progress.

## 2. PRO RATA LOADS ON THE FUTURE SEWER MASTER PLAN ITEMS

If required, the pro rata loads of the proposed development on the relevant master plan items can be calculated.

Yours sincerely  
 COMMUNITY ENGINEERING SERVICES  
 REG. NO.: 96/13328/07




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Per: DR BF LOUBSER

16 August 2005

The Director : Water & Sanitation  
Tshwane Metropolitan Municipal Council  
Centurion Administration  
P O Box 6338  
**PRETORIA**  
0001

**Attention: Mr Ansen Lamprecht**

**CES**

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**COMMUNITY  
ENGINEERING  
SERVICES**

Dear Sir

## **DEVELOPMENT OF MONAVANI**

The attached request by Dekker & Gelderblom, dated 28 June 2005 with regards to accommodation of the proposed development in the water distribution system, refers.

This document should be read in conjunction with:

- A Strategy and Master Plan - Tshwane Bulk Water Supply System (CEs - June 2004)
- Computer Analysis and Master Planning - Centurion Water Distribution Network (CEs - June 2004)

Herewith are the details to provide Bulk water services to the development area.

### **1. WATER DISTRIBUTION SYSTEM**

#### **1.1 *Distribution zone***

The proposed development was conceptually taken into consideration for the recently completed master plan (June 2004).

The master planning as done for this request indicated that this development area should be accommodated in the Mnandi reservoir and the future Mooiplaats reservoir zones, as shown on Figure 1.

The development is situated outside the water priority area and the developer will have to install/construct certain link services and external bulk services, and make pro rata contributions for services provided by other developers.

#### **1.2 *Water demand***

The original water analysis for the master plan was done with a total annual average daily demand (AADD) for the development of 6 050 kℓ/d.

Directors:  
L C Geustyn  
F J Haupt  
J E Kock  
L H Matlala  
S S Dube





For this re-analysis the AADD for the proposed development was calculated using the areas and densities supplied by Dekker & Gelderblom as follows:

• Area 2 @ 40 units/ha	=	226 kℓ/d
• Area 3 @ 25 units/ha	=	366 kℓ/d
• Area 4 @ 25 units/ha	=	580 kℓ/d
• Area 5A @ 25 units/ha	=	720 kℓ/d
• Area 5B @ 15 units/ha	=	536 kℓ/d
• Area 7A @ 25 units/ha	=	510 kℓ/d
• Area 7B @ 40 units/ha	=	370 kℓ/d
• Area 7A @ 40 units/ha	=	400 kℓ/d
• Area 7B @ 60 units/ha	=	205 kℓ/d
• Area 11A @ 15 units/ha	=	478 kℓ/d
• Area 11B @ 25 units/ha	=	664 kℓ/d
• Area 12 @ 40 units/ha	=	295 kℓ/d
• Area 13 @ 15 units/ha	=	348 kℓ/d
• Area 14 @ 15 units/ha	=	272 kℓ/d
• Area 15 @ 40 units/ha	=	58 kℓ/d
• Monavani x 3 @ 7 units/ha	=	655 kℓ/d
• Monavani x 6 @ 15 units/ha	=	908 kℓ/d
• Monavani x 8-17 @ 25 units/ha	=	<u>1 003 kℓ/d</u>
TOTAL		8 596 kℓ/d

Fire Flow : 15 ℓ/s @ 8 m for density < 30 units/ha  
 : 50 ℓ/s @ 15 m for density ≥ 30 units/ha

### 1.3 Present situation

The development falls within the existing Mnandi reservoir and future Mooiplaats reservoir zones. As an interim solution, until the Mooiplaats reservoir is constructed, the development can be supplied by the Mnandi reservoir. (It is assumed that the temporary 450 mm / 400 mm Ø supply pipe from the Pretoriusrand reservoir site to the Mnandi reservoir is operational).

The following items are required to accommodate the development and to comply with the criteria as set out in the master plan:

• MNR.B3	: 15 000 kℓ Upgraded Mnandi reservoir (Phase 1)	R8 003 000 *
• Item 1	: 770 m x 500 mm Ø main pipe	R 1 009 000 *
• Item 2	: 1 955 m x 315 mm Ø main pipe	R 1 423 000 *
• Item 3	: 385 m x 250 mm Ø main pipe	R 211 000 *
• Item 4	: 675 m x 200 mm Ø main pipe	R 260 000 *
• Item 5	: 985 m x 250 mm Ø main pipe	R 505 000 *
• Item 6	: 880 m x 200 mm Ø main pipe	R 333 000 *
• Item 7	: 960 m x 200 mm Ø main pipe	R 362 000 *
• Item 9	: 570 m x 450 mm Ø main pipe	R 682 000 *
• Item 10	: 405 m x 200 mm Ø main pipe	R 163 000 *
• Item 11	: Install PRV and set @ 71 m, e.g.l ± 1 520 m.asl	R 86 000 *
• Item 12	: 480 m x 200 mm Ø main pipe	R 190 000 *
• Item 13	: Install PRV and set @ 57 m, e.g.l ± 1 520 m.asl	R 86 000 *
• Item 14	: Install PRV and set @ 63 m, e.g.l ± 1 513 m.asl	R 109 000 *

(\* Excluding P & G, Contingencies, Fees and VAT - Year 2003/04 Rand Value).

When Mooiplaats reservoir is constructed, the following items are required to switch the areas (7A, 7B, 11A, 11B, 12, 13 & 14) below the 1 450 m contour, over from the Mnandi reservoir to the Mooiplaats reservoir:

• MPR.B1	:	5 410 m x 700 mm Ø Feeder main	R11 783 000 *
• MPR.B3	:	Inlet flow control	R 479 000 *
• MPR.B4	:	20 000 kℓ New Mooiplaats reservoir	R 9 963 000 *
• MPR.F8	:	820 m x 700 mm Ø main pipe	R 1 620 000 *
• MPR.F20	:	505 m x 00 mm Ø main pipe	R 888 000 *
• MPR.F21	:	500 m x 600 mm Ø main pipe	R 880 000 *
• Item 8	:	450 m x 500 mm Ø main pipe	R 612 000 *
• Item 14	:	Close PRV	

#### 1.4 Master plan

Adjustments to the proposed master plan items of July 2004 are required to accommodate the development, due to new information regarding land use and township layout supplied by Dekker & Gelderblom. The following master plan items have changed:

- MNR.3 is replaced by Item 1
- MNR.14 is replaced by:
  - MNR.25 : 50 m X 250 mm Ø pipe link R 76 000 \*
  - MNR.26 : 175 m X 315 mm Ø parallel reinforcement R 211 000 \*
  - MNR.27 : 25 m x 250 mm Ø parallel reinforcement R 60 000 \*
- MNR.15 is replaced by Item 2 R275 000 \*
- MNR.28 : 25 m x 250 mm Ø pipe link R 60 000 \*
- MNR.29 : 10 m x 160 mm Ø pipe link R 16 000 \*

Many such applications for township development in the Mooiplaats reservoir zone are being received. It is suggested that priority be given to implementing the bulk water supply infrastructure for this zone.

## 2. PRO RATA LOADS ON THE FUTURE WATER PLAN ITEMS

If required, the pro-rata loads of the proposed developments on the relevant master plan items can be calculated.

Yours sincerely  
 COMMUNITY ENGINEERING SERVICES  
 REG. NO.: 96/13328/07



Per: DR BF LOUBSER

# Annexure P

# PROCEDURE FOR WASTE MANAGEMENT

## 1. **INTRODUCTION/PURPOSE**

The purpose of this procedure is to ensure that all waste material generated at within the proposed Monavoni X 44 Development is correctly sorted, stored, handled and where possible recycled or otherwise disposed of in accordance with legislative requirements, SHEQ policy and objectives and targets.

## 2. **APPLICATION/SCOPE**

All Erven within the proposed development.

## 3. **Related Documents**

SANS 10228  
DWA Minimum Requirements  
Occupational Health and Safety Act

## 4. **SAFETY, HEALTH AND ENVIRONMENT**

The procedure includes practices to protect the safety and health of employees and the environment from possible negative impacts of waste handling and disposal.

## 5. **PROCEDURE**

A waste is any unwanted or superfluous material generated on site that needs to be disposed of on site or off site.

### **6.1 Waste Identification**

6.1.1 The SHE Team will list all waste generated on site in a waste register and shall identify each waste stream as being of the following categories:

- (a) Hazardous, or
- (b) Non-hazardous.

6.1.2 Hazardous waste is defined as an inorganic or organic element or compound that, because of its toxicological, physical, chemical or persistency properties, may exercise detrimental acute or chronic impacts on human health and the environment.

6.1.3 Non-hazardous waste (or general waste) is waste that does not pose an immediate threat to man or to the environment, i.e., household or kitchen waste, garden waste, dry industrial and commercial waste which has not been contaminated by any hazardous waste.

6.1.4 When in doubt as to whether a waste stream is hazardous or not, assume that it is hazardous until expert advice has been obtained.

For these purposes, a waste is assumed to be hazardous if it has not been decontaminated and contains:

- Any chemicals or substances from the production process at any site, excluding clean water;
- Packaging from any process chemicals;
- Sludges, scaling or precipitates from any tanks, sumps or drains;
- Laboratory chemicals;
- Oil and solvents;
- Fluorescent tubes.

### **6.2 Waste Classification**

6.2.1 All hazardous waste generated and which is disposed of off site must be classified as per SANS 10228 and the Department of Water Affairs (DWA) Minimum Requirements<sup>1</sup> for the following requirements:

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<sup>1</sup> Department of Water Affairs and Forestry; 'Minimum Requirements for Waste Disposal by Landfill'; Second Edition 1998

## PROCEDURE FOR WASTE MANAGEMENT

- (a) SANS Class;
- (b) Hazard Rating, and
- (c) Disposal and treatment options.
- 6.2.2 A waste stream is classified as follows:
- (a) If no classification is already available to the waste stream, or where uncertainty exists about whether a waste is hazardous or not, the Manager of the facility in question shall instruct the SHEQ Team to collect a representative sample of the waste and send this to approved laboratories for analysis.
- (b) The Manager shall then determine the information in 6.2.1. in accordance with the Minimum Requirements.
- (c) External specialist assistance may also be obtained.
- (d) Records of such analysis and classification shall be recorded in the Waste Register.
- 6.2.3 Following the classification of each stream, the disposal and treatment options shall be identified in accordance with legal requirements. A suitable contractor shall be identified by the SHEQ Team to recycle and/or dispose of the waste. A contract or service level agreement shall be compiled to this effect for each site, stating the treatment and disposal options.
- 6.2.4 In terms of the OHS Act (GNR 1179, reg. 15), the facility shall investigate options for the recycling and re-use of hazardous chemical waste prior to disposal, so long as the options investigated are reasonable and cost-effective.

### 6.3 Waste Separation

- 6.3.1 The SHEQ Team shall ensure that the appropriately labelled bins are available for waste disposal on site. Each Waste Storage Area shall have a sign describing the waste stream which may be disposed of to that container/area.
- 6.3.2 The SHEQ Team shall therefore ensure that wastes are being separated into the following streams:

<b>Waste Stream</b>	<b>Sources</b>	<b>Notes</b>	<b>Typical disposal or recycling options</b>
<i>General Domestic Waste</i>	General office bins stored inside the office areas and kitchens.	Paper and hazardous office waste to be removed. (Except where such extensive separation is not practical due to the unavailability of waste recyclers and the remoteness of the site)	Disposal to Municipal General Landfill
<i>Used PPE</i>	Stores	Used PPE may be disposed off as general waste. PPE must be dismantled or cut up to prevent it from being used again.	Disposal to Municipal General Landfill
<i>Office and Administrative Paper Waste</i>	Each office building will have a labelled bin for office paper waste. The paper waste will be recycled.	Ensure that paper waste is not contaminated with oil or chemicals.	Recycled
<i>Boiler Ash</i>	Boilers		Depending on classification: may be land filled to general

## PROCEDURE FOR WASTE MANAGEMENT

<b>Waste Stream</b>	<b>Sources</b>	<b>Notes</b>	<b>Typical disposal or recycling options</b>
			or hazardous landfill or given/sold to contractors.
<i>Scrap metal</i>	Maintenance	All scrap metal will be inspected for contamination and, if clean, stored in a designated area. Scrap metal must be decontaminated and/or oil prior to being issued to scrap metal dealers. All oil and paint drums and cans must be drained of all oil and paint.	Given/sold to a scrap metal recycler if not contaminated.
<i>Fluorescent Tubes</i>	All	All waste fluorescent tubes will be crushed manually, ensuring that no escape of the dust from the tubes takes place. This drum will be sealed with a tight fitting lid so that no dust may escape during transport.	Landfilled to H:h landfill
<i>Oils</i>	Unknown / Maintenance	To be stored in non-leaking sealed drums.	Recycled.
<i>Medical waste</i>	Clinics or First Aid Stations	All sharps and other surgical blades used at the clinic shall be disposed of by the sister, into the dedicated sharps bin in the clinic.	This waste shall be removed by an approved medical waste contractor for incineration.
<i>Vegetation</i>	Grass cutting, leaves, branches.		Removed and delivered to the appropriate general waste disposal site in the absence of specific garden refuse sites. Or recycled to composters.
<i>Hazardous Maintenance Waste</i>	Maintenance Department	Batteries, Contaminated oil drums and tins, oily rags and contaminated sawdust/absorbent material. Normal amounts of empty pen cartridges, white board markers, tipex, photocopy toner units, inks to be disposed of in general waste.	Class H:h landfill.
<i>Cooking oil</i>	Kitchens	No rancid oils shall be used in the making of any food substances.	Class H:h landfill. NOT to sewer or stormwater.
<i>Building rubble</i>	Maintenance Department	Building rubble has been removed from the exclusions of hazardous waste and has to be classified prior to disposal. Use of building rubble as fill material is prohibited.	Depending on classification.
<i>Asbestos waste</i>	Maintenance	All asbestos waste is to be stored and disposed of according to the	Placed into double-lined plastic bags,



## PROCEDURE FOR WASTE MANAGEMENT

<b>Waste Stream</b>	<b>Sources</b>	<b>Notes</b>	<b>Typical disposal or recycling options</b>
	Department	Asbestos Regulations as per the Occupational Health and Safety Act 85 of 1993. Broken asbestos sheeting is to be replaced with non asbestos material.	labelled as "Asbestos Waste" and disposed of to a general landfill permitted to receive asbestos waste.
<i>Chemical Bags and other chemical containers</i>	Process areas	Containers of chemicals are classified according to the chemicals which they contained.	Depending on the classification. Where possible bags and containers are recycled to the supplier.
<i>Laboratory wastes (including containers)</i>	Laboratories	Laboratory waste is to be classified as Class 9 (Miscellaneous waste), unless the containers can be decontaminated and returned to the supplier.	Hazardous waste (H:h landfill) OR returned to supplier if decontaminated.
<i>Process wastes</i>	Process operations	To be identified and classified respectively	Depends on the classification. Process waste is recycled to the process in most cases.

### 6.4 Site specific waste

- 6.4.1 The waste register and waste classifications for each waste stream unique to each site shall determine the storage and treatment options for those waste streams.
- 6.4.2 Sweepings and waste recovered from processes shall be recycled wherever possible. If they cannot be re-used or recycled in the process, then they shall be stored as per 6.6 until classified, and then disposed of in accordance with the recommendations of the classification.

### 6.5 Waste Transfer

- 6.5.1 Waste is transferred from the source to a collection skip or drums in such a manner so as not to generate any environmental impacts, such as surface water and soil contamination through spills or leaks.
- 6.5.2 Any spills or leaks shall be addressed immediately through the Spill Response section of the Emergency Response Procedure by containing the spill with absorbent material, and disposing of the absorbent material and any contaminated soil into the same container as the waste stream which was spilt/leaked.
- 6.5.3 Any contaminated soil shall be removed immediately if the spill involved hazardous waste, and this soil and any absorbent material shall be disposed of to the same container as the waste which was spilt.

### 6.6 Hazardous Waste Storage Areas

- 6.6.1 Access control shall be implemented through the general site security.
- 6.6.2 Unless a specific permit is granted or where the bin is kept indoors, hazardous waste storage shall occur on impervious cement hard standing of good quality, and the area shall be bunded to prevent stormwater ingress. The quality of the cement bund and surface shall be inspected regularly and repairs effected if

## PROCEDURE FOR WASTE MANAGEMENT

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necessary. Each site owner shall be responsible for specifying the particular waste storage area.

- 6.6.3 The area shall be roofed or all containers and skips shall be covered in such a way that rainwater shall not leak into the waste.
- 6.6.4 The area shall drain to a sump. Any spills or contaminated stormwater shall be treated prior to disposal to effluent sewer. Stormwater or other water which appears clean (i.e. no discolouration or oil film) shall be disposed of to the effluent sewer and not to stormwater.
- 6.6.5 Dry, dusty hazardous wastes shall be covered during transfer and storage.
- 6.6.6 The above does not apply to hazardous waste containers situated in a building where rain ingress and spillage are not possible.

### 6.7 Waste Collection, Monitoring and Reporting

- 6.7.1 A suitable trained competent person shall supervise the collection of waste from site by approved waste collection companies and/or the Municipality.
- 6.7.2 The Waste collection and data input procedure is therefore as follows:
  - (a) The waste skip is placed on site by the contractor.
  - (b) When the waste skip or other container (such as a sump) is full, the authorised person shall inspect the waste container for cross-contamination. If the waste stream is satisfied with the waste consistency, than authorised person shall notify the SHEQ team who shall notify the waste contractor is notified and set a date for collection of the waste.
  - (c) Upon arrival at the site, the replacement skip/tanker and vehicle of the waste contractor is inspected by security or the SHEQ team for rusting, leaks and/or prior contamination prior to them being allowed on site. If security is doubtful as to the integrity of the skip, then the SHEQ team shall be contacted to resolve the matter.
  - (d) Security directs the contractor to the waste and shall notify one of the authorised personnel who shall receive the contractor, check and supervise the loading operation. Any problems or irregularities are to be reported to the SHEQ team before the truck leaves the site.
  - (e) The waste is collected by the contractor and replacement skip placed in the correct location (if required).
  - (f) The waste manifest document is signed by the driver of the truck and the authorised person.
  - (g) The Waste Manifest document is delivered to the SHEQ team who shall enter the data into the details of the waste load for future monitoring.

### 6.8 Waste Contracts

- 6.8.1 The contract with the Waste Disposal company shall specify that:
  - Any skips not approved by security or the SHEQ team shall be replaced at the cost of the contractor, and
  - The contractor shall comply with the provisions of GN R 1179 (of the OHS Act), in particular regulation 15, which states that all vehicles, re-usable containers and covers which have been in contact with hazardous chemical waste are cleaned and decontaminated after use in such a way that the vehicles, containers or covers do not cause a hazard to the environment, the on site staff and the waste contractor as well as the public (i.e. during transport).
- 6.8.2 If waste is to be removed in a skip or other open container, by vehicle, the designated person should ensure that this has a lid or an attachable cover, to prevent the contents from spilling or generating dust or litter during transit.

## PROCEDURE FOR WASTE MANAGEMENT

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It shall be the duty of the SHEQ team to ensure that the waste contractor is informed in writing of the nature and classification of the waste which is to be disposed.

### **6.9 Waste contractor audits**

- 6.9.1 The Environmental Manager shall request all waste contractors to provide proof of audit results on an annual basis.
- 6.9.2 The audits should have consisted of reviewing the operational practice of the contractor/supplier against any permits, DWA's Minimum Requirements and any applicable SANS codes for the handling of dangerous goods.
- 6.9.3 These audits results shall be used in the Management Review and Legal Compliance Audits.

### **6.10 Labelling of containers and Signage for Hazardous Waste Storage Areas**

- 6.10.1 Each hazardous waste storage area shall be signposted with a sign with the following specifications:
  - (a) Have a dedicated sign with the words "Hazardous Waste" clearly visible at the entrance to the gate or access point. The sign shall also display the name of the waste stream (e.g. "Used Oil") if the container in that area accepts only that waste stream. If containers are used to collect a variety of waste streams, then only the words "Hazardous Waste" shall appear on the sign.
  - (b) The signs for the waste storage areas shall also comply with the following:
    - Suitably protected from the elements.
    - Mounted in a conspicuous position above the waste bins or skips.
  - (c) Containers used to receive the waste shall comply with the following:
    - Containers shall be checked for leaking. Any leaking containers shall be replaced. For containers (skips) provided by contractors, these shall be approved prior to being allowed on site in accordance.
    - Containers containing dusty waste shall be covered.
    - All containers owned by the individual site owners which are position on site shall be clearly marked with the words: "Hazardous Waste".

# Annexure Q



# **MONAVONI MASTER PLAN**

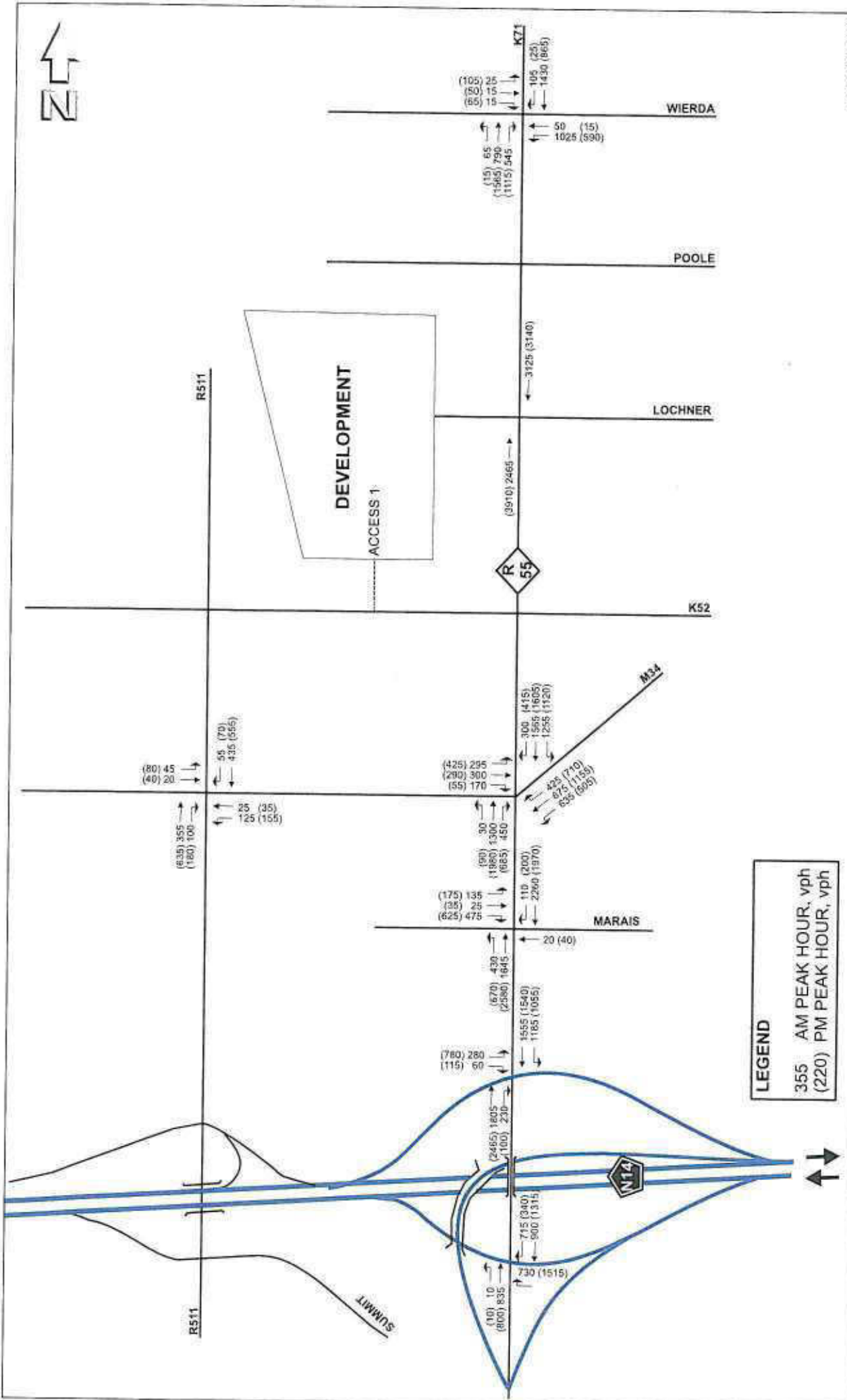
**Proposed developments located**

**West of the R55 (K71) and North of P102-1**

*August 2009*

29 De Havilland Crescent  
Pro Park  
Building 1  
Persequor Park 0020

Tel: (012) 349 1664  
Fax: (012) 349 1665  
e-mail: [mail@itse.co.za](mailto:mail@itse.co.za)

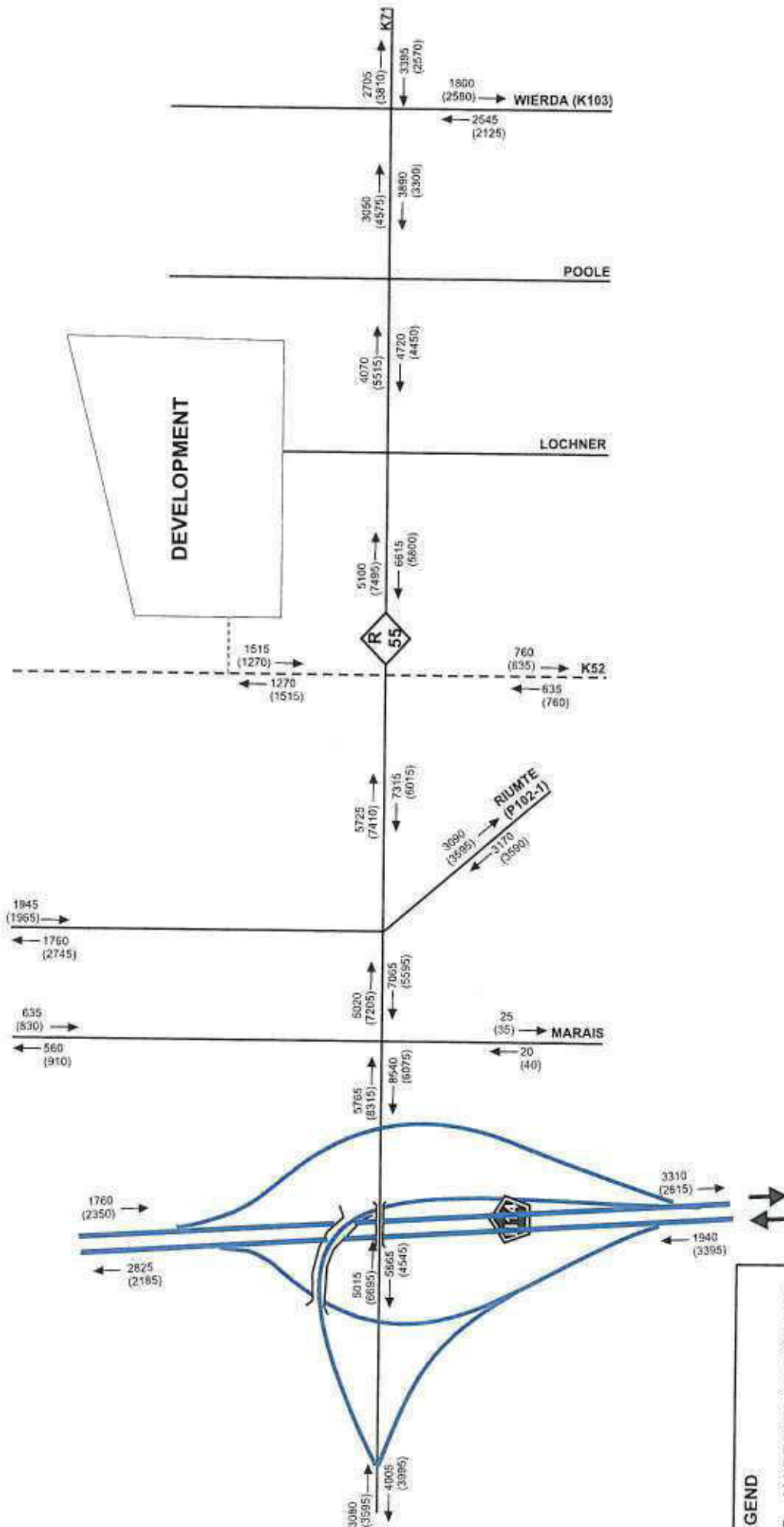


2675\Figure 4b\_LATENT RIGHTS.cdr

Project:	MONAVONI MASTER PLANNING	Figure:	LATENT RIGHTS TRAFFIC
No.:	4b		







SCHEMATIC

2875\Figure 5a\_LINK VOLUMES.cdr

Figure:

2019 BACKGROUND TRAFFIC; LATENT RIGHTS AND DEVELOPMENT TRAFFIC; LINK VOLUMES (ALTERNATIVE 1)

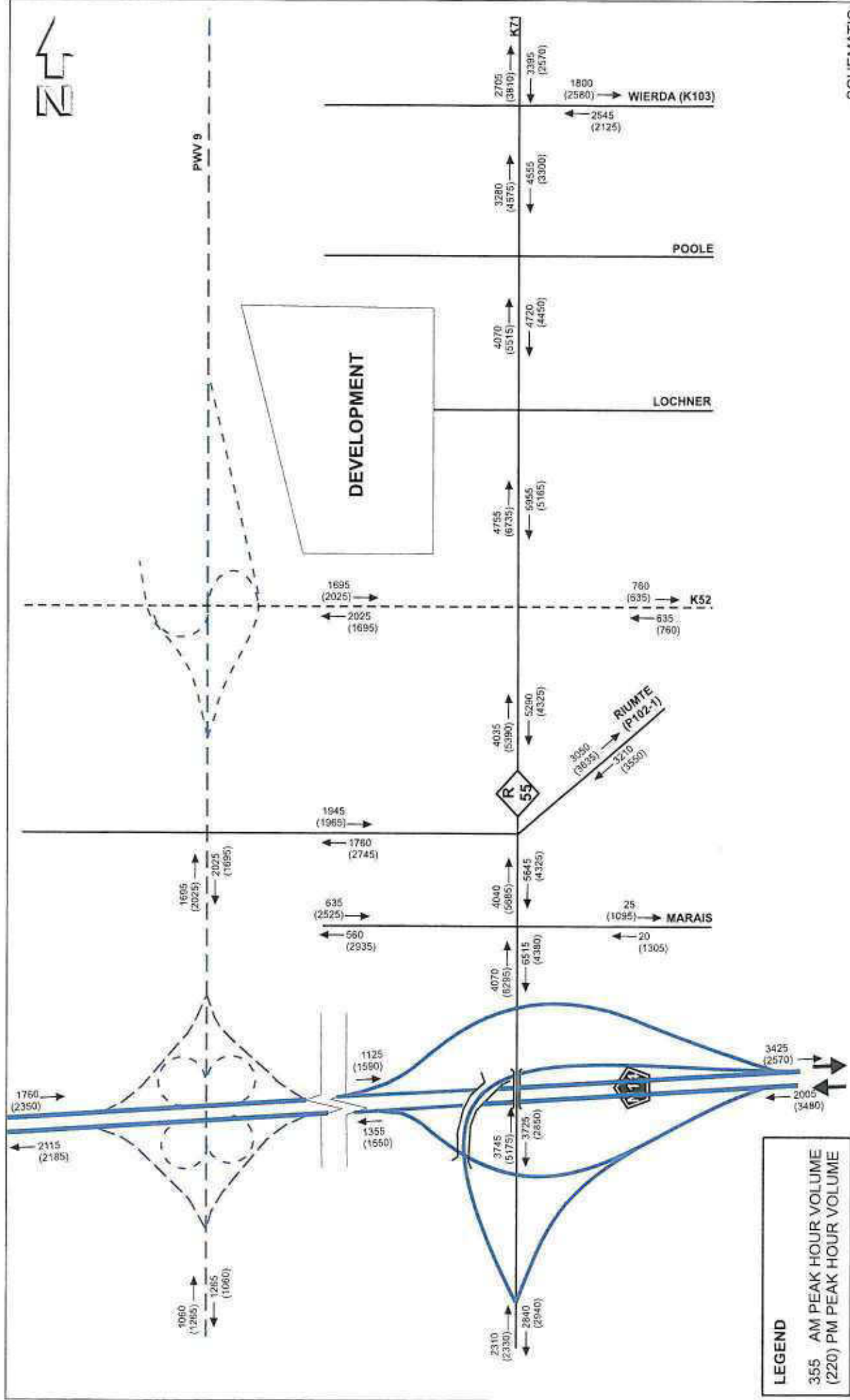
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5a

Project:

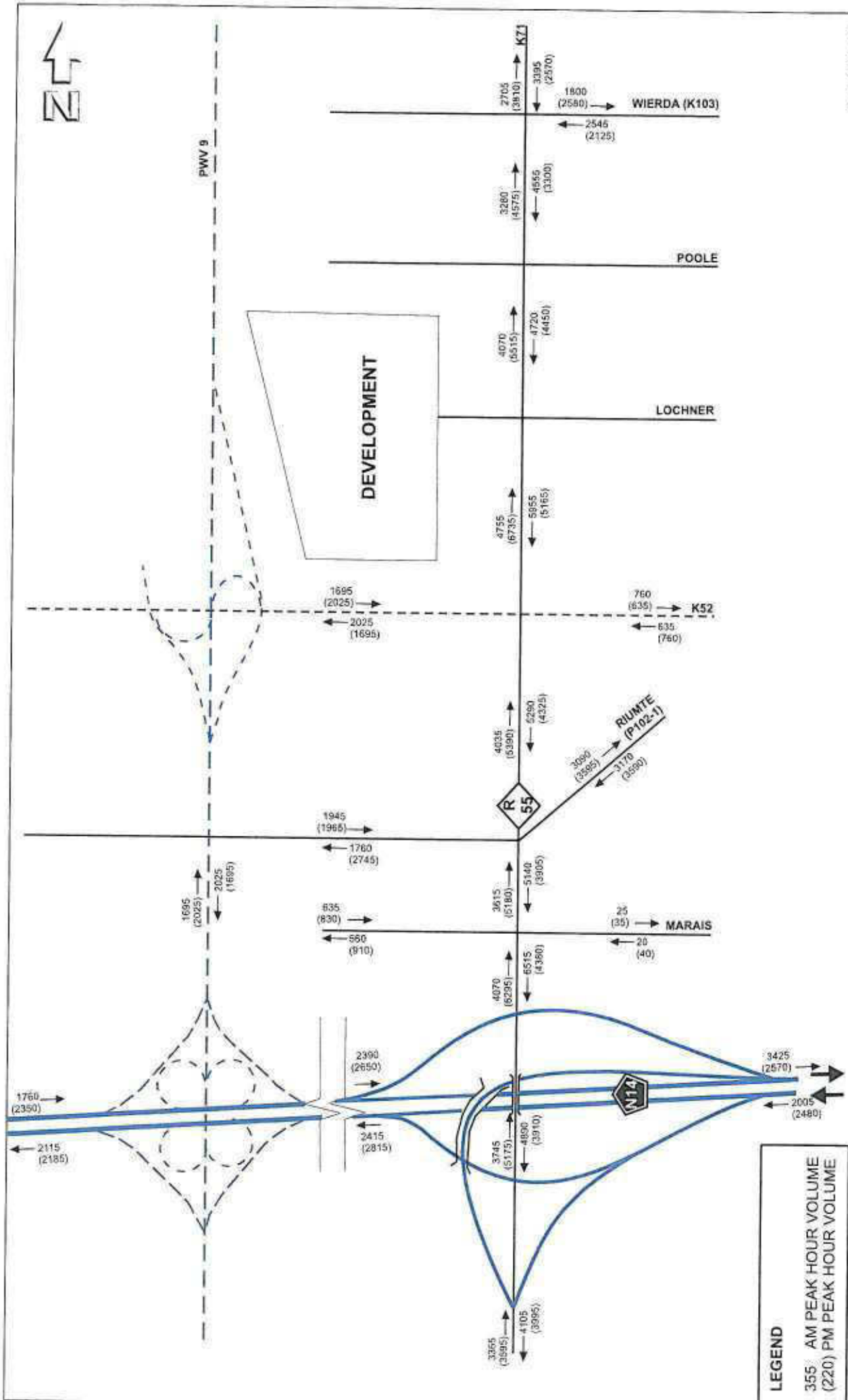
MONAVONI MASTER PLANNING





Project:	MONAVONI MASTER PLANNING	No. 5b
Figure:	2019 BACKGROUND TRAFFIC, LATENT RIGHTS AND DEVELOPMENT TRAFFIC: LINK VOLUMES (ALTERNATIVE 2)	





SCHEMATIC

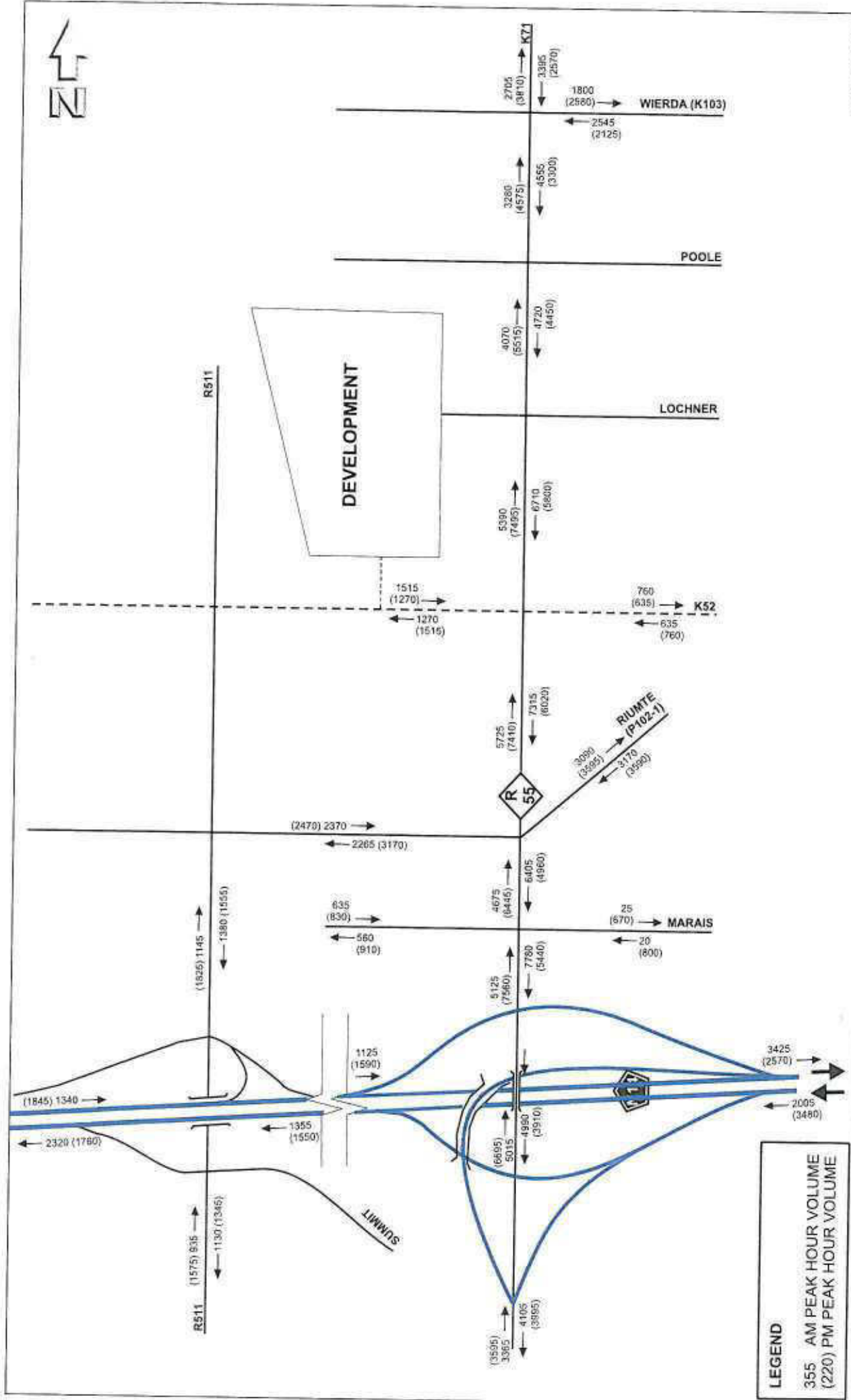
2675\Figure 5c\_LINK VOLUMES.cdr

Project: **MONAVONI MASTER PLANNING**

Figure: **2019 BACKGROUND TRAFFIC, LATENT RIGHTS AND DEVELOPMENT TRAFFIC: LINK VOLUMES (ALTERNATIVE 3)**

No. **5C**






SCHEMATIC

2675\Figure 5d\_LINK VOLUMES.cdr

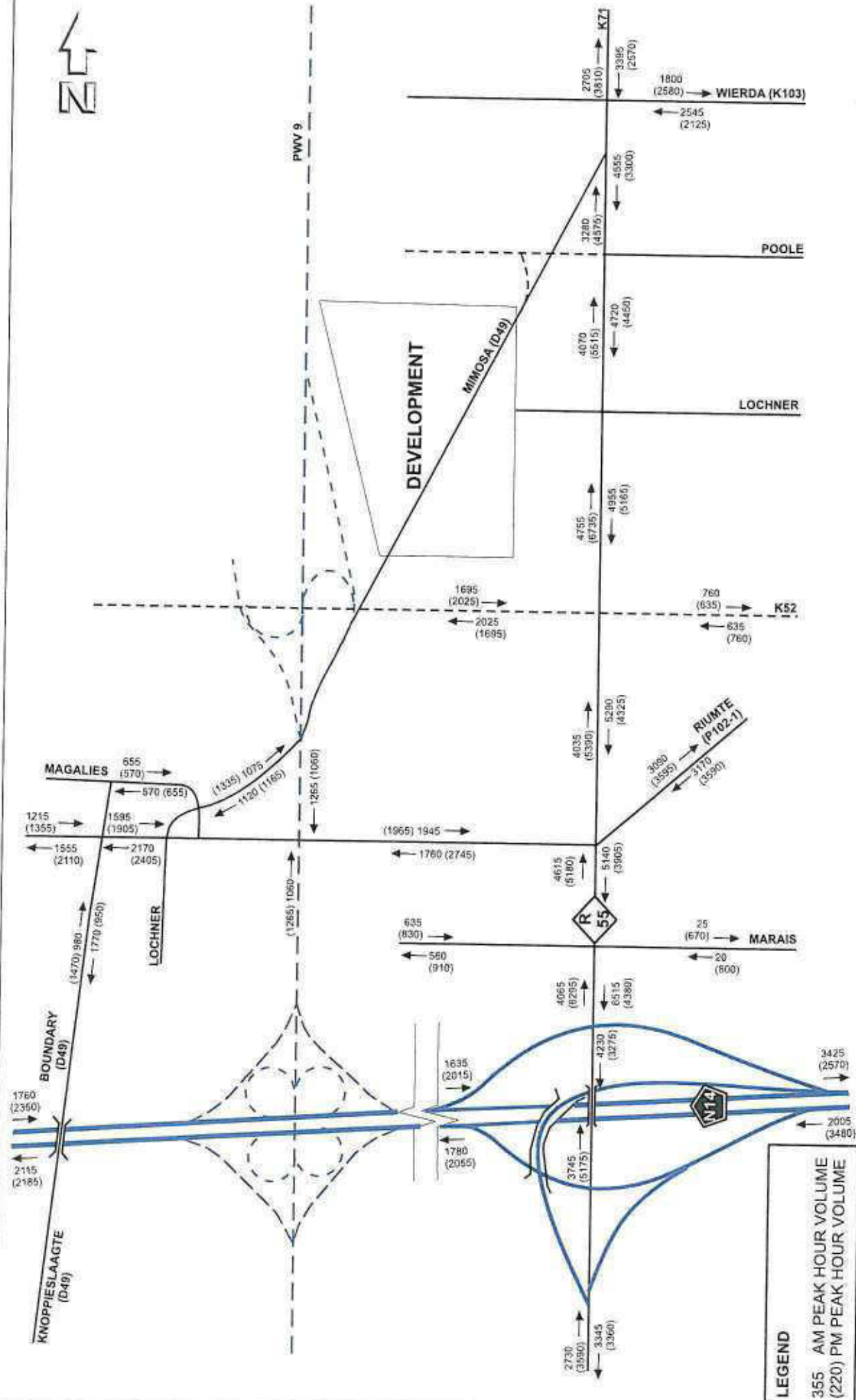
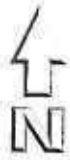
Project: **MONAVONI MASTER PLANNING**

Figure: **2019 BACKGROUND TRAFFIC, LATENT RIGHTS AND DEVELOPMENT TRAFFIC: LINK VOLUMES (ALTERNATIVE 4)**

No. **5d**







**LEGEND**  
**355** AM PEAK HOUR VOLUME  
**(220)** PM PEAK HOUR VOLUME

SCHMATIC

2675\Figure 5e\_LINK VOLUMES.cdr

No. 5e

TRIP DISTRIBUTION (ALTERNATIVE 5)

Figure:

MONAVONI MASTER PLANNING

Project:











# **Monavoni Master Planning of all extentions**

## **Traffic Impact Study**

### **TABLE OF CONTENTS**

1. Traffic Impact Study Summary Table
2. Appendix A – Tables
3. Appendix B – Figures

<b>Monavoni Master Planning of all extentions</b>		
	<b>Description</b>	<b>Refer to Appendix</b>
<b>1. Introduction</b>	A new large mixed land use development is planned by M&T Development in the Monavoni area. All extensions of the proposed Monavoni development will cover approximately 323 ha and will consist of residential, offices, motor trade, light industrial and commercial land use. The locality of the proposed development is shown in <b>Figure 1</b> .	Appendix B, Figure 1
<b>2. Land Use</b>	The development will consist of: <ul style="list-style-type: none"> <li>➤ 164 257 m<sup>2</sup> Offices</li> <li>➤ 197109 m<sup>2</sup> Industrial</li> <li>➤ 10762 units Residential</li> </ul> The areas shown are gross leasable area (GLA)	
<b>3. Latent Rights</b>	A number of developments were approved or their applications have been submitted for approval in the vicinity of the proposed development. The developments included in the analysis as latent rights are shown in <b>Table 2</b> . The locality and the volumes of the latent rights are shown in <b>Figure 4a and Figure 4b</b> .  The required upgrades for the latent rights are summarised and shown in <b>Table 3 and Figure 4c</b> .  Conclusion regarding latent rights is summarised in <b>Table 4</b> . The upgrades proposed for K71 between Lochner and N14 are inadequate because the latent rights will only provide one additional lane between Marais and N14, whereas two additional lanes are recommended. The upgrades proposed for the other roads are adequate.	Appendix A, Table 2, Table 3 and Table 4, Appendix B, Figure 4a and 4b
<b>4. Trip Generation</b>	The development will generate the following: <ul style="list-style-type: none"> <li>➤ 12 198 trips during the weekday AM and PM peak hours if the adjustment factor is not applied (Option 1).</li> <li>➤ 10 799 trips during the weekday AM and PM peak hours if the adjustment factor of 0.7 is applied to make provision for internal trips between residential, office and industrial (Option 2).</li> <li>➤ 9 292 trips during the weekday AM and PM peak hours if the adjustment factor of 0.8 is applied to indicate that 20% of trips will use public transport (Option 3).</li> </ul> <p><i>Note: Option 3 trips was used for the purpose of this report as it addresses the usage of public transport and make provision for internal trips between industrial, residential and offices.</i></p>	Appendix A, Table 1a, 1b and 1c

<b>Monavoni Master Planning of all extentions</b>		
	<b>Description</b>	<b>Refer to Appendix</b>
	Refer to <b>Table 1a, 1b and 1c</b> for the detail of the trip generation.	
<b>5. Expected Trip Distribution and Trip Assignment</b>	<p>The additional vehicle trips that will be generated by the proposed development were distributed to the adjacent road network. The trip distribution for the study was done based on the examination of the existing traffic flow patterns in the area, surveys conducted in the previous studies, as well as local knowledge of the area. The expected trip distribution of the proposed development is shown in <b>Figure 3a, 3b, 3c, 3d and 3e</b>.</p> <p>It should be noted that there are five alternatives in terms of trip distribution, the aim was to check most suitable trip distribution that will resolve the capacity especially on K71. The five alternatives are explained below:</p> <ul style="list-style-type: none"> <li>➤ <b>Alternative 1:</b> All traffic towards south will use K71.</li> <li>➤ <b>Alternative 2:</b> 40% of traffic towards south to use PWV9.</li> <li>➤ <b>Alternative 3:</b> 40% of traffic towards south to use PWV9 until at N14, then 25% will join N14 to join K71 south (PWV will be constructed until N14)</li> <li>➤ <b>Alternative 4:</b> 20% of traffic towards south to use R511 via Riumte (P102-1).</li> <li>➤ <b>Alternative 5:</b> 25% of traffic towards south to use PWV9 until at N14, then 10% will join N14 to join K71 south (PWV will be constructed until N14), also 15% towards south will use D49.</li> </ul> <p><i>Alternative 5 was used for the purpose of this study as it will reduce chances of adding more traffic on K71 because K71 will not have spare capacity by the time most of the developments will be developed.</i></p> <p>The link volumes are shown in <b>Table 5a, 5b, 6a, 6b, 7a, 7b, 8a, 8b, 9a and 9b</b> for different alternatives.</p>	Appendix B, Figure 3a, 3b, 3c, 3d and 3e and Appendix A, Table 5a, 5b, 6a, 6b, 7a, 7b, 8a, 8b, 9a and 9b
<b>6. Background Volumes</b>	The surveyed traffic volumes were obtained from traffic counts conducted in June 2009 by ITS Engineers as well as from the study conducted by Arup (Forest Hill City) during August 2008 the counts were conducted during August 2005 and were grown with 4% per annum for our study purposes. .	Appendix B, Figure 2a and Figure 2b

<b>Monavoni Master Planning of all extensions</b>		
	<b>Description</b>	<b>Refer to Appendix</b>
<b>7. Expected Link Demand and Capacity Analysis</b>	<p>For each of the adjacent roads that will carry additional traffic generated by the development, the following was therefore calculated:</p> <ul style="list-style-type: none"> <li>➤ The existing traffic demand was determined from survey conducted by ITS Engineers.</li> <li>➤ Traffic generated by latent rights was obtained from other traffic studies.</li> <li>➤ Traffic generated by this development was calculated and assigned to each road.</li> <li>➤ A link volume / capacity ratio was calculated and based on this; a decision was made if additional lanes are required on the link.</li> </ul> <p>The results of capacity analysis and link volumes are shown in the attached <b>Table 5a, 5b, 6a, 6b, 7a, 7b, 8a, 8b, 9a and 9b</b> for different alternatives.</p> <p>The road upgrades that were determined on a link level, based on the capacity analyses, are shown in <b>Table 11</b>. The cost of each upgrade, in August 2009 Rands, are also indicated. The proposed upgrades exclude all internal roads in the development, also excluding Mimosa Road that is regarded by the City of Tshwane as a Class 4 road.</p>	Appendix A, Table 5a, 5b, 6a, 6b, 7a, 7b, 8a, 8b, 9a and 9b as well as Table 11
<b>8. Phasing of proposed road upgrades</b>	<p>The proposed road upgrades will not happen at once, but will be phased with the different extensions of the proposed townships. In order to provide an estimate of when which upgrades should be carried out, a matrix was developed in which the 10% of traffic generated per year was tied with a specific road upgrade. This matrix is shown in <b>Table 10</b>.</p> <p>The aim of this matrix was to balance spending of road upgrades, capacity required and traffic generated by each phase of the development.</p> <p>It is foreseen that the proposed upgrades are used as a planning guideline, and that as individual townships are established, a more detailed traffic impact study be carried out to determine the detail of the upgrades.</p>	Appendix A, Table 10

### Monavoni Master Planning of all extensions

	Description	Refer to Appendix
<b>9. Conclusion and recommendation</b>	<p>This document provides a master plan of road upgrades for the proposed development. It should not be regarded as a detailed traffic impact study, but as a guideline to determine macro level road upgrades that will be required to accommodate the development. The proposed development of approximately 164 257m<sup>2</sup> for offices, 197109m<sup>2</sup> for industrial and 10762 units for residential is expected to generate also 9292 vehicles per hour in the peak hour. The road network where the development will be located will require substantial upgrades to accommodate this extent of traffic volumes. This include widening a large section of K71, including the interchange with the N14, provision of a section of K52 and PWV9, upgrading access routes and the provision of several traffic signals. The estimated cost of all the road upgrades is +/- R 95 million. The funding of these road upgrades will have to be resolved with the relevant authorities, i.e. Gautrans and the City of Tshwane.</p> <p>The upgrades proposed in this report will provide adequate regional capacity that will be able to accommodate the traffic generated by the development, and the development, from a macro planning point of view, can therefore proceed.</p>	



**Monavoni Master Planning of all extentions**

**APPENDIX A**

**TABLES AND ADDITIONAL INFORMATION**

## APPENDIX A

### TABLES AND ADDITIONAL INFORMATION

Table 1a	Summary of Land use and peak hour trip generation
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Table 2	Trip Generation - Latent Rights Traffic
Table 3	Proposed Roads upgrades (by Latent Rights)
Table 4	Issues regarding Latent Rights
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Table 6a	Monavoni master summary of link weekday AM Peak traffic volumes and capacity requirements – Alternative 2
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Table 10	Proposed phasing of upgrades
Table 11	Estimated cost of external road upgrades

# Monavoni Master Planning of all extensions

## APPENDIX A

### TRIP GENERATION

Table 1a below indicates the summary of Land use and expected peak hour trip generation

AM Peak Hour										
Nr.	Land Use	Extent	Units	FAR	GLA	Trip Rate (vph)	Adjustment factor	Inbound (vph)	Outbound (vph)	Total (vph)
1	Office	328514	m <sup>2</sup>	0.5	164257	2	1	2792	493	3285
2	Industrial	492771	m <sup>2</sup>	0.4	197109	0.7	1	1104	276	1380
3	Residential	10762	units	N.a	N.a	0.7	1	1883	5650	7533
Totals								5780	6419	12198
PM Peak Hour										
Nr.	Land Use	Extent	Units	FAR	GLA	Trip Rate (vph)	Adjustment factor	Inbound (vph)	Outbound (vph)	Total (vph)
1	Office	328514	m <sup>2</sup>	0.5	164257	2	1	493	2792	3285
2	Industrial	492771	m <sup>2</sup>	0.4	197109	0.7	1	276	1104	1380
3	Residential	10762	units	N.a	N.a	0.7	1	5650	1883	7533
Totals								6419	5780	12198

Table 1b below indicates the summary of Land use and expected peak hour trip generation

AM Peak Hour										
Nr.	Land Use	Extent	Units	FAR	GLA	Trip Rate (vph)	Adjustment factor	Inbound (vph)	Outbound (vph)	Total (vph)
1	Office	328514	m <sup>2</sup>	0.5	164257	2	0.7	1955	345	2300
2	Industrial	492771	m <sup>2</sup>	0.4	197109	0.7	0.7	773	193	966
3	Residential	10762	units	N.a	N.a	0.7	1	1883	5650	7533
Totals								4611	6188	10799
PM Peak Hour										
Nr.	Land Use	Extent	Units	FAR	GLA	Trip Rate (vph)	Adjustment factor	Inbound (vph)	Outbound (vph)	Total (vph)
1	Office	328514	m <sup>2</sup>	0.5	164257	2	0.7	345	1955	2300
2	Industrial	492771	m <sup>2</sup>	0.4	197109	0.7	0.7	193	773	966
3	Residential	10762	units	N.a	N.a	0.7	1	5650	1883	7533
Totals								6188	4611	10799
✓ The adjustment factor of 0.7 applied above is to make provision for internal trips between residential, office and industrial.										

**Table 1c** below indicates the summary of Land use and expected peak hour trip generation

<b>AM Peak Hour</b>										
<b>Nr.</b>	<b>Land Use</b>	<b>Extent</b>	<b>Units</b>	<b>FAR</b>	<b>GLA</b>	<b>Trip Rate (vph)</b>	<b>Adjustment factor</b>	<b>Inbound (vph)</b>	<b>Outbound (vph)</b>	<b>Total (vph)</b>
1	Office	328514	m <sup>2</sup>	0.5	164257	2	0.7	1955	345	2300
2	Industrial	492771	m <sup>2</sup>	0.4	197109	0.7	0.7	773	193	966
3	Residential	10762	units	N.a	N.a	0.7	0.8	1507	4520	6027
Totals								4234	5058	9292
<b>PM Peak Hour</b>										
<b>Nr.</b>	<b>Land Use</b>	<b>Extent</b>	<b>Units</b>	<b>FAR</b>	<b>GLA</b>	<b>Trip Rate (vph)</b>	<b>Adjustment factor</b>	<b>Inbound (vph)</b>	<b>Outbound (vph)</b>	<b>Total (vph)</b>
1	Office	328514	m <sup>2</sup>	0.5	164257	2	0.7	345	1955	2300
2	Industrial	492771	m <sup>2</sup>	0.4	197109	0.7	0.7	193	773	966
3	Residential	10762	units	N.a	N.a	0.7	0.8	4520	1507	6027
Totals								5058	4234	9292
<p><b>1. The adjustment factor of 0.7 applied above is to make provision for internal trips between residential, office and industrial.</b></p> <p><b>2. The adjustment factor of 0.8 applied above is to indicate that 20% of trips will use public transport.</b></p>										

*Note: The trip generation rate of 0.7 vehicle trips per hour per dwelling unit, with a directional split of 25:75 (in:out) during the AM peak hour was used.*

*The reason for this trip generation rate is that recent studies showed that for an area of a significant scale, the average trip rate should be used and not the 75<sup>th</sup> percentile which is in this case 1 vehicle per hour and not the 1,1 vehicles per unit normally used for the expected type of income group.*

## LATENT RIGHTS

**Table 2: Trip Generation - Latent Rights Traffic**

No.	Development	Extent	Land Use	Trip Rate	Peak Period	Trip Generation (vph)		
						In	Out	Total
1	The Reeds Extension 3	172 units	Residential	1.1	AM	46	143	189
					PM	143	46	
2	The Reeds Extension 18	405 units	Residential	1.1	AM	109	336	445
					PM	336	109	
3	ABSA development	1463 units	Residential*	-	AM	512	951	1666
					PM	112	91	
		2 000 pupils	Educational		AM	951	515	
					PM	0	0	
4	Sundreland Ridge Extension 17	7 735 m <sup>2</sup>	Educational	-	AM	75	25	200
					PM	20	80	
5	Sundreland Ridge Extension 14	35 322 m <sup>2</sup>	Industrial, Storage and Offices	-	AM	130	30	320
					PM	30	130	
6	Hoekplaats / Mooiplaats Development	49 500 m <sup>2</sup> , 844 units and 450 pupils	Residential, Retail, Industrial, Commercial, Primary School and Office	-	AM	715	965	4454
					PM	1511	1263	
7	Portion R/29 Vlakplaats 354-JR	60 000 m <sup>2</sup> , 1 500 units	Residential, Retail and Office	-	AM	1116	1362	6195
					PM	1981	1736	
8	Forest Hill City	155 500 m <sup>2</sup> , 190 rooms and 1450 units	Offices, Retail, Residential and Hotel	-	AM	1313	1717	9392
					PM	3407	2955	
9	Heuweloord Extension 13	950 units	Residential	1.1	AM	260	780	1040
					PM	780	260	
10	Rooihuiskraal Noord Extension 33	2 804 units	Residential	1.1	AM	771	2313	3084
					PM	2313	771	
11	ABSA Amberfield East	1 533 units	Residential**	1.1	AM	337	1349	1686
					PM	1349	337	
12	Monavoni Extension 3 and 4	1 806 units	Residential	1	AM	452	1354	1806
					PM	1354	452	
13	Monavoni Extension 6	730 units	Residential	1	AM	182	548	730
					PM	548	182	
14	Monavoni Extension 19	550 units	Residential	1	AM	138	413	550
					PM	413	138	
15	Celtisdal Extension 20	1 548 units, 500 pupils, 2 500 m <sup>2</sup> business and 8 280 m <sup>2</sup> retail	Residential, Educational, Business and Retail	-	AM	476	1558	1734
					PM	1385	611	
16	Rua Vista Extension 12	634 units	Residential	1.1	AM	174	523	809
					PM	17	95	
17	Rua Vista Extension 13	485 m <sup>2</sup>	Offices	2.3	AM	523	174	809
					PM	95	17	
17	Rua Vista Extension 13	298 units	Residential	1.1	AM	82	246	328
					PM	246	82	
<b>Total</b>					AM	7017	14799	21816
					PM	17385	9858	27243



**Table 3: Proposed Roads upgrades (by Latent Rights)**

No.	Intersection Name	Description of Road Upgrading
1	N14 / K71 (R55/P66-1) Interchange (Southern Terminal)	<ul style="list-style-type: none"> <li>- Traffic Signal</li> <li>- Construction of an additional through lane on the northern and southern approaches.</li> <li>- New left turn loop.</li> </ul>
2	N14 / K71 (R55/P66-1) Interchange (Northern Terminal).	<ul style="list-style-type: none"> <li>- Traffic Signal</li> <li>- Construction of an additional through lane on the northern and southern approaches.</li> <li>- Construction of an additional left turn lane on the western and northern approach.</li> <li>- Construction of an additional right turn lane on the southern approach.</li> </ul>
3	K71 (R55/P66-1) / Ruimte Road (P102-1/M34)	<ul style="list-style-type: none"> <li>- Convert to a great separation</li> <li>- Traffic Signal</li> <li>- Construction of an additional right turn lane on the eastern approach.</li> <li>- Construction of an additional through lane on both eastern and western approaches</li> <li>- Construction of an additional right turn lane on both southern and northern approaches.</li> </ul>
4	K71 (R55/P66-1) / Poole	<ul style="list-style-type: none"> <li>- Traffic Signal</li> <li>- Construction of an additional right turn lane on the northern approach.</li> <li>- Construction of two additional left turn lanes on the southern approach.</li> <li>- Construction of an additional left and right turn lanes on the eastern approach.</li> <li>- Construction of an additional left and right turn lanes on the western approach.</li> </ul>
5	K71 (R55/P66-1) / Wierda (K103)	<ul style="list-style-type: none"> <li>- Traffic Signal</li> <li>- Construction of an additional right turn lanes on the eastern and western approaches.</li> <li>- Construction of an additional right turn lane on the southern approach.</li> </ul>
6	Ruimte Road (P102-1/M34) / Boundary D49	<ul style="list-style-type: none"> <li>- Traffic Signal</li> <li>- Construction of an additional right turn lanes on the southern and western approaches.</li> </ul>

**Table 4: Issues regarding Latent Rights**

No.	Name of Road	Description of Issues
1	K71 (R55/P66-1)	<ul style="list-style-type: none"> <li>- Will require three more lanes per direction</li> <li>- The road reserve is 65m.</li> <li>- Won't be able to accommodate three more lanes per direction.</li> <li>- No spare capacity for Monavoni development.</li> </ul>
2	North of K71 (R55/P66-1)	<ul style="list-style-type: none"> <li>- It will generate 1670 vph, which means it will require one more lane per direction.</li> <li>- Spare capacity for Monavoni development and Latent rights will be available.</li> </ul>
3	Ruimte Road (P102-1/M34)	<ul style="list-style-type: none"> <li>- It will generate 2370 vph to the east of K71 and 1870 vph to the west of K71, which means it will require two more lanes per direction to the east and one more lane per direction to the west.</li> <li>- Grade separation intersection on K71 and Ruimte (P102-1) is proposed.</li> <li>- The road reserve is 48,4 m</li> <li>- Recently the road is being upgraded to two lanes per direction</li> <li>- There is sufficient space to add one more lane.</li> <li>- One more lane will be required to the east.</li> <li>- It makes more sense to construct one lane per direction on K52 between K71 to P102-1, because K52 has more important function.</li> <li>- Ruimte (P102-1) to the east of K71 will have a spare capacity for latent rights.</li> </ul>
4	N14	<ul style="list-style-type: none"> <li>- Latent rights add 1500 vph to the east of K71 and 900 vph to the west of K71.</li> <li>- One extra lane will be required per direction on both east and west of K71.</li> <li>- Road reserve is 82 m.</li> </ul>
5	East of Wierda (K103)	<ul style="list-style-type: none"> <li>- It will generate 960 vph, which means it will require one more lane per direction.</li> <li>- Spare capacity for Monavoni development and Latent rights will be available.</li> </ul>
6	Mimosa (D49)	<ul style="list-style-type: none"> <li>- It will generate 560 vph, which means it will require one more lane per direction.</li> <li>- Spare capacity for Monavoni development and Latent rights will be available.</li> </ul>

TABLE 5a: MONAVONI MASTER SUMMARY OF LINK WEEKDAY AM PEAK TRAFFIC VOLUMES AND CAPACITY REQUIREMENTS - ALTERNATIVE 1

Road	Section	Direction and Lane Requirements	2009 Background Traffic (vph)	Latent Rights (vph)	2009 Background Traffic + Latent Rights (vph)	Development Traffic (vph)	2009 Background Traffic + Latent Rights + Development Traffic (vph)	Nr. of Lanes Required for Background Traffic	Nr. of Lanes Required for Development Traffic	Nr. of Lanes Required for 2009 Traffic + Latent Rights + Development Traffic	2019 Background Traffic (vph)	2019 Background Traffic + Latent Rights (vph)	2019 Background Traffic + Latent Rights + Development Traffic (vph)	Nr. of Lanes Required for 2019 Background Traffic	Existing nr. of lanes	Nr. of Lanes Required for 2019 Traffic + Latent Rights + Development Traffic
K71 (R55) Voornbeek Road	Between Wierds and P33-1	Northbound	935	617	1752	508	2258	0.6	0.3	1.5	1364	2201	2707	0.9	2.0	1.8
		Southbound	970	1534	2504	423	2928	0.6	0.3	2.0	1436	2370	2393	1.0	2.0	2.3
	Between Wierda and Poole	Northbound	585	1174	1759	1012	2771	0.4	0.7	1.8	866	2040	3052	0.8	2.0	2.0
		Southbound	940	1892	2832	847	3680	0.6	0.6	2.3	1240	3045	3892	0.8	2.0	2.6
	Between Poole and Lechnar	Northbound	570	2466	3036	759	3795	0.4	0.5	2.5	844	3310	4059	0.6	2.0	2.7
		Southbound	660	3124	3784	635	4419	0.4	0.4	2.9	967	4086	4771	0.8	2.0	3.1
	Between Lechnar and K52	Northbound	545	2178	2723	2117	4840	0.4	1.4	3.2	607	2985	5102	0.5	2.0	3.4
		Southbound	715	3028	3743	2529	6272	0.5	1.7	4.2	1058	4086	6615	0.7	2.0	4.4
	Between K52 and Rummie	Northbound	845	2020	2865	2752	5617	0.4	1.8	3.6	965	2975	5727	0.6	2.0	3.8
		Southbound	610	3124	3734	3288	7022	0.4	2.2	4.7	903	4027	7316	0.6	2.0	4.9
	Between Rummie and Macas	Northbound	810	1494	2304	2329	4633	0.5	1.6	3.1	1199	2893	5022	0.8	2.0	3.3
		Southbound	1355	2278	3633	2782	6415	0.9	1.9	4.3	2006	4294	7066	1.3	2.0	4.7
Between Macas and N14 North Terminal	Northbound	915	2083	2998	2329	5327	0.6	1.6	3.6	1254	3438	5766	0.9	2.0	3.8	
	Southbound	2040	2736	4776	2782	7560	1.4	1.9	5.0	3020	5758	8540	2.0	2.0	5.7	
Between N14 North Terminal and South Terminal	Northbound	725	2035	2760	1895	4655	0.5	1.3	3.1	1073	3188	5013	0.7	2.0	3.3	
	Southbound	1200	1613	2813	2276	5089	0.8	1.5	3.4	1776	3390	5666	1.2	2.0	3.8	
South of N14 Southern Terminal	Northbound	845	558	1403	1270	2673	0.6	0.8	1.8	1251	1809	3079	0.8	2.0	2.1	
	Southbound	1140	802	1942	1517	3459	0.8	1.0	2.3	1687	2489	4007	1.1	2.0	2.7	
West of R55	Westbound	340	1005	1345	253	1598	0.2	0.2	1.1	593	1506	1761	0.3	1.0	1.2	
	Eastbound	655	785	1440	212	1652	0.4	0.1	1.1	970	1735	1945	0.6	1.0	1.3	
East of R55	Westbound	825	1735	2560	212	2771	0.6	0.1	1.8	1221	2956	3769	0.8	1.0	2.1	
	Eastbound	560	2067	2627	253	2880	0.4	0.2	1.9	629	2836	3089	0.6	1.0	2.1	
West of R55	Westbound	0	603	603	0	603	0.0	0.0	0.4	0	560	560	0.0	1.0	0.4	
	Eastbound	0	635	635	0	635	0.0	0.0	0.4	0	635	635	0.0	1.0	0.4	
East of R55	Westbound	0	20	20	0	20	0.0	0.0	0.0	0	20	20	0.0	1.0	0.0	
	Eastbound	0	25	25	0	25	0.0	0.0	0.0	0	25	25	0.0	1.0	0.0	
Between Access 1 and R65	Westbound	0	0	0	1270	1270	0.0	0.8	0.8	0	0	1270	0.0	0.0	0.8	
	Eastbound	0	0	0	1517	1517	0.0	1.0	1.0	0	0	1517	0.0	0.0	1.0	
East of R55	Westbound	0	0	0	635	635	0.0	0.4	0.4	0	0	635	0.0	0.0	0.4	
	Eastbound	0	0	0	759	759	0.0	0.5	0.5	0	0	759	0.0	0.0	0.5	
West of PWW9	Westbound	905	795	1700	759	2459	0.6	0.5	1.6	1340	2065	2823	0.9	2.0	1.9	
	Eastbound	265	735	1000	635	1635	0.2	0.4	1.1	392	1127	1762	0.3	2.0	1.2	
Between PWW9 and R65	Westbound	905	735	1640	759	2399	0.6	0.5	1.6	1340	2065	2823	0.9	2.0	1.9	
	Eastbound	265	735	1000	635	1635	0.2	0.4	1.1	392	1127	1762	0.3	2.0	1.2	
East of R65	Westbound	475	730	1205	606	1711	0.3	0.3	1.1	703	1433	1939	0.5	2.0	1.3	
	Eastbound	995	1415	2410	423	2833	0.7	0.3	1.9	1473	2888	3311	1.0	2.0	2.2	
East of R65	Westbound	710	1073	1783	423	2206	0.5	0.3	1.5	1051	2124	2547	0.7	1.0	1.7	
	Eastbound	495	560	1055	306	1561	0.3	0.3	1.0	753	1283	1798	0.5	1.0	1.2	

Note 1: Lanes required to accommodate the demand, based on a lane capacity of (vph): 1500  
 Note 2: The growth rate of 4% per annum has been used to determine the growth of traffic between 2009 and 2019.



TABLE 5b: MONAVONI MASTER SUMMARY OF LINK WEEKDAY PM PEAK TRAFFIC VOLUMES AND CAPACITY REQUIREMENTS - ALTERNATIVE 1

Section	Direction and Lane Requirements	2009 Background Traffic (vph)	2009 Latent Rights Traffic (vph)	2009 Background Traffic (vph) + Latent Rights Traffic (vph)	Nr. of Lanes Required for Background Traffic	Nr. of Lanes Required for Development Traffic	Nr. of Lanes Required for 2009 Traffic + Latent Rights + Development Traffic	2019 Background Traffic (vph)	2019 Latent Rights Traffic (vph)	2019 Background Traffic (vph) + Latent Rights Traffic (vph)	Nr. of Lanes Required for Background Traffic	Existing Lanes	Nr. of Lanes Required for 2019 Traffic + Latent Rights + Development Traffic	
K21 (R55) Vosewoker Road	Between Wierds and P39.1	Northbound: 1160 Southbound: 793	2033 1853	423 506	0.8 0.5	0.3 0.3	2.2 1.5	3087 2570	3087 2570	3087 2570	1.1 0.8	2.0 2.0	2.5 1.7	
	Between Wierds and Poort	Northbound: 650 Southbound: 610	3270 1995	847 1072	0.6 0.4	0.6 0.7	2.7 2.0	4573 3003	4573 3003	4573 3003	0.9 0.6	2.0 2.0	3.0 2.2	
	Between Poort and Lochter	Northbound: 525 Southbound: 500	4105 3160	535 759	0.4 0.3	0.4 0.5	3.5 2.8	4682 4449	4682 4449	4682 4449	0.5 0.5	2.0 2.0	3.7 3.0	
	Between Lochter and K52	Northbound: 580 Southbound: 455	4165 2950	2028 2117	0.4 0.3	1.7 1.4	4.8 3.7	4964 3003	4964 3003	4964 3003	0.6 0.6	2.0 2.0	5.0 3.9	
	Between K52 and Ruis	Northbound: 550 Southbound: 565	3310 2430	3288 2752	0.4 0.4	2.2 1.8	4.4 3.8	4124 3266	4124 3266	4124 3266	0.5 0.6	2.0 2.0	4.5 4.0	
	Between Ruis and Myrals	Northbound: 990 Southbound: 870	2950 1840	2782 2329	0.7 0.6	1.9 1.6	4.5 3.0	4423 3268	4423 3268	4423 3268	1.0 0.9	2.0 2.0	4.8 3.7	
	Between Myrals and N14 North Terminal	Northbound: 1415 Southbound: 905	3440 2405	2782 2329	0.9 0.6	1.9 1.6	5.1 3.8	5525 3745	5525 3745	5525 3745	1.4 0.9	2.0 2.0	5.5 4.0	
	Between N14 North Terminal and South Terminal	Northbound: 1120 Southbound: 870	2780 1350	3883 2220	0.7 0.6	1.5 1.3	4.1 2.6	4418 2538	4418 2538	4418 2538	1.1 0.9	2.0 2.0	4.5 3.0	
	South of N14 South Terminal	Northbound: 725 Southbound: 1065	1005 1120	1730 2205	0.5 0.7	1.0 0.8	2.2 2.3	1073 1696	2078 3996	1073 1696	0.7 1.1	2.0 2.0	2.4 2.7	
	Ruis Road (M34) P102-1	West of R55	Westbound: 500 Eastbound: 635	1660 770	212 353	0.4 0.4	0.1 0.2	1.6 1.1	2462 1658	2462 1658	2462 1658	0.8 0.6	1.0 1.0	1.8 1.3
		East of R55	Westbound: 655 Eastbound: 670	3370 2095	253 212	0.4 0.6	0.2 0.1	2.2 2.1	3278 3177	3278 3177	3278 3177	0.6 0.9	1.0 1.0	2.4 2.4
		West of R55	Westbound: 0 Eastbound: 0	910 830	0 0	0.0 0.0	0.0 0.0	0.0 0.0	910 830	910 830	910 830	0.0 0.0	1.0 1.0	0.6 0.6
East of R55		Westbound: 0 Eastbound: 0	40 35	0 0	0.0 0.0	0.0 0.0	0.0 0.0	40 35	40 35	40 35	0.0 0.0	1.0 1.0	0.0 0.0	
K52	Between Access 1 and R55	Westbound: 0 Eastbound: 0	0 0	1517 1270	0.0 0.0	1.0 0.8	1.0 0.8	1517 1270	1517 1270	1517 1270	0.0 0.0	0.0 0.0	1.0 0.8	
	East of R55	Westbound: 0 Eastbound: 0	0 0	759 635	0.0 0.0	0.5 0.4	0.5 0.4	759 635	759 635	759 635	0.0 0.0	0.0 0.0	0.5 0.4	
N14	West of PWV9	Westbound: 810 Eastbound: 470	306 895	635 759	0.4 0.3	0.4 0.5	1.2 1.4	1199 1591	1199 1591	1199 1591	0.8 0.5	2.0 2.0	1.5 1.6	
	Between PWV9 and R55	Westbound: 810 Eastbound: 470	306 895	635 759	0.4 0.3	0.4 0.5	1.2 1.4	1199 1591	1199 1591	1199 1591	0.8 0.5	2.0 2.0	1.5 1.6	
	East of R55	Westbound: 905 Eastbound: 645	1515 1155	2500 2305	0.7 0.4	0.3 0.3	1.9 1.5	1408 955	1408 955	1408 955	1.0 0.6	2.0 2.0	2.0 1.7	
	East of R55	Westbound: 695 Eastbound: 670	607 1164	1202 423	0.5 0.4	0.3 0.3	1.2 1.5	1014 992	1014 992	1014 992	0.7 0.7	1.0 1.0	1.4 1.7	

Note 1: Lanes required to accommodate the demand, based on a lane capacity of (vph): 1500

Note 2: The growth rate of 4% per annum has been used to determine the growth of traffic between 2009 and 2019.

TABLE 8a: MONAYONI MASTER SUMMARY OF LINK WEEKDAY AM PEAK TRAFFIC VOLUMES AND CAPACITY REQUIREMENTS - ALTERNATIVE 2

Road	Section	Direction and Lane Requirements	2009 Background Traffic (vph)	Latent Rights (vph)	2009 Background Traffic + Latent Rights (vph)	Developed Background Traffic (vph)	2009 Background Traffic + Latent Rights + Development Traffic (vph)	Nr. of Lanes Required for Background Traffic	Nr. of Lanes Required for Development Traffic	Nr. of Lanes Required for 2019 Traffic + Latent Rights + Development Traffic	2019 Background Traffic (vph)	2019 Background Traffic + Latent Rights + Development Traffic (vph)	Nr. of Lanes Required for Background Traffic	Existing Lanes	Nr. of Lanes Required for Latent Rights + Development Traffic
K71 (R55) Voortrekker Road	Between Wierds and P39-1	Northbound	835	817	1752	245	2258	0.6	0.3	1.5	1384	2201	1.3	2.0	1.8
		Southbound	370	1534	2504	421	2828	0.6	0.3	2.0	1438	2970	1.3	2.0	3.3
	Between Wierds and P39-1	Northbound	585	1402	1987	1012	2999	0.4	0.7	2.0	866	2868	0.6	2.0	3.7
		Southbound	840	2467	3307	847	4154	0.8	0.6	3.0	1243	3710	0.8	2.0	3.8
	Between Pardi and Lechner	Northbound	570	2466	3036	759	3795	0.4	0.5	2.3	844	3310	0.6	2.0	2.7
		Southbound	650	3124	3774	635	4409	0.4	0.4	2.1	862	4068	0.6	2.0	3.1
	Between Lechner and K52	Northbound	545	2466	3011	1482	4493	0.4	1.3	3.0	807	3273	0.5	2.0	3.2
		Southbound	715	3124	3839	1770	5609	0.5	1.3	3.1	1058	4182	0.7	2.0	3.8
	Between K52 and Pardi	Northbound	845	2020	2865	1209	3723	0.4	0.7	2.4	955	2975	0.6	2.0	3.2
		Southbound	610	3124	3734	1265	4999	0.4	0.8	3.3	903	4027	0.5	2.0	3.5
	Between Pardi and Marais	Northbound	810	1782	2592	1059	3651	0.5	0.7	3.4	1189	2981	0.8	2.0	3.2
		Southbound	1355	2374	3729	1265	4993	0.7	0.8	3.3	2036	4379	1.2	2.0	3.4
Between Marais and N14 North Terminal and South Terminal	Northbound	815	2076	2890	605	3495	0.6	0.4	3.4	1354	3433	0.9	2.0	3.1	
	Southbound	2040	2738	4778	759	5537	1.4	0.5	3.7	3920	5768	3.5	2.0	4.2	
Between N14 North Terminal and South Terminal	Northbound	725	2035	2760	639	3395	0.5	0.4	3.0	1073	3108	0.7	2.0	3.3	
	Southbound	1255	1813	2868	253	3121	0.8	0.2	3.1	1856	3471	1.3	2.0	3.3	
South of N14 Southern Terminal	Northbound	845	848	1691	212	1903	0.6	0.1	1.3	1251	2097	0.8	2.0	1.5	
	Southbound	1140	898	2038	253	1291	0.8	0.2	1.5	1687	2585	1.1	2.0	1.9	
West of R55	Westbound	340	1005	1345	253	1598	0.2	0.2	1.1	503	1508	0.3	1.0	1.2	
	Eastbound	655	765	1420	212	1632	0.4	0.1	1.1	970	1735	0.6	1.0	1.3	
East of R55	Westbound	825	1735	2560	253	2813	0.6	0.2	1.9	1221	2956	0.8	1.0	2.1	
	Eastbound	560	2007	2567	212	2779	0.4	0.1	1.5	829	3048	0.6	1.0	2.0	
West of R55	Westbound	0	580	580	0	580	0.0	0.0	0.4	0	580	0.0	1.0	0.4	
	Eastbound	0	635	635	0	635	0.0	0.0	0.4	0	635	0.0	1.0	0.4	
East of R55	Westbound	0	20	20	0	20	0.0	0.0	0.0	0	20	0.0	1.0	0.0	
	Eastbound	0	25	25	0	25	0.0	0.0	0.0	0	25	0.0	1.0	0.0	
Between PW9 and R55	Westbound	0	0	0	2023	2023	0.0	1.1	1.3	0	0	2023	0.0	0.0	1.3
	Eastbound	0	0	0	1694	1694	0.0	1.1	1.1	0	0	1694	0.0	0.0	1.1
East of R55	Westbound	0	0	0	635	635	0.0	0.4	0.4	0	0	635	0.0	0.0	0.4
	Eastbound	0	0	0	759	759	0.0	0.5	0.5	0	0	759	0.0	0.0	0.5
Between K52 and N14	Northbound	0	0	0	1694	1694	0.0	1.1	1.1	0	0	1694	0.0	0.0	1.1
	Southbound	0	0	0	2023	2023	0.0	1.3	1.3	0	0	2023	0.0	0.0	1.3
South of N14	Northbound	0	0	0	1059	1059	0.0	0.7	0.7	0	0	1059	0.0	0.0	0.7
	Southbound	0	0	0	1265	1265	0.0	0.8	0.8	0	0	1265	0.0	0.0	0.8
West of PW9	Westbound	425	735	1160	759	1929	0.3	0.5	1.3	629	1354	0.3	2.0	1.4	
	Eastbound	265	735	1000	585	1635	0.2	0.4	1.1	392	1127	0.3	2.0	1.2	
Between PW9 and R55	Westbound	435	735	1180	0	1180	0.3	0.0	0.8	629	1354	0.4	2.0	0.9	
	Eastbound	265	735	1000	0	1000	0.2	0.0	0.7	392	1127	0.3	2.0	0.8	
East of R55	Westbound	575	730	1305	423	1788	0.4	0.3	1.2	651	1581	0.6	2.0	1.3	
	Eastbound	1015	1415	2430	506	2936	0.7	0.3	2.0	1502	2917	1.6	2.0	2.3	
East of R55	Westbound	710	1073	1783	423	2206	0.5	0.3	1.5	1051	2124	0.7	2.0	1.7	
	Eastbound	405	640	1045	506	1551	0.3	0.3	1.0	733	1233	0.5	2.0	1.2	

Note 1: Lanes required to accommodate the demand, based on a lane capacity of (vph) 1500

Note 2: The growth rate of 4% per annum has been used to determine the growth of traffic between 2009 and 2019.







TABLE 7a: MONAVON MASTER SUMMARY OF LINK WEEKDAY AM PEAK TRAFFIC VOLUMES AND CAPACITY REQUIREMENTS - ALTERNATIVE 3

Road	Section	Direction and Lane Requirements	2009 Background Traffic (vph)	2009 Latent Rights Traffic (vph)	2009 Background Traffic + Latent Rights Traffic (vph)	Development Traffic (vph)	2009 Background Traffic + Latent Rights Traffic + Development Traffic (vph)	Nr. of Lanes Required for Development Traffic	Nr. of Lanes Required for Background Traffic + Latent Rights Traffic + Development Traffic (vph)	2019 Background Traffic (vph)	2019 Latent Rights Traffic (vph)	2019 Background Traffic + Latent Rights Traffic (vph)	Nr. of Lanes Required for Background Traffic + Latent Rights Traffic + Development Traffic (vph)	Nr. of Lanes Required for 2019 Traffic + Latent Rights + Development Traffic
K31 (R52) Veetwaker Road	Between Wierds and P39-1	Northbound	935	817	1752	506	2258	0.6	0.3	1384	2261	2707	0.9	2.0
		Southbound	970	1534	2504	423	2928	0.8	0.3	1438	2970	3393	1.0	2.0
	Between Wierds and Poels	Northbound	585	1492	2077	1612	2989	0.4	0.7	848	2988	3736	0.8	2.0
		Southbound	840	2457	3297	847	3710	0.8	0.6	1243	3710	4557	0.8	2.0
	Between Poels and Lothier	Northbound	570	2456	3026	759	3785	0.4	0.5	844	3780	4624	0.6	2.0
		Southbound	680	3124	3774	635	4409	0.4	0.4	962	4086	4721	0.6	2.0
	Between Lothier and K52	Northbound	545	2456	3011	1482	4493	0.4	1.4	807	3273	4080	0.5	2.0
		Southbound	715	3124	3839	1770	5609	0.5	1.3	1098	4182	5053	0.7	2.0
	Between K52 and Burnie	Northbound	645	2020	2665	1959	3723	0.4	0.7	905	3975	4923	0.6	2.0
		Southbound	610	3124	3734	1265	4999	0.4	0.8	902	4027	5291	0.6	2.0
	Between Burnie and Marais	Northbound	810	1792	2592	635	3227	0.5	0.4	1199	2981	3616	0.8	2.0
		Southbound	1305	2374	3729	708	4407	0.6	0.5	2006	4379	5138	1.3	2.0
Between Marais and N14 North Terminal	Northbound	515	2076	2593	535	3628	0.6	0.4	1384	3437	4068	0.9	2.0	
	Southbound	2040	2736	4776	759	5537	1.4	0.5	3620	5758	6516	2.2	2.0	
Between N14 North Terminal and South Terminal	Northbound	725	2035	2760	635	3395	0.5	0.4	1079	3108	3743	0.7	2.0	
	Southbound	1255	1613	2868	1517	4386	0.8	1.0	1685	3471	4968	1.2	2.0	
South of N14 South Terminal	Northbound	845	846	1691	1270	2961	0.8	0.8	1251	2997	3387	0.8	2.0	
	Southbound	1140	896	2036	1017	3053	0.8	1.0	1667	2985	4103	1.1	2.0	
Rurima Road (R54) P102-1	Westbound	349	1025	1374	253	1598	0.2	0.2	503	1508	1761	0.3	1.0	
	Eastbound	655	765	1420	212	1632	0.4	0.3	876	1725	1948	0.6	1.0	
K52	Westbound	825	1705	2530	212	2742	0.8	0.3	1221	2966	3188	0.9	1.0	
	Eastbound	560	2017	2577	253	2830	0.4	0.3	829	2836	3069	0.5	1.0	
East of R51	Westbound	0	0	0	2023	2023	0.6	1.3	0	0	2023	0.2	0.0	
	Eastbound	0	0	0	1034	1034	0.0	1.1	0	0	1034	0.2	0.0	
Marais	Westbound	0	0	0	0	0	0.0	0.4	0	0	0	0.0	0.0	
	Eastbound	0	0	0	0	0	0.0	0.4	0	0	0	0.0	0.0	
PWV9	Westbound	0	0	0	0	0	0.0	0.0	0	0	0	0.0	0.0	
	Eastbound	0	0	0	0	0	0.0	0.0	0	0	0	0.0	0.0	
Wierds	Westbound	0	0	0	0	0	0.0	0.0	0	0	0	0.0	0.0	
	Eastbound	0	0	0	0	0	0.0	0.0	0	0	0	0.0	0.0	

Note 1: Lanes required to accommodate the demand, based on a lane capacity of 1900.  
 Note 2: The growth rate of 4% per annum has been used to determine the growth of traffic between 2009 and 2019.

TABLE 7b: MONAVONI MASTER SUMMARY OF LINK WEEKDAY PM PEAK TRAFFIC VOLUMES AND CAPACITY REQUIREMENTS - ALTERNATIVE 3

Road	Section	Direction and Link Requirements	2009 Background Traffic (vph)	2009 Latent Rights (vph)	2009 Development Traffic (vph)	2009 Background Traffic + Latent Rights + Development Traffic (vph)	Nr. of Lanes Required for Background Traffic	Nr. of Lanes Required for Development Traffic	Nr. of Lanes Required for Traffic + Latent Rights + Development Traffic	2019 Background Traffic (vph)	2019 Latent Rights (vph)	2019 Development Traffic (vph)	2019 Background Traffic + Latent Rights + Development Traffic (vph)	Nr. of Lanes Required for Background Traffic	Nr. of Lanes Required for Development Traffic	Nr. of Lanes Required for Traffic + Latent Rights + Development Traffic
Between Wincha and P39-1	Northbound	1160	1670	2830	483	3254	0.8	0.3	2.2	1717	3387	3811	5117	1.1	2.0	3.1
Between Wilcha and P39-1	Northbound	950	2320	3270	847	4117	0.6	0.6	2.7	1406	3728	4673	5537	0.9	2.0	2.9
Between P39-1 and Lochner	Northbound	525	4105	4680	935	5265	0.4	0.4	3.5	277	4882	5517	6289	0.5	2.0	2.5
Between K52 and K52	Northbound	495	4105	4685	1770	6455	0.4	1.8	4.3	859	4954	6734	7593	0.6	2.0	2.6
Between K52 and P39-1	Northbound	550	3310	3860	1255	5125	0.4	0.6	3.4	814	4124	3389	4203	0.5	2.0	2.5
Between Rums and Marais	Northbound	895	2995	3945	769	4704	0.7	0.5	3.1	1473	4423	5132	5605	1.0	2.0	3.0
Between Marais and N14 North Terminal	Northbound	1415	3440	4855	759	5514	0.9	0.5	2.7	2095	3535	4230	4825	1.4	2.0	3.4
Between N14 North Terminal and South Terminal	Northbound	1189	2765	3880	759	4639	0.7	0.5	3.1	1658	4418	5177	5835	1.1	2.0	3.1
South of N14 Southern Terminal	Northbound	725	1005	1730	1517	3247	0.5	1.9	2.2	1073	2078	2596	2967	0.7	2.0	2.7
West of R55	Westbound	590	1660	2250	213	2463	0.4	0.1	1.6	873	2523	2745	3416	0.6	1.0	1.6
East of R55	Westbound	655	2370	3075	253	3278	0.4	0.2	2.2	879	3360	3502	4179	0.6	1.0	1.6
Between PW99 and R55	Westbound	0	0	0	1694	1694	0.0	1.1	1.1	0	0	1694	1694	0.0	0.0	1.1
East of R55	Westbound	0	0	0	739	739	0.0	0.5	0.5	0	0	739	739	0.0	0.0	0.5
West of R55	Westbound	0	910	910	0	910	0.0	0.0	0.6	0	0	910	910	0.0	0.0	0.6
East of R55	Westbound	0	40	40	0	40	0.0	0.0	0.0	0	0	40	40	0.0	0.0	0.0
Between K52 and M14	Westbound	0	0	0	3033	3033	0.0	1.3	1.3	0	0	3033	3033	0.0	0.0	1.3
South of N14	Westbound	0	0	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0
West of PW99	Westbound	810	350	1160	605	1765	0.5	0.4	1.2	1198	1548	2146	2344	0.8	2.0	2.8
Between PW99 and R55	Westbound	810	350	1160	1265	2425	0.5	0.8	1.6	1199	1549	2147	2346	0.8	2.0	2.8
East of R55	Westbound	945	1515	2500	506	3006	0.7	0.3	2.9	1458	2973	3479	3937	1.0	2.0	3.0
East of R55	Westbound	645	607	1202	506	1797	0.5	0.3	1.2	1014	1621	2125	2323	0.7	1.0	1.7

Note 1: Lanes required to accommodate the demand, based on a lane capacity of 1600.

Note 2: The growth rate of 4% per annum has been used to determine the growth of traffic between 2009 and 2019.



TABLE 8a: MONAYONI MASTER SUMMARY OF LINK WEEKDAY AM PEAK TRAFFIC VOLUMES AND CAPACITY REQUIREMENTS - ALTERNATIVE 4

Road	Section	Direction and Lane Requirements	2009 Background Traffic (vph)	2009 Latent Traffic (vph)	2009 Background Traffic + Latent Traffic (vph)	Development Traffic (vph)	Nr. of Lanes Required for Background Traffic	Nr. of Lanes Required for Development Traffic	2019 Background Traffic + Latent Traffic (vph)	2019 Background Traffic (vph)	Nr. of Lanes Required for Background Traffic	Nr. of Lanes Required for Development Traffic	Nr. of Lanes Required for 2019 Traffic + Latent Traffic + Development Traffic
K52	Between Wanda and P10-1	Northbound	835	817	1752	206	0.6	0.3	1384	2201	0.9	2.0	2.9
		Southbound	370	1534	2304	423	0.8	0.3	1435	2070	1.0	2.0	3.0
	Between Wanda and P10-2	Northbound	905	1422	1987	1012	0.4	0.7	1665	2288	0.6	2.0	2.6
		Southbound	840	2457	3307	447	0.5	0.6	1743	3710	0.8	2.0	2.8
	Between P10-1 and P10-2	Northbound	570	2486	3056	159	0.4	0.5	1444	3310	0.6	2.0	2.6
		Southbound	650	3124	3774	635	0.4	0.4	1582	4021	0.6	2.0	2.6
	Between Lochet and K52	Northbound	545	2465	3011	2117	0.4	1.4	1607	3273	0.5	2.0	2.5
		Southbound	715	3124	3839	2539	0.5	1.7	1956	4182	0.7	2.0	2.7
	Between K52 and P10-1	Northbound	645	2025	2665	2758	0.4	1.8	1955	3975	0.6	2.0	2.6
		Southbound	610	3124	3734	3288	0.4	2.2	1903	4027	0.6	2.0	2.6
	Between Ruenda and P10-1	Northbound	810	1782	2592	1884	0.5	1.1	1159	2981	0.8	2.0	2.8
		Southbound	1305	2374	3729	2023	0.8	1.3	2006	4379	1.3	2.0	3.3
Between Marais and N14 North Terminal	Northbound	915	2078	2993	1094	0.6	1.1	1384	3453	0.9	2.0	2.9	
	Southbound	2040	2738	4778	2025	1.4	1.3	3620	5749	2.0	2.0	4.0	
Between N14 North Terminal and South Terminal	Northbound	745	3005	3750	1905	0.5	1.3	1073	3108	0.7	2.0	2.7	
	Southbound	1255	1613	2868	1517	0.8	1.0	1850	3471	1.2	2.0	3.2	
South of N14	Northbound	845	846	1691	1270	0.6	0.8	1251	2097	0.8	2.0	2.8	
	Southbound	1140	898	2038	1517	0.8	1.0	1607	2588	1.1	2.0	3.1	
Ruenda Road (M34) P10-1	Westbound	340	1005	1345	749	0.2	0.5	503	1508	0.3	1.0	1.3	
	Eastbound	655	765	1420	635	0.4	0.4	970	1735	0.6	1.0	1.6	
East of R55	Westbound	835	1755	2590	2712	0.8	0.1	1221	2956	0.9	1.0	1.9	
	Eastbound	560	2007	2567	253	0.4	0.2	829	2036	0.6	1.0	1.6	
Between Access 1 and R55	Westbound	0	0	0	1370	0.0	0.0	0	0	0	0.0	0.0	
	Eastbound	0	0	0	1517	0.0	1.0	0	0	0	0.0	1.0	
East of R55	Westbound	0	0	0	638	0.0	0.4	0	0	0	0.0	0.4	
	Eastbound	0	0	0	759	0.0	0.5	0	0	0	0.0	0.5	
West of R55	Westbound	0	560	560	0	0.0	0.0	0	0	0	0.0	0.0	
	Eastbound	0	635	635	0	0.0	0.0	0	0	0	0.0	0.0	
East of R55	Westbound	0	20	20	0	0.0	0.0	0	0	0	0.0	0.0	
	Eastbound	0	25	25	0	0.0	0.0	0	0	0	0.0	0.0	
South of N14	Northbound	0	300	300	935	0.0	0.4	0	0	0	0.0	0.4	
	Southbound	0	370	370	1129	0.0	0.5	0	0	0	0.0	0.5	
Between N14 and Ruenda	Northbound	0	300	300	867	0.0	0.6	0	0	0	0.0	0.6	
	Southbound	0	370	370	1012	0.0	0.7	0	0	0	0.0	0.7	
West of R511	Northbound	425	725	1150	203	0.3	0.2	620	1354	0.4	2.0	2.4	
	Southbound	265	705	970	212	0.2	0.1	392	1127	0.3	2.0	2.3	
Between R511 and R55	Northbound	425	725	1150	0	0.3	0.0	620	1354	0.4	2.0	2.4	
	Southbound	265	705	970	0	0.2	0.0	392	1127	0.3	2.0	2.3	
East of R55	Westbound	575	730	1305	453	0.4	0.3	851	1541	0.6	2.0	2.6	
	Eastbound	1015	1415	2430	506	0.7	0.3	1500	2917	1.0	2.0	3.0	
East of R55	Westbound	710	1073	1783	443	0.5	0.3	1051	2124	0.7	1.0	1.7	
	Eastbound	495	1055	1550	506	0.3	0.3	723	1290	0.5	1.0	1.5	

Note 1: Lanes required to accommodate the demand, based on a lane capacity of 1500  
 Note 2: The growth rate of 4% per annum has been used to determine the growth of traffic between 2008 and 2018.

TABLE Bb: MONAVONI MASTER SUMMARY OF LINK WEEKDAY PM PEAK TRAFFIC VOLUMES AND CAPACITY REQUIREMENTS - ALTERNATIVE 4

Road	Section	Direction and Lane Requirements	2009 Background Traffic + Latent Rights (vph)	2009 Background Traffic + Latent Rights (vph)	2009 Developments in Traffic (vph)	2009 Background Traffic + Latent Rights + Development Traffic (vph)	Nr. of Lanes Required for Background Traffic	Nr. of Lanes Required for Development Traffic	2019 Background Traffic + Latent Rights + Development Traffic (vph)	2019 Background Traffic + Latent Rights + Development Traffic (vph)	2019 Background Traffic + Latent Rights + Development Traffic (vph)	Nr. of Lanes Required for Background Traffic	Nr. of Lanes Required for Development Traffic	Existing lanes	Nr. of Lanes Required for 2019 Traffic + Latent Rights + Development Traffic
K7 (R05) Voortrekker Road	Between Wierda and P39-1	Northbound	1160	1670	423	3254	0.8	0.3	3387	2064	3811	1.1	0.8	2.0	2.5
		Southbound	785	880	306	2188	0.5	0.3	2064	2570	2870	0.8	0.8	2.0	1.7
	Between Wierda and Poof	Northbound	959	2020	647	4117	0.5	0.6	3726	3200	4573	0.9	0.9	2.0	3.0
		Southbound	619	1385	1012	3002	0.4	0.7	2288	3300	3900	0.6	0.6	2.0	2.2
	Between Poole and Lechner	Northbound	525	4705	636	5265	0.4	0.4	4825	5517	5517	0.5	0.9	2.0	3.7
		Southbound	500	3950	759	4209	0.3	0.5	3680	4449	4449	0.5	0.5	2.0	3.0
	Between Lechner and K52	Northbound	560	4105	2029	7214	0.4	1.7	4014	7493	7493	0.6	2.0	2.0	5.0
		Southbound	455	2950	2117	5562	0.3	1.4	3683	5800	5800	0.5	2.0	2.0	3.9
	Between K52 and Ramin	Northbound	550	3310	3288	7148	0.4	2.2	4124	4124	7412	0.5	2.0	2.0	4.9
		Southbound	565	2430	2752	5747	0.4	1.8	3268	6518	6518	0.6	2.0	2.0	4.0
	Between Ramin and Marais	Northbound	995	2950	2023	5968	0.7	1.3	4423	6445	6445	1.0	2.0	2.0	4.3
		Southbound	870	1980	1694	4544	0.6	1.1	3268	4961	4961	0.9	2.0	2.0	3.3
Between Marais and N14 North Terminal	Northbound	1415	3440	2023	6878	0.9	1.3	4855	7568	7568	1.4	2.0	2.0	5.0	
	Southbound	905	2465	1694	5004	0.6	1.1	3345	5438	5438	0.9	2.0	2.0	3.6	
Between N14 North Terminal and South Terminal	Northbound	1120	2760	2276	6156	0.7	1.5	4418	5594	5594	1.1	2.0	2.0	4.5	
	Southbound	870	1350	1270	3490	0.6	0.8	2628	3908	3908	0.9	2.0	2.0	2.6	
South of N14 South Terminal	Northbound	725	1005	1517	3247	0.5	1.0	2078	3586	3586	0.7	2.0	2.0	2.4	
	Southbound	1085	1120	2205	3475	0.7	0.8	1606	2726	3098	1.1	2.0	2.0	2.7	
Between R55 and R511	Westbound	590	1660	635	2885	0.4	0.4	19	2033	2168	0.5	1.0	2.0	2.1	
	Eastbound	635	770	759	2164	0.4	0.5	940	1710	2469	0.8	1.0	1.0	1.6	
East of R55	Westbound	655	2770	263	3278	0.4	0.2	22	3240	3502	0.6	1.0	2.0	2.4	
	Eastbound	970	2095	212	3177	0.8	0.1	21	1268	3083	0.9	1.0	2.0	2.4	
Between Access 1 and R55	Westbound	0	0	1517	1517	0.9	1.0	0	0	1517	0.0	0.0	1.0	1.0	
	Eastbound	0	0	1270	1270	0.0	0.8	0	0	1270	0.0	0.0	0.0	0.8	
East of R55	Westbound	0	0	759	759	0.0	0.5	0	0	759	0.0	0.0	0.0	0.5	
	Eastbound	0	0	635	635	0.0	0.4	0	0	635	0.0	0.0	0.0	0.4	
West of R55	Westbound	0	910	910	910	0.0	0.0	0	910	910	0.0	0.0	1.0	0.6	
	Eastbound	0	830	0	830	0.0	0.6	0	830	830	0.0	0.0	1.0	0.6	
East of R55	Westbound	0	40	759	799	0.0	0.5	0	40	799	0.0	0.0	1.0	0.5	
	Eastbound	0	35	635	670	0.0	0.4	0	35	670	0.0	0.0	1.0	0.4	
South of N14	Northbound	0	815	759	1574	0.0	0.5	0	815	1574	0.0	0.0	1.0	1.0	
	Southbound	0	710	635	1345	0.0	0.4	0	710	1345	0.0	0.0	1.0	0.9	
Between N14 and Ramin	Northbound	0	815	1012	1827	0.0	0.7	0	815	1827	0.0	0.0	1.0	1.2	
	Southbound	0	710	847	1557	0.0	0.6	0	710	1557	0.0	0.0	1.0	1.0	
West of R511	Westbound	810	350	1160	212	1372	0.5	0.1	1199	1549	1241	0.9	2.0	1.2	
	Eastbound	470	895	1365	250	1618	0.3	0.2	698	1521	1844	0.5	2.0	1.2	
Between R511 and R55	Westbound	810	350	1160	0	1160	0.5	0.0	1199	1549	1549	0.8	2.0	1.0	
	Eastbound	470	895	1365	0	1365	0.3	0.0	698	1521	1521	0.5	2.0	1.1	
East of R55	Westbound	685	1515	2500	506	3006	0.7	0.3	1458	2973	3476	1.0	2.0	2.3	
	Eastbound	670	1150	1625	423	2248	0.4	0.3	982	2117	2570	0.7	2.0	1.7	
East of R55	Westbound	685	607	1282	906	1797	0.5	0.3	1014	1621	2126	0.7	1.0	1.4	
	Eastbound	670	1164	1804	423	2257	0.4	0.3	982	2155	2579	0.7	1.0	1.7	

Note 1: Lanes required to accommodate the demand, based on a lane capacity of 1500  
 Note 2: The growth rate of 4% per annum has been used to determine the growth of traffic between 2009 and 2019.





TABLE 1B: MONDAY MASTER SUMMARY OF LINK WEEKDAY PM PEAK TRAFFIC VOLUMES AND CAPACITY REQUIREMENTS - ALTERNATIVE 3

Link	Direction and Lane Requirements	2008 Background Traffic (Vph)	2009 Background Traffic + Latent Rights (Vph)	2009 Development Traffic (Vph)	2009 Background Traffic + Latent Rights + Development Traffic (Vph)	Nr. of Lanes Required for Development Traffic	2019 Background Traffic (Vph)	2019 Background Traffic + Latent Rights (Vph)	2019 Background Traffic + Latent Rights + Development Traffic (Vph)	Nr. of Lanes Required for 2019 Traffic + Latent Rights + Development Traffic	
K75 (R65) Vespene/Road	Between West 1st and 2nd St	1120	1570	3820	423	0.8	1717	2044	3811	1.1	2.0
	Between West 1st and 2nd St	756	1094	1663	206	0.3	1177	2044	3578	0.8	2.0
	Between West 1st and 2nd St	345	4350	3570	447	0.6	1406	2028	4573	0.5	2.0
	Between West 1st and 2nd St	410	1348	1896	1032	0.7	372	2298	3329	0.5	2.0
K75 (R65) Vespene/Road	Between West 1st and 2nd St	525	4125	4820	625	0.4	777	4692	5517	0.5	2.0
	Between West 1st and 2nd St	540	2850	3450	759	0.3	789	3093	4444	0.5	2.0
	Between West 1st and 2nd St	548	4355	4825	1719	0.4	859	4064	6724	0.6	2.0
	Between West 1st and 2nd St	495	3850	3455	4487	0.3	733	3083	5105	0.5	2.0
K75 (R65) Vespene/Road	Between West 1st and 2nd St	555	3310	3840	1381	0.4	874	4129	5370	0.5	2.0
	Between West 1st and 2nd St	565	3420	3855	1124	0.4	836	3566	4235	0.5	2.0
	Between West 1st and 2nd St	395	2835	3845	759	0.3	777	4413	5182	0.5	2.0
	Between West 1st and 2nd St	370	1940	2850	625	0.4	1088	3076	3903	0.8	2.0
K75 (R65) Vespene/Road	Between West 1st and 2nd St	1415	3448	4555	739	0.4	3095	3255	6250	1.8	2.0
	Between West 1st and 2nd St	965	2485	3310	3048	0.6	1340	3345	4300	0.9	2.0
	Between West 1st and 2nd St	1120	2760	3840	759	0.3	1558	4418	5177	1.3	2.0
	Between West 1st and 2nd St	920	1959	2850	635	0.4	1248	2638	3072	0.9	2.0
K75 (R65) Vespene/Road	Between West 1st and 2nd St	795	1055	1238	754	0.5	1672	2078	2957	0.7	2.0
	Between West 1st and 2nd St	1448	1190	3245	631	0.4	1898	2725	3781	1.1	2.0
	Between West 1st and 2nd St	103	1620	1923	242	0.1	241	1991	2112	0.2	1.0
	Between West 1st and 2nd St	222	270	963	253	0.2	301	1551	1754	0.2	1.0
K75 (R65) Vespene/Road	Between West 1st and 2nd St	276	1620	1876	623	0.1	620	1845	2104	0.2	1.0
	Between West 1st and 2nd St	423	1778	1733	598	0.2	827	1917	2650	0.4	1.0
	Between West 1st and 2nd St	599	1600	2292	212	0.4	872	2513	2745	0.8	1.0
	Between West 1st and 2nd St	835	1778	1400	253	0.4	840	1718	1863	0.6	1.0
K75 (R65) Vespene/Road	Between West 1st and 2nd St	145	1330	2025	253	0.4	350	3348	3162	0.6	1.0
	Between West 1st and 2nd St	378	1395	2265	217	0.2	1281	3391	2196	0.8	1.0
	Between West 1st and 2nd St	100	0	180	206	0.1	148	148	654	0.1	1.0
	Between West 1st and 2nd St	100	0	180	420	0.1	543	148	971	0.1	1.0
K75 (R65) Vespene/Road	Between West 1st and 2nd St	59	599	345	759	0.8	74	550	3319	0.0	1.0
	Between West 1st and 2nd St	190	251	451	635	0.1	148	579	1941	0.1	1.0
	Between West 1st and 2nd St	215	372	623	759	0.1	378	711	1483	0.2	1.0
	Between West 1st and 2nd St	94	175	283	825	0.1	845	316	562	0.1	1.0
K75 (R65) Vespene/Road	Between West 1st and 2nd St	0	0	0	1484	0.8	11	0	1844	0.0	0.8
	Between West 1st and 2nd St	0	0	0	3033	0.8	11	0	3023	0.0	0.8
	Between West 1st and 2nd St	0	0	0	759	0.8	0	0	759	0.0	0.8
	Between West 1st and 2nd St	0	0	0	635	0.8	0	0	635	0.0	0.8
K75 (R65) Vespene/Road	Between West 1st and 2nd St	0	910	319	0	0.1	0	910	0.0	1.0	
	Between West 1st and 2nd St	0	820	309	0	0.1	0	820	0.0	1.0	
	Between West 1st and 2nd St	0	48	40	0	0.0	0	40	0.0	1.0	
	Between West 1st and 2nd St	0	35	35	0	0.0	0	35	0.0	1.0	
K75 (R65) Vespene/Road	Between West 1st and 2nd St	0	0	0	1265	0.8	0	0	1265	0.0	0.8
	Between West 1st and 2nd St	0	0	0	1059	0.8	0	0	1059	0.0	0.8
	Between West 1st and 2nd St	0	0	0	0	0.0	0	0	0	0.0	0.0
	Between West 1st and 2nd St	0	0	0	0	0.0	0	0	0	0.0	0.0
K75 (R65) Vespene/Road	Between West 1st and 2nd St	810	350	1140	835	0.4	1192	1648	2166	0.8	1.0
	Between West 1st and 2nd St	470	486	1055	338	0.3	686	1581	2349	0.5	1.0
	Between West 1st and 2nd St	810	156	1345	525	0.3	1198	1549	2056	0.8	1.0
	Between West 1st and 2nd St	430	485	1265	521	0.2	696	1581	2014	0.5	1.0
K75 (R65) Vespene/Road	Between West 1st and 2nd St	280	1515	2528	535	0.2	1431	2925	3439	1.2	2.0
	Between West 1st and 2nd St	470	1158	1222	421	0.4	952	2147	2819	0.7	2.0
	Between West 1st and 2nd St	485	482	1222	528	0.2	1014	1624	2136	0.7	1.0
	Between West 1st and 2nd St	670	1164	1031	421	0.4	952	2135	2339	0.7	1.0

Note 1: Values required to accommodate the demand based on a low capacity of 1000

Note 2: The growth rate of 4% per annum has been used to determine the growth of traffic between 2008 and 2019.



**Table 10: Proposed phasing of upgrades**

Year	All Latent Rights (vph)	Monavoni (vph)	Latent Rights + Monavoni (vph)	Cumulative volumes of Monavoni + Latent Rights (vph)	Cumulative volumes of Monavoni (vph)	No. of Lanes for both Latent Rights and Monavoni	No. of Lanes for Monavoni	No. of Lanes based on trip distribution	Roads that should be upgraded	Phasing	Conditions
1	1740	506	2246	2246	506	1.5	0.3	0.2			Traffic to South can use K71 and no extra lane should be provided by Monavoni
2	1740	506	2246	4492	1012	3.0	0.7	0.3	K52	1	Construction of K52 with one lane per direction
3	1740	506	2246	6738	1518	4.5	1.0	0.2	D49	2	Upgrade link to D49
4	1740	506	2246	8984	2024	6.0	1.3				
5	1740	506	2246	11230	2530	7.5	1.7	0.4	PWV	3	Construction of PWV9 from K52 to N14 if not in place
6	1740	506	2246	13476	3036	9.0	2.0				
7	1740	506	2246	15722	3542	10.5	2.4				
8	1740	506	2246	17968	4048	12.0	2.7	0.3	K71	4	Contribution to K71 North of K103
9	1740	506	2246	20214	4554	13.5	3.0	0.3	K73	5	Contribution to K73 East of K71
10	1740	506	2246	22460	5060	15.0	3.4	0.5	K71	6	Contribution to K71 South of K71 northern terminal if PWV South of N14 is not in place
Total	17400	5060	22460								
<i>Capacity per lane: 1500</i>											

Table 11: Estimated cost of external road upgrades

Table 11: Monavoni Masterplan - Estimated cost of external road upgrades

Nr	Route	Section	Upgrade	Extent	Estimated cost	Cumulative Cost
1	K71	North of Wierda (K103)	Additional through lanes for both directions	2000 m x 2 lanes	R 11,900,000	R 11,900,000
2	PWV 9	K52 to N14	Construction of 1 lane per direction, Bridge and Ramps to the east **	3000m x 2 lanes + 100m Bridge for 2 lanes + 800m ramps	R 56,900,000	R 68,800,000
3	K52	K71 to Riumte (P102-1)	1 lane per direction, new road	2200m x 2 lanes	R 14,960,000	R 83,760,000
4	D49 / Magalies	Intersection	1 lane per direction, reconstruction	1000m x 2 lanes + 2 x R0,5m for traffic signals	R 3,960,000	R 87,720,000
5	Theron	Riumte to Von Willich	1 lane per direction, reconstruction	1000m x 2 lanes	R 1,600,000	R 89,320,000
6	K52	K71 to PWV9	1 lane per direction, new road	2600m x 2 lanes	R 6,120,000	R 95,440,000
7	<b>TOTAL</b>				<b>R 95,440,000</b>	

*Note: The initial cost estimate was done in August 2009 at an average rate for the following:  
R850.00 per sqm for road.  
R25 000.00 per sqm for the bridge.  
R400.00 per sqm for reconstruction of road.  
\*\* Land expropriation cost is excluded.*

**Monavoni Master Planning of all extensions**

**APPENDIX B**

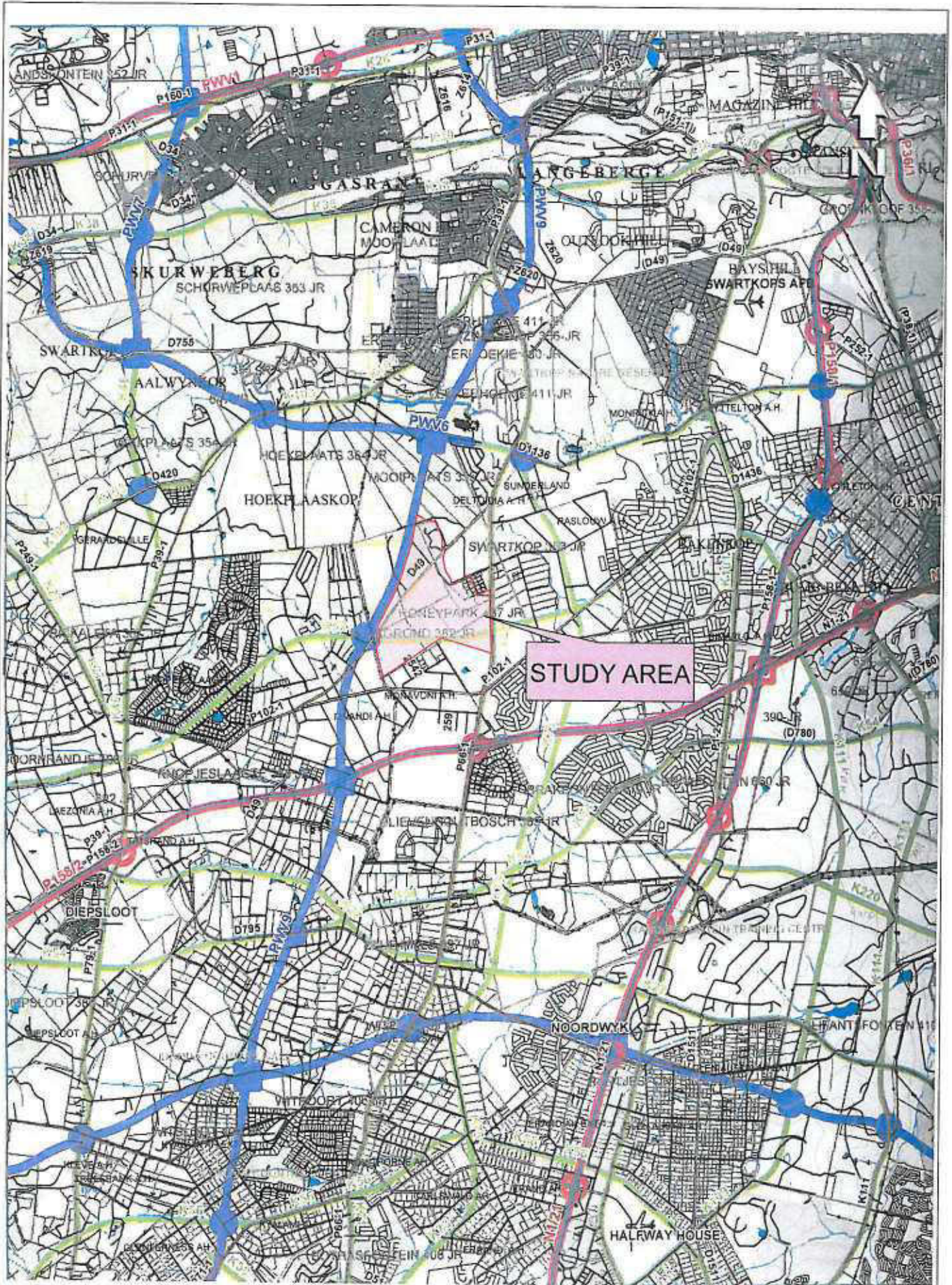
**FIGURES**

## APPENDIX B

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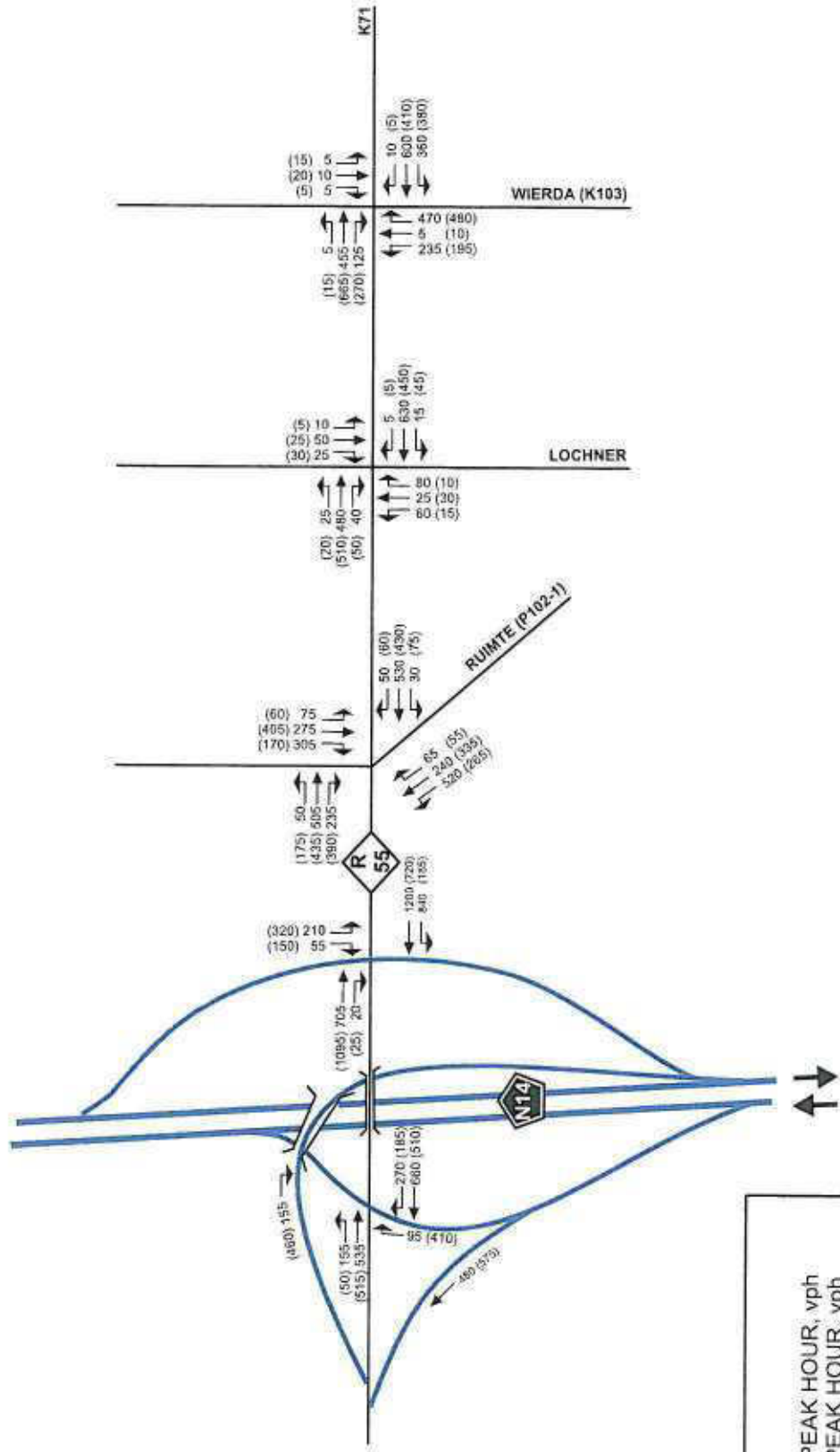
SCHMATIC

2675 /Road Network.cdr



Project:	Monavoni Master Planning	Figure:	Locality and Provincial Road Network	No.	1
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**LEGEND**  
 355 AM PEAK HOUR, vph  
 (220) PM PEAK HOUR, vph  
 DATE OF COUNTS: 02 JUNE 2009

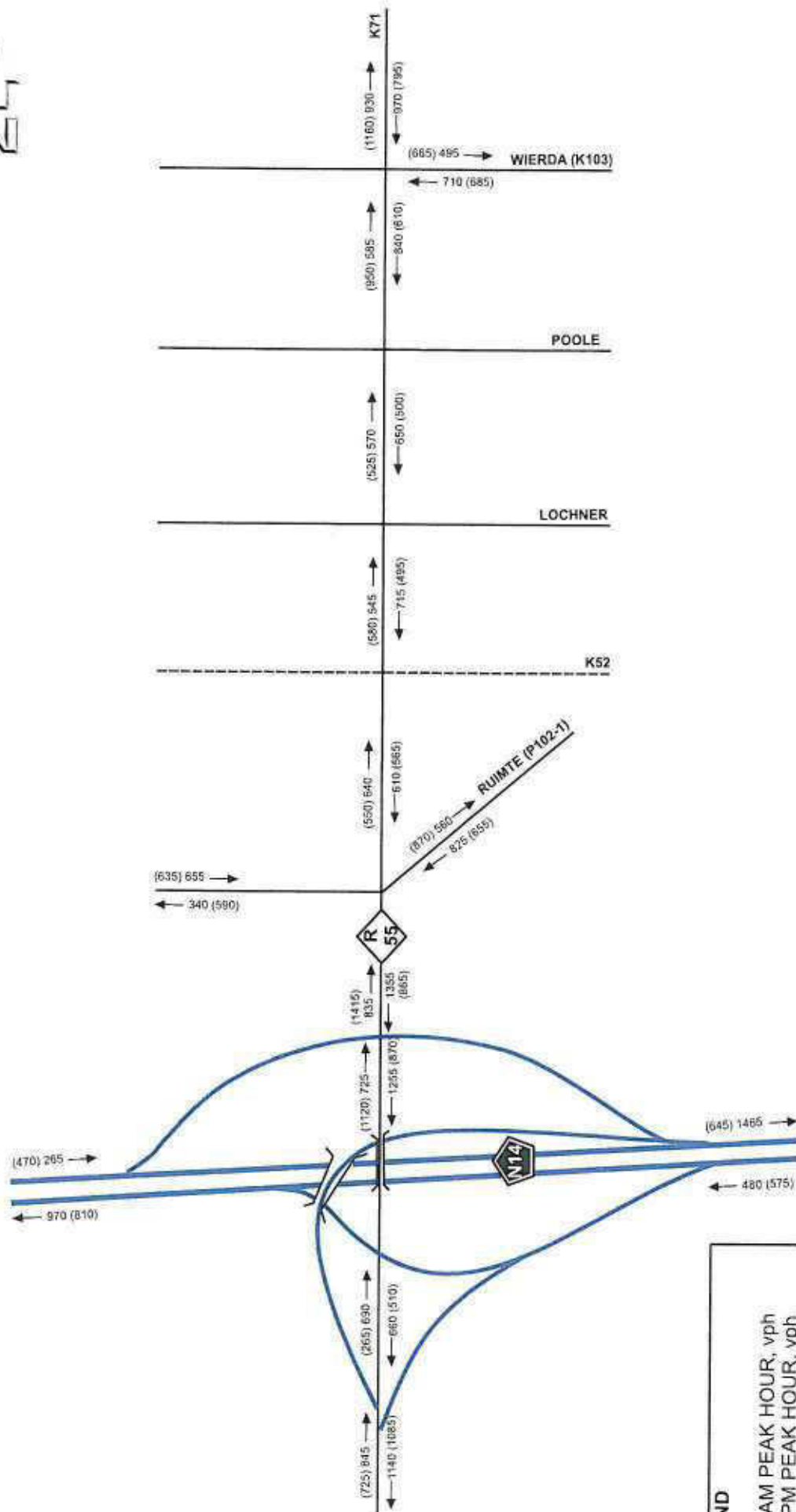
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2675\Figure 2a\_Background Traffic Vol.cdr

Project:	MONAVONI MASTER PLANNING
Figure:	BACKGROUND TRAFFIC VOLUMES
No.:	2a







SCHEMATIC

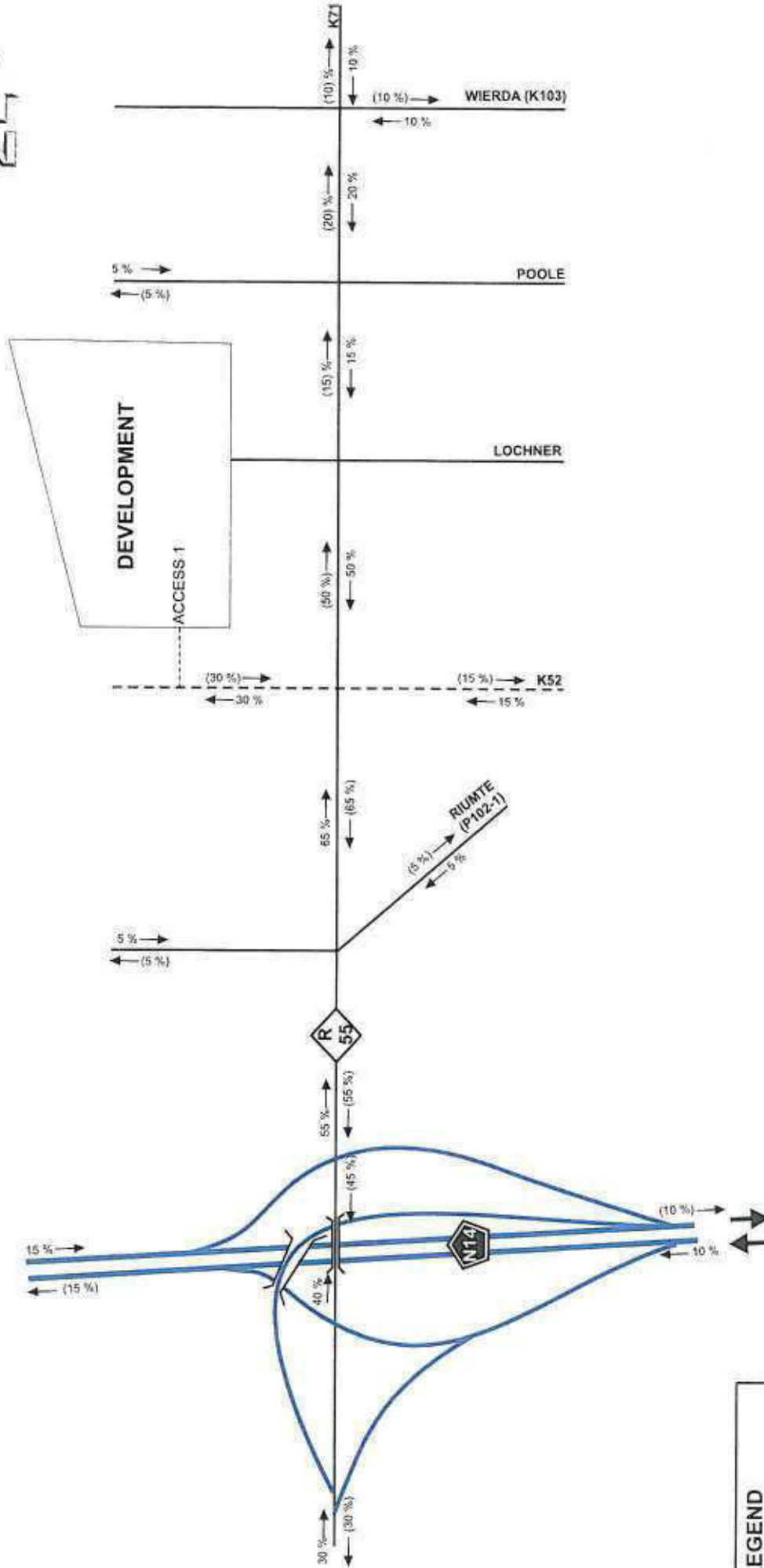
2675\Figure 2b\_Link Vol for Background Traffic.cdr

Project: MONAVONI MASTER PLANNING

Figure: BACKGROUND TRAFFIC: LINK VOLUMES

No. 2b





**LEGEND**  
10% INBOUND  
(10%) OUTBOUND

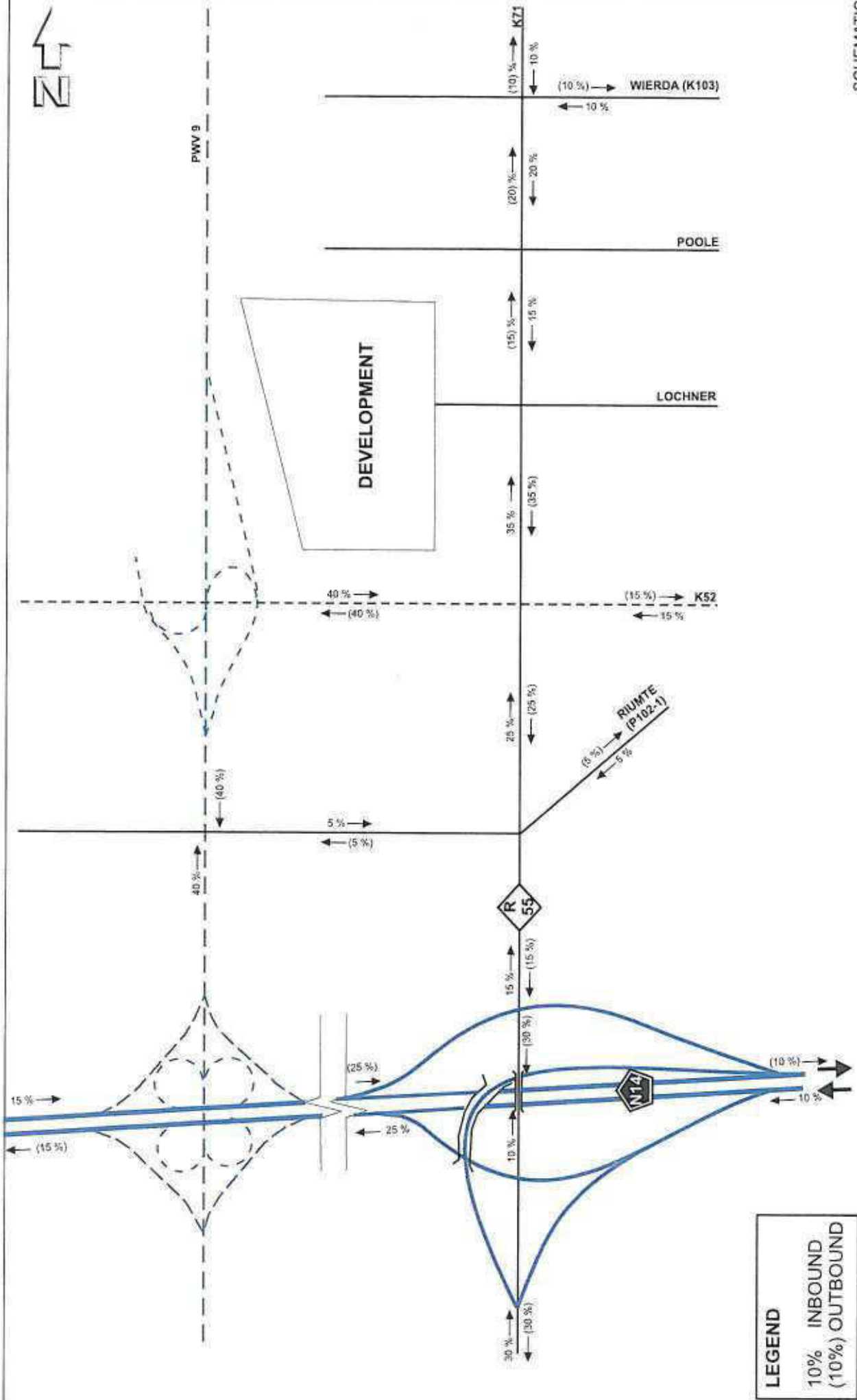
SCHEMATIC

2675\Figure 3a\_TRIP DISTRIBUTION.cdr

Project:	MONAVONI MASTER PLANNING	Figure:	TRIP DISTRIBUTION (ALTERNATIVE 1)	No.:	3a
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SCHEMATIC

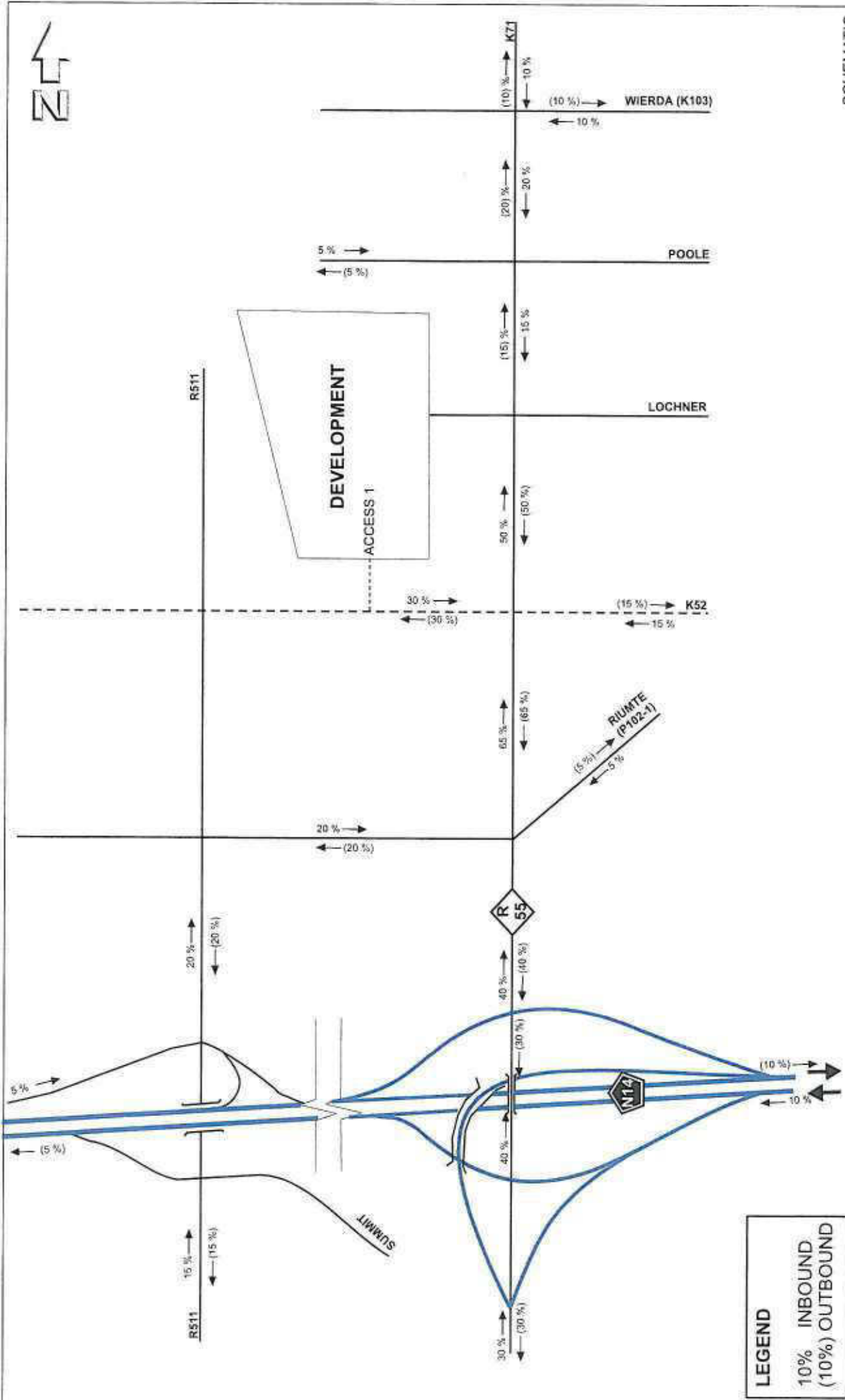
2675\Figure 3c\_TRIP DISTRIBUTION.cdr

No. 3c

TRIP DISTRIBUTION (ALTERNATIVE 3)

Project: MONAVONI MASTER PLANNING





SCHMATIC

2675\Figure 3d\_TRIP DISTRIBUTION.cdr

No. 3d

TRIP DISTRIBUTION (ALTERNATIVE 4)

Figure:

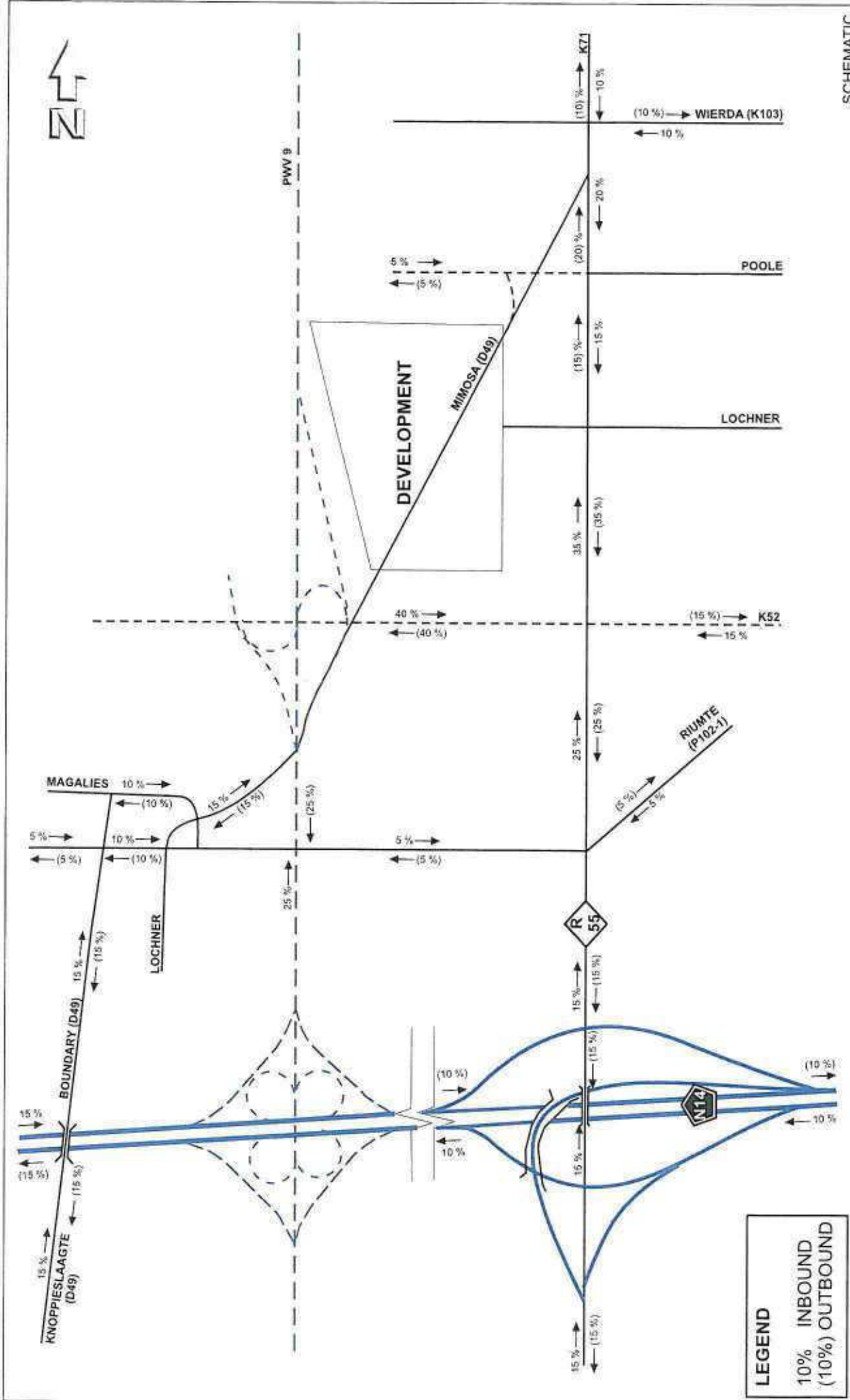
MONAVONI MASTER PLANNING

Project:



**LEGEND**  
 10% INBOUND  
 (10%) OUTBOUND





**LEGEND**  
 10% INBOUND  
 (10%) OUTBOUND

SCHEMATIC

2675\Figure 33\_TRIP DISTRIBUTION.cdr

Project: <b>MONAVONI MASTER PLANNING</b>	Figure: <b>TRIP DISTRIBUTION (ALTERNATIVE 5)</b>
No. <b>3e</b>	



# Annexure R

# Annexure R(1)

# NOTICE OF ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

Notice is given of an application for Environmental authorization that was submitted to the Gauteng Department of Agriculture, Conservation and Environment, in terms of regulation no. R385 published in the Government Notice no. 28753 of 21 April 2006 of the National Environment Management Act, 1998 (Act No. 107 of 1998) governing Scoping procedures (Notice 1 and 2 – Governing Notice R386 & R387) for the following activity:

**Name of project:** Monavoni x 44

**Reference Number:** Gaut: 002/08-09/N0588

**Property description:** Part of Portion 1 of the farm Stukgrond, 382-JR

**Project description:** Mixed land use development: commercial, offices, motor trade, light industrial & commercial.

## Activities

The application was submitted for the following activities in terms of the Government Notice R. 386 & R. 387, 21 April 2006:

R. 386, 21 April 2006	Activity 1k	The bulk transportation of sewage and water, including storm water, in pipelines with (i) an internal diameter of 0.36 metres or more or (ii) a peak throughput of 120 litres per second or more
R. 386, 21 April 2006	Activity 1v	Advertisements as defined in classes 1(a), 1(b), 1(c), 3(a), 3(b),3(l) of the South African Manual for Outdoor Advertising Control
R. 386, 21 April 2006	Activity 7	The above ground storage of dangerous good, including petrol, diesel, liquid paraffin, in containers with a combined capacity of more than 30 cubic metres but less than 1 000 cubic metres at any one location.
R. 386, 21 April 2006	Activity 14	The construction of masts of any material or type and of any height, including those used for telecommunication broadcasting and radio transmission, but excluding - (a) masts of 15 metres and lower exclusively used (i) by radio amateurs; or (ii) for lighting purposes (b) flag poles; and (c) lightning conductor poles.
R. 386, 21 April 2006	Activity 15	The construction of a road that is wider than 4 metres of that has a reserve wider than 6 metres, excluding roads that fall within the ambit of another listed activity or which are access roads of less than 30 metres long
R.386, 21 April 2006	Activity 16 (b)	The transformation of undeveloped, vacant or derelict land to – residential, mixed, retail, commercial, industrial or institutional use where such development does not constitute infill and where the total area to be transformed is bigger than 1 hectare.
R. 386, 21 April 2006	Activity 17	Phased activities where any one phase of the activity may be below a threshold specified in the Schedule but where a combination of the phases, including expansions or extensions, will exceed a specified threshold
R. 386, 21 April 2006	Activity 19	The development of a new facility or the transformation of an existing facility for the conducting of manufacturing processes, warehousing, bottling, packaging or storage, which, including associated structures or infrastructure, occupies an area of 1 000 square metres or more outside an existing area zoned for industrial purposes
R. 387, 21 April 2006	Activity 1 (c)	The construction of facilities or infrastructure, including associated structures or infrastructure, for – 1(c)The above ground storage of a dangerous good, including petrol, diesel, liquid paraffin, in containers with a combined capacity of more than 1 000 cubic metres or more including the storage of one or more dangerous goods, in tank farm.
R. 387, 21 April 2006	Activity 1 (g)	The construction of facilities or infrastructure, including associated structures or infrastructure, for – 1(g)The use, recycling, handling, treatment, storage or final disposal of hazardous waste.
R. 387, 21 April 2006	Activity 2	Any development activity, including associated structures and infrastructure, where the total area of the development area is, or is intended to be, 20 hectares or more.
R. 387, 21 April 2006	Activity 5	The route determination of road and design of associated physical infrastructure, including roads that have not yet been built for which routes has been determined before the publication of this notice and which has been authorized by a competent authority in terms of the Environmental Impact Assessment Regulations, 2006 made under section 24(5) of the Act and published in Government notice No. R. 385 of 2006, where – (a) It is a national road as defined in section 40 of the South African National Roads Agency Limited and National Roads Act, 1998 (Act No. 7 of 1998); (b) it is a road administered by a provincial authority; (c) the road reserve is wider than 30 metres. (d) The road will cater for more than one lane of traffic in both directions

**Extent:** The study area is approximately 34.193 hectares in extent

**Name of the proponent:** JR 209 Investments (Pty) Ltd

**Date of notice:** 20 April 2009

**Location:** The Proposed Development is situated north of the N14 and west of the R55.

### Queries regarding this matter should be referred to:

Bokamoso Landscape Architects and Environmental Consultants  
Philip Beukes  
P.O. Box 11375  
Maroelana  
0161

Tel: (012) 346 3810  
Fax: (012) 460 7079  
E-mail: lizelleg@mweb.co.za

In order to ensure that you are identified as an interested and/or affected party, please submit your name, contact information and interest in the matter to the contact person given above within 30 days of this advertisement.

# Annexure R(ii)







# Annexure R (iii)

# NOTICE OF ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

Notice is given of an application for Environmental authorization that was submitted to the Gauteng Department of Agriculture, Conservation and Environment, in terms of regulation no. R385 published in the Government Notice no. 28753 of 21 April 2006 of the National Environment Management Act, 1998 (Act No. 107 of 1998) governing Scoping procedures (Notice 1 and 2 – Governing Notice R386 & R387) for the following activity:

**Name of project:** Monavoni x 44

**Reference Number:** Gaut: 002/08-09/N0588

**Property description:** Part of Portion 1 of the farm Stukgrond, 382-JR

**Project description:** Mixed land use development: commercial, offices, motor trade, light industrial & commercial.

## Activities

The application was submitted for the following activities in terms of the Government Notice R. 386 & R. 387, 21 April 2006:

R. 386, 21 April 2006	Activity 1k	The bulk transportation of sewage and water, including storm water, in pipelines with (i) an internal diameter of 0.36 metres or more or (ii) a peak throughput of 120 litres per second or more
R. 386, 21 April 2006	Activity 1v	Advertisements as defined in classes 1(a), 1(b), 1(c), 3(a), 3(b),3(l) of the South African Manual for Outdoor Advertising Control
R. 386, 21 April 2006	Activity 7	The above ground storage of dangerous good, including petrol, diesel, liquid paraffin, in containers with a combined capacity of more than 30 cubic metres but less than 1 000 cubic metres at any one location.
R. 386, 21 April 2006	Activity 14	The construction of masts of any material or type and of any height, including those used for telecommunication broadcasting and radio transmission, but excluding - (a) masts of 15 metres and lower exclusively used (i) by radio amateurs; or (ii) for lighting purposes (b) flag poles; and (c) lightning conductor poles.
R. 386, 21 April 2006	Activity 15	The construction of a road that is wider than 4 metres of that has a reserve wider than 6 metres, excluding roads that fall within the ambit of another listed activity or which are access roads of less than 30 metres long
R.386, 21 April 2006	Activity 16 (b)	The transformation of undeveloped, vacant or derelict land to – residential, mixed, retail, commercial, industrial or institutional use where such development does not constitute infill and where the total area to be transformed is bigger than 1 hectare.
R. 386, 21 April 2006	Activity 17	Phased activities where any one phase of the activity may be below a threshold specified in the Schedule but where a combination of the phases, including expansions or extensions, will exceed a specified threshold
R. 386, 21 April 2006	Activity 19	The development of a new facility or the transformation of an existing facility for the conducting of manufacturing processes, warehousing, bottling, packaging or storage, which, including associated structures or infrastructure, occupies an area of 1 000 square metres or more outside an existing area zoned for industrial purposes
R. 387, 21 April 2006	Activity 1 (c)	The construction of facilities or infrastructure, including associated structures or infrastructure, for – 1(c)The above ground storage of a dangerous good, including petrol, diesel, liquid paraffin, in containers with a combined capacity of more than 1 000 cubic metres or more including the storage of one or more dangerous goods, in tank farm.
R. 387, 21 April 2006	Activity 1 (g)	The construction of facilities or infrastructure, including associated structures or infrastructure, for – 1(g)The use, recycling, handling, treatment, storage or final disposal of hazardous waste.
R. 387, 21 April 2006	Activity 2	Any development activity, including associated structures and infrastructure, where the total area of the development area is, or is intended to be, 20 hectares or more.
R. 387, 21 April 2006	Activity 5	The route determination of road and design of associated physical infrastructure, including roads that have not yet been built for which routes has been determined before the publication of this notice and which has been authorized by a competent authority in terms of the Environmental Impact Assessment Regulations, 2006 made under section 24(5) of the Act and published in Government notice No. R. 385 of 2006, where – (a) It is a national road as defined in section 40 of the South African National Roads Agency Limited and National Roads Act, 1998 (Act No. 7 of 1998); (b) it is a road administered by a provincial authority; (c) the road reserve is wider than 30 metres. (d) The road will cater for more than one lane of traffic in both directions

**Extent:** The study area is approximately 34.193 hectares in extent

**Name of the proponent:** JR 209 Investments (Pty) Ltd

**Date of notice:** 20 April 2009

**Location:** The Proposed Development is situated north of the N14 and west of the R55.

### Queries regarding this matter should be referred to:

Bokamoso Landscape Architects and Environmental Consultants  
Philip Beukes  
P.O. Box 11375  
Maroelana  
0161

Tel: (012) 346 3810  
Fax: (012) 460 7079  
E-mail: lizelleg@mweb.co.za

In order to ensure that you are identified as an interested and/or affected party, please submit your name, contact information and interest in the matter to the contact person given above within 30 days of this advertisement.

# Annexure R(iv)





# Annexure R(v)

## Ontvangs

**From:** Monika Widmer [moni@absamail.co.za]  
**Sent:** 03 August 2010 12:37 PM  
**To:** Lizelle Gregory  
**Subject:** Re: FW: Monavoni projects notification

Dear George Gericke

Regarding the proposed developments, township establishments to be known as Monavoni X 43-52, I would like to register as an interested/affected party.

I own and reside on Plot 126 Marjorie Road, Mnandi Guest Farm, Knoppieslaagte, (Portion 126 of the farm Knoppieslaagte 385 JR) near to the proposed development. The aforementioned property is 100% reliant on the ground water as a means of primary supply to the occupants on the property. The ground water level has come under increasing strain as a result of climatic conditions as well as increased development in the area. I object to the development until such time that a full impact assessment on the effect that the proposed application will have on the ground water as well as proposed alternatives, should the study prove that the ground water supply will not support the proposed development.

In addition to this, I object to the proposed development until such time that more details are provided in terms of the roads plan and the impact that the plan will have on the aforementioned property, and consequential losses have been agreed.

I would also like to object to the development until such time that clarity is provided on areas such as:

1. Sewerage - How and where will the sewerage be managed?
2. Conditions during building - Such as noise levels, dust blankets, blasting /compacting. How will the proposed developer address my concerns regarding these issues?
3. Security - What security measures will be put in place during construction and building to prevent an increase in crime to the area?
4. Type of development - What target market are these developments aimed at and will this have a negative impact on the area and/or land values.

Please acknowledge receipt of this email and the proposed actions thereafter.

I look forward to your response.

Kind regards  
Brenda Sellak  
073 216 9359  
P.O.Box 51503  
Wierda Park  
0149

>  
>  
>  
> To whom it may concern  
>  
>  
>  
> I hereby inform you of proposed projects in the Monavoni area.  
> Attached you will find the public notices together with maps of the  
> area for the following proposed projects:  
>  
> \* Monavoni Ext 43  
>  
> \* Monavoni Ext 44  
>  
> \* Monavoni Ext 45  
>  
> \* Monavoni Ext 46  
>

# Annexure R(vi)



**Agriculture and Environmental Management Department**  
**Environmental Management Division**

Galleria Office | 1<sup>st</sup> Floor | Sammy Marks | Vermeulen Street | Pretoria | 0001  
PO Box 1454 | Pretoria | 0001  
Tel: 012 358 8871 | Fax: 012 358 8934  
Email: [livhuwanis@tshwane.gov.za](mailto:livhuwanis@tshwane.gov.za) | [www.tshwane.gov.za](http://www.tshwane.gov.za)

My ref: 8/4/R/4 Tel: 012 358 8848  
Your ref: GAUT 002/08-09/N0588 Fax: 012 358 8934  
Contact person: J. Prinsloo Email:  
Section: Open Space Management Section Date: 18 June 2010

Bokamoso Environmental Consultants  
P.O. 11375  
Maroelana  
0161

**Attention: Ms Hazel Engelbrecht**  
**Tel: (012) 346 3810**  
**Fax: 086 570 5659**

Dear Madam,

**DRAFT SCOPING REPORT FOR THE PROPOSED DEVELOPMENT ON PART OF PORTION 1 OF THE FARM STUKGROND 382-JR, TO BE KNOWN AS MONAVONI X44**

Your Report dated 28 April 2010 refers,

## 1. INTRODUCTION

The Agriculture and Environmental Management Department (the Department) has considered the Draft Scoping Report in respect of the above-mentioned application. The Draft Scoping Report is submitted to the Agriculture and Environmental Management Department of the City of Tshwane, hereafter referred to as "the City", as a commenting authority in terms of the National Environmental Management Act 1998 (Act 107 of 1998) (NEMA) and EIA Regulations of April 2006.

## 2. PROJECT LOCATION AND DESCRIPTION

Bokamoso Environmental was appointed by M&T Development to complete an Environmental Impact Process for the proposed Township Development on Part of Portion 1 of the Farm Stukgrond 382-JR, to be known as Monavoni x44. The proposed application site is approximately 39,2234 in extent. The proposed application site is located within the jurisdiction of the City of Tshwane.

The proposed application entails the establishment of a Township Development consisting of the following land-uses:

- "Residential 3" (2 erven) with an average density of 80 units per hectare; and
- "Special" for the purpose of Commercial uses, Light Industrial and Business Buildings.

The proposed application site is located east of the Mnandi Agricultural Holdings, on the corner of Monument Road and Mimosa Road, within the South-Western part of Centurion. The proposed

application site is divided within a northern and a southern portion due to the strip of land in-between which is reserved for the future alignment of the Provincial K52 Road.

### 3. KEY FACTORS INFORMING THE COMMENTS

In making comments in respect of the proposed Activity the Department has taken, *inter alia*, the following into consideration:

- a) The information contained in the Draft Scoping Report as submitted by Bokamoso Environmental to the Department on 28 April 2010.
- b) Information obtained from the Section's information base including *inter alia*:
  - Geographic Information System (GIS); and
  - Gauteng Open Space Plan (GOSP).
- c) Compliance with applicable Municipal, Provincial, and National Policies and Guidelines including:
  - The National Environmental Management Act 1998 (Act 107 of 1998) (NEMA): its decision-making principles and Environmental Impact Assessment Regulations;
  - The Tshwane Integrated Environmental Policy (TIEP); and
  - The Tshwane Open Space Framework (TOSF) Policy Statements and Typologies.

### 4. DISCUSSION

In reviewing the application the Department made the following findings:

- a) According to the Tshwane Open Space Framework the proposed site is situated within and adjacent to the following open space typologies:
  - A **Green Node**, namely Hennopsvallei Conservancy. Green nodes are the most important elements in the provisioning of environmental goods and services, the protection of biodiversity, endangered species and ecological systems, as well as eco-based activity. Green nodes must be protected for conservation purposes.
- b) The Report indicated that due to the area within which the development is proposed, has been earmarked for commercial and retail development, no development alternatives were considered. The proposed development is considered to be in line with the current and future planning for the area.
- c) The Report indicated that the proposed development will be in line with the Monavoni Development Framework.
- d) According to the Report the Hennopsvallei Conservancy is situated on the North-Western boundary of the proposed application site. The proposed application site is not affected by any ridges or drainage lines which could facilitate linkages within the adjacent Hennopsvallei Conservancy.
- e) The Report indicated that the adjacent Hennopsvallei Conservancy is extensively disturbed by human activities such as a land-fill site and informal settlements.
- f) The Report indicated that the proposed development will consist of 4 Erven, including 1 erven for "Residential 3", 1 erven for "Special" for Commercial, Light Industrial and Business land-uses, 1 erven for Streets and 1 erven for the Provincial Road K52.



- g) According to the report the proposed application site is vacant and no sensitive ecological features such as wetlands, ridges or drainage lines were identified.
- h) According to the Report the proposed application site is underlain by dolomite.
- i) The Report indicated that the proposed development is not affected by any flood lines as the closest water resource; the Swartbooi Spruit is located approximately 820m south west of the proposed application site.
- j) According to the Report the Natural Primary Grassland and Rocky outcrop which covers the northern part of the proposed application site were deemed sensitive.
- k) The Report indicated that the Orange-listed *Hypoxis hemerocallidea* was sparsely scattered across the proposed application site and should be relocated before any construction commence on the proposed application site.
- l) The Report indicated that several Melodius Lark bird species were observed on the proposed application site. The Melodius Lark has been removed from the GDARD List of priority species.
- m) The Report indicated that Golder Associates registered as an Interested and Affected Party and indicated that the proposed development of Monavoni x44 will not be affected by the 800m buffer zone from the adjacent waste disposal facility (landfill site).

## 5. RECOMMENDATIONS

The Department supports the proposed development subject to the following recommendations:

- a) Details regarding the Land-use for "Special" including the Commercial, Light Industrial and Business land-uses shall be discussed within the EIA Report. It is important to note that this Department will not support intensive Industrial land-uses due to the Hennopsvallei Conservancy adjacent to the site and due to the Sunderland Ridge Industrial Area located in close proximity of the proposed application site.
- b) A detailed Geotechnical Report and Dolomite Stability Assessment for the proposed Development shall be included within the EIA Report. The Report shall include a land-use specific map for Monavoni x44 in regards to the Geotechnical Stability which will indicate all the Geotechnical zones and allowed land-uses for each zone.
- c) All conditions in regards to the Monavoni x44 Development, within the letter of Council for Geosciences (dated 12 November 2009, page 4& 5) shall be included within the final EMP as part of the EIA Report.
- d) A site specific Fauna and Flora Assessment for Monavoni x44 shall be included within the EIA Report due to the proposed application site been affected by GDARD Irreplaceable Sites. The Report shall include a map which will include the vegetation zones identified on site. Further the Report shall include a letter from GDARD Biodiversity, indicating possible sensitive Fauna and Flora species on the proposed application site. The Report shall address all issues and species as identified by GDARD Biodiversity.
- e) Due to the Monavoni Development Framework not been approved, the layout within the EIA Report shall uphold and incorporate all sensitive features on site, including the Primary Grassland and Rocky outcrop. These areas shall be included within the development as Open Space. The layout should also be sensitively designed to incorporate as much as possible, the existing indigenous vegetation

clumps and trees on site. A conceptual layout indicating building positions, internal streets, vegetation to be retained and proposed open spaces shall be included within the EIA Report.


- f) Possible negative Noise pollution from the future K52 road proposed to traverse the application site should be discussed within the EIA Report. Possible mitigation measures and design recommendations for especially the Residential component of the proposed Township shall be discussed and included within the EIA.
- g) A Traffic Impact Study for the proposed Monavoni x44 Township must be included within the EIA Report. This Report should aim to address expected traffic volumes and recommendations on road upgrades within the direct vicinity to accommodate the proposed development.
- h) Comments from the Hennopsvallei Conservancy must be included in the final EIA report. Any issues identified by the Conservancy shall be addressed and included. Proof of notification to Hennopsvallei Conservancy shall be included within the EIA Report.
- i) A Stormwater Management Plan must be included within the EIA Report. The plan should aim to prevent pollution, erosion and siltation during both the construction and operational phases. The increase in speed, quantity and quality of surface stormwater should also be addressed.
- j) A Rehabilitation plan should be implemented after construction and should aim to prevent erosion and aid the return of natural, endemic and indigenous vegetation cover to at least 80% of the rehabilitated area. The proposed rehabilitation plan should be discussed as part of the EMP included within the EIA Report.
- k) An Environmental Management Plan should be included within the final EIA Report. The EMP should address impacts and mitigation measures for the pre-construction, construction and post-construction activities. All issues and recommendations as indicated above should be included within the final and approved EMP. An Environmental Control Officer and contact details should also be included within the EMP.

## 6. CONCLUSION

The Department has no objection to the Draft Scoping Report, subject to the consideration and inclusion of the recommendations as outlined above within the EIA Report.

The Department will only provide final comments after the EIA Report has been submitted to the Department for review.

Yours faithfully,



.....  
**Mr L. Siphuma**

18/06/2010  
.....  
**Date**

### EXECUTIVE DIRECTOR: ENVIRONMENTAL MANAGEMENT

CC Gauteng Department of Agriculture and  
Rural Development

Attn:

Mr. Teboho Leku

Tel: (011)355 1860

Fax: 086 606 1197

# Annexure R(vii)



## water affairs

Department:  
Water Affairs  
**REPUBLIC OF SOUTH AFRICA**

OFFICE OF THE REGIONAL DIRECTOR: GAUTENG  
Sanlam Plaza East, 285 Schoeman Street, Pretoria

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☎:	(012) 392-1486	✉	P/Bag X995	✉	Nevondo Mpho
	086 5499 966		PRETORIA	☎	(012) 392 1405
e-mail:	<a href="mailto:NevondoM2@Dwa.gov.za">NevondoM2@Dwa.gov.za</a>		0001	📁	16/2/7/A210/N58

06 June 2010

Bokamoso Landscape Architects and Environmental Consultant  
P.O Box 11375  
Maroelana  
0161

ATTENTION: Lizelle Gregory

### THE ENVIRONMENTAL SCPOING REPORT FOR THE PROPOSED MONAVONI EXTENSION 44 DEVELOPMENT.

The Basic Assessment Report for the above mentioned proposed development prepared by Bokamoso Environmental consultant on behalf of M and T development refers:

The Department has evaluated the report and the following comments are brought to your attention.

- All municipal by laws must be adhered to.
- Provision should be made for a storm water system. Storm water polluted by refuse, sewage and other surface pollution should be kept from coming into contact with public streams/ clean water systems.
- The proposed development must comply with all Sections of the National Water Act, 1998 (Act 36 of 1998) and Water Service Act, 1997 (Act 107 of 1997).
- This department requires a letter from municipality stating that there is capacity in the sewage works to accommodate effluent from the

Department of Water Affairs • Departement van Waterwese • Muhasaho wa zwa Madi • uMnyango wezaManzi • Ndzawulo ya la Mati  
Lefapha la Dilaba tsa Metsi • Kgoro ya Merero ya Meetse • Lefapha la Merero ya Metsi • LiTiko la Temantli  
ISebe lezaManzi • UmNyango weeNdaba zaManzi

development. The development is not recommended until such capacity is confirmed.

- Stockpiling of any material is not allowed within 100 / 1:100 year flooding metres from a watercourse.
- All waste generated on site must be managed and disposed of at permitted/ approved dumping site as stipulated in section 20 of the Environmental Conservation Act, 1989 (Act 73 of 1989).
- The Department (Department of Water Affairs) must be notified of any deviations from the conditions and commitments.

Should you have any questions on the content of this letter, you are welcome to contact this office at the above contact details.

Yours Faithfully

  
REGIONAL HEAD: GAUTENG REGION  
DATE: 07/06/2010



# Annexure R(viii)



## water affairs

Department:  
Water Affairs  
REPUBLIC OF SOUTH AFRICA

OFFICE OF THE REGIONAL DIRECTOR: GAUTENG  
Sanlam Plaza East, 285 Schoeman Street, Pretoria

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☎:	(012) 392-1486	✉	P/Bag X995	✉	Nevondo Mpho
	086 5499 966		PRETORIA	☎	(012) 392 1405
e-mail:	<a href="mailto:NevondoM2@Dwa.gov.za">NevondoM2@Dwa.gov.za</a>		0001	📁	16/2/7/A210/N58

06 June 2010

Bokamoso Landscape Architects and Environmental Consultant  
P.O Box 11375  
Maroelana  
0161

ATTENTION: Lizelle Gregory

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ISebe lezaManzi • UmNyango weeNdaba zaManzi

development. The development is not recommended until such capacity is confirmed.

- Stockpiling of any material is not allowed within 100 / 1:100 year flooding metres from a watercourse.
- All waste generated on site must be managed and disposed of at permitted/ approved dumping site as stipulated in section 20 of the Environmental Conservation Act, 1989 (Act 73 of 1989).
- The Department (Department of Water Affairs) must be notified of any deviations from the conditions and commitments.

Should you have any questions on the content of this letter, you are welcome to contact this office at the above contact details.

Yours Faithfully

  
REGIONAL HEAD: GAUTENG REGION  
DATE: 07/06/2010

# Annexure S

# Monavoni X 44

Part of Portion 1 of the Farm Stukgrond 382 –JR  
Gaut: 002/08-09/N0588

## Draft Environmental Management Plan Version 1 October 2013

### **B O K A M O S O**

LANDSCAPE ARCHITECTS AND ENVIRONMENTAL CONSULTANTS

Tel: (012) 346 3810

Fax: 086 570 5659

E-mail: [lizelleg@mweb.co.za](mailto:lizelleg@mweb.co.za)

P O BOX 11375

MAROELANA

0161





# 1 Project Outline

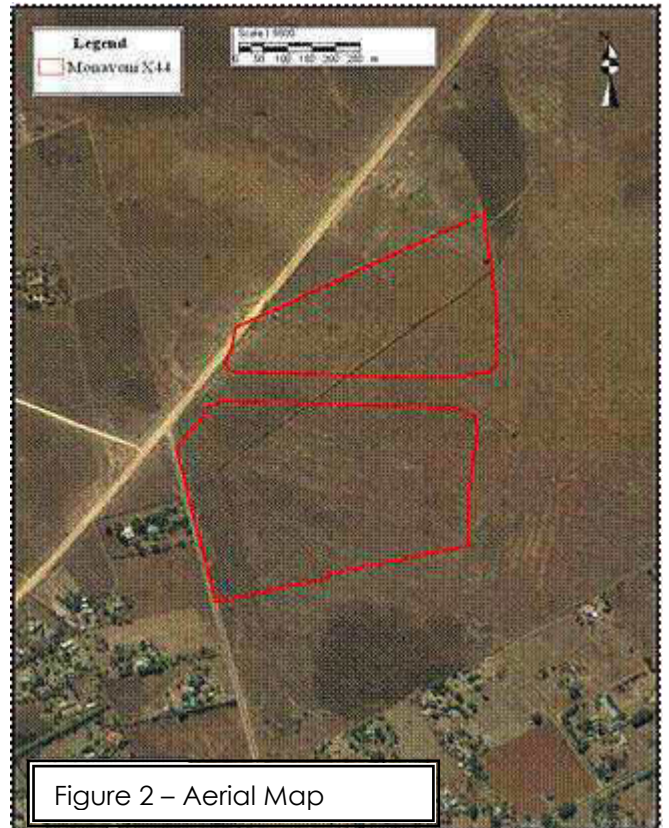
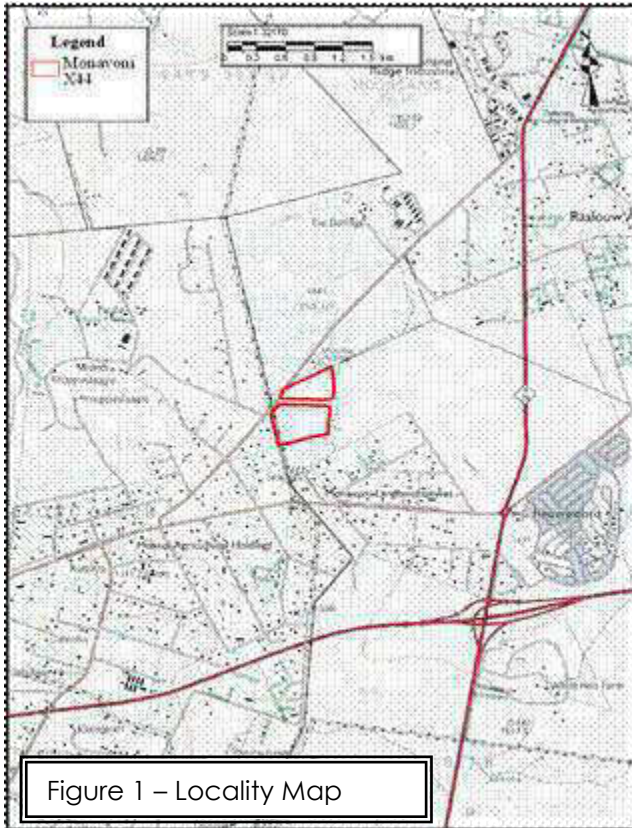
## 1.1 Background

**Bokamoso Environmental Consultants** was appointed by **JR 209 Investments (Pty) Ltd** to compile an Environmental Impact Assessment Report for the proposed **Monavoni X 44** development and its associated activities. The Report had been prepared to comply with Section 32 of the National Environmental Management Act (NEMA), 1998 (Act 107 of 1998).

## 1.2 Project description

The proposed **Monavoni X 44** is situated on **Part of Portion 1 of the Farm Stukgrond 382 JR (Refer to Figure 1 for the Locality Map and Figure 2 for Aerial Map)**. The proposed **Monavoni X 44** development forms part of the larger Monavoni development for which a Monavoni Development Framework had been compiled (refer to Figure 3).

The study area is approximately **38,8293 hectares** in extent and is located in the area of jurisdiction of the **City of Tshwane** in **Gauteng Province**.







**Timeframe for construction:**

The construction for the proposed Development of Monavoni X 44 will commence as soon as approval for the proposed development has been secured from the relevant authorities.

**The EMP will be a binding document for purposes of compliance.**

**1.3 Receiving Environment**

**Geology:**

The study area is underlain by Basement granite in the extreme south-western corner, by quartzite and shale of the Black Reef Formation separating the underlying granite from the overlying dolomite and chert of the Oak tree Formation (Malmani Subgroup) of the Chuniespoort Group. The Black Reef Formation and the overlying Chuniespoort Group forms the basal portion of the Transvaal Supergroup.

**Hydrology:**

The study area is not affected by any rivers, wetlands or floodlines.

**Fauna and flora:**

Four plant communities were identified on or within 200m of the study area: namely:

- Natural primary grassland;
- Mixed alien and indigenous vegetation;
- Old cultivated fields; and
- Rocky outcrop vegetation.

No Red listed fauna and flora species were identified on site.

Some Orange listed species i.e. *Hypoxis hemerocallidea* occurred on site.

**Cultural /Historical:**

- No obvious features, sites or artefacts of cultural significance that could be impacted on by the proposed development were identified.

**Visual:**

- The study area will be visible from the proposed K52 and PWV9. The proposed development is in line with the future proposals and developments for the area and will therefore not be visually out of place.

**Noise:**

- Some noise impact will occur from the proposed K52.

**Dust:**

- Dust could impact the surrounding residences if the construction will be done during the dry and windy months. It is proposed that regular damping down of the study area must be done if constructed during dry and windy months.

## **2 EMP Objectives and context**

---

### **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 Record of Decision of GDARD and 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 GDARD. In addition, all mitigation measures recommended in the EIA report are included in the EMP.

This EMP addresses the following three phases of the development:

- Pre-construction planning phase;
- Construction 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 specialists 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 RoD. 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.

### **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.

### **Contact details of appointed ECO**

**ECO details will be available as soon as developer appointed a company.**

- 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 laborers 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 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 diary.

### 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.

### 3.8 Acts

#### 1. 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 study area is not affected by any rivers or flood lines. In terms of Section 21 of the National Water Act the 1:100 year floodline must be indicated on layout maps.

## **2. National Environmental Management: Air Quality Act (Act No. 39 of 2004)**

This act replaced the Atmospheric Pollution Prevention Act (Act No. 45 of 1965), however Part 2 of this act is still applicable. Part 2 of the act deals with the control of noxious or offensive gases. The proposed development will not release any of the listed gases into the atmosphere and this act is therefore not applicable to the proposed development.

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."

The purpose of the Act is "To provide for the prevention of the pollution of the atmosphere, for the establishment of a National Air Pollution Advisory Committee, and for matters incidental thereto".

The Atmospheric Pollution Prevention Act was traditionally administered by the Department of Health until 1995, when it was transferred to the jurisdiction of the Department of Environmental Affairs and Tourism. The Act controls four forms of air pollution:

- ❑ Part II                    Noxious or Offensive gases
- ❑ Part III                   Atmospheric Pollution by Smoke
- ❑ Part IV                   Dust Control
- ❑ Part V                    Air Pollution by Fumes Emitted by Vehicles

### **Impact on proposed Development:**

**Significant –** During the construction phase dust pollution can become a significant factor, especially to the surrounding developments and landowners. Dust control would be adequately minimised during this phase by way of water spraying and possible dust-nets, when required.

The additional vehicles generated by the proposed development will have an insignificant impact on the air pollution due to emissions gasses created by any additional vehicles or traffic of the proposed development.

## **3. 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.

**Impact on proposed Development:**

**Significant –** The proposed development of Monavoni X 44 is listed under the activities as regulated under NEMA.

**4. The Municipal Systems Act (Act 32 of 2000)**

This Act was introduced to provide for the core principles, mechanisms and processes that are necessary to enable municipalities to move progressively towards the social and economic upliftment of local communities, and ensure universal access to essential services that are affordable to all.

The proposed development will support the local authority in complying with the principles of the Municipal Systems Act, by assisting in providing the community with essential services, such as water and sewage infrastructure.

**Impact on proposed Development:**

**Significant –** The proposed development will promote the Municipal System within City of Tshwane as the proposed development will upgrade and improve the essential services such as water and sewerage to the area, therefore contributing to the social and economic upliftment of the City of Tshwane.

**5. The Draft Red Data Species Policy**

This policy is provided for the protection, conservation and maintenance of Red Data species within the Gauteng Province.

**Impact on proposed Development:**

**Not significant – No** red listed species were identified on site.

**6. National Veld and Forest Fire Act, 1998 (Act No. 101, 1998)**

The purpose of this Act is to prevent and combat veld, forest and mountain fires throughout the Republic. Furthermore the Act provides for a variety of institutions, methods and practices for achieving the prevention of fires.

**Impact on proposed Development:**

**Significant –** Fires of construction workers may only be lit in the designated site camp as indicated in assistance with the ECO. It is important that a site development camp be located on a part of the application site that is already disturbed.

**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 0.5ha. The Act makes

provision for the potential destruction to existing sites, pending the archaeologist's recommendations through permitting procedures. Permits are administered by the South African Heritage Resources Agency (SAHRA).

**Impact on proposed Development:**

**Not significant** – No features of Heritage importance are present on site.

**8. Conservation of Agricultural Resources Act (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 and the vegetation and the combating of weeds and invader plants; and for matters connected therewith.

**Impact on proposed Development:**

**Not significant** – According to the agricultural specialist the site cannot be used economically for agricultural purposes. The site does not fall within any Agricultural Hub.

**9. Water Services Act, 1997 (Act No. 108 of 1997)**

This Act provides for the minimum standards and measures of which the following Water Services should adhere to:

- o Basic sanitation
- o Basic water supply
- o Interruption in provision of water services
- o Quality of potable water
- o Control of objectionable substances
- o Disposal of grey water
- o Use of effluent
- o Quantity and quality of industrial effluent discharged into a sewerage system
- o Water services audit as a component in the Water Services Development Plan
- o Water and effluent balance analysis and determination of water losses
- o Repair of leaks
- o Consumer installations other than meters
- o Pressure in reticulation system

**Impact on proposed Development:**

**Significant** – The proposed development will have to be supplied with the basic water bearing services; therefore the water should comply with the minimum standards and measures of this Act.

**10. National Environmental Management Act: Biodiversity Act (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 listed species were identified.

**11. National Spatial Biodiversity assessment**

The National Spatial Biodiversity Assessment (NSBA) classifies areas as worthy of protection based on its biophysical characteristics, which are ranked according to priority levels.

**Impact on proposed Development:**

**Not significant – No** red listed species were identified.

**12. Protected Species – Provincial Ordinances**

Provincial ordinances were developed to protect particular plant species within specific provinces. The protection of these species is enforced through permitting requirements associated with provincial lists of protected species. Permits are administered by the Provincial Departments of Environmental Affairs.

**Impact on proposed Development:**

**Not significant – No** red listed plant species were identified.

**13. 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:**

**Not Significant – No** area was identified as a system which needs protection, conservation and management.

**14. Gauteng Transport Infrastructure Act, 2001**

To consolidate the laws relating to roads and other transport infrastructure in Gauteng; and to provide for the planning, design, development, construction, financing, management, control, maintenance, protection and rehabilitation of provincial roads, railway lines and other transport infrastructure in Gauteng.

**Impact on proposed Development:**

**Not significant** – Some upgrading of the surrounding road network will be needed, but is deemed as insignificant as this will only provide entrance to the proposed development.

**15. National Road Traffic Act, 1996 (Act No. 93 of 1996)**

This Act provides for all road traffic matters which shall apply uniformly throughout the Republic and for matters connected therewith.

**16. Environmental Conservation Act: Noise Regulations, 1989 (Act no.73 of 1989)**

The purpose of this Act is to provide measures and management relating Noise levels. This Act enables Noise levels to be acceptable to standards within a specific area and community.

**Impact on proposed Development:**

**Significant** – The proposed development may include some noisy activities with the installation of necessary infrastructure and services.

**17. National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)**

The purpose of the act is to reform the law 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; to provide for institutional arrangements and planning matters; to provide for national norms and standards for regulating the management of waste by all spheres of government; to provide for specific waste management measures; to provide for the licensing and control of waste management activities; to provide for the remediation of contaminated land; to provide for the national waste information system; to provide for compliance and enforcement; and to provide for matters connected therewith.

**Impact on proposed Development:**

**Not Significant** – The proposed development does not trigger any listed activities in terms of the Waste Act.

## 4 Project activities

### 4.1 Pre-Construction Phase

<i>TYPE</i>	<i>Environmental risk or issue</i>	<i>Objective or requirement</i>	<i>Mitigation measure</i>	<i>Performance indicator</i>	<i>Responsibility</i>	<i>Frequency of Action</i>	<i>Applicable Act no.</i>
<b>General</b>	<b>Project contract</b>	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		Developer	-	3
			All municipal by laws must be adhered to.				
			The DWA must be notified of any deviations from the conditions and commitments.				
			The proposed development must comply with all Sections of the National Water Services Act, 1997 (Act 107 of 1997).				
<b>Design and planning</b>	<b>Stability of structures and restriction of land use due to geology</b>	To ensure stability of structures	<ol style="list-style-type: none"> <li>1) The layout and land uses must correspond to the stability zonation and development types recommended by the geotechnical engineer.</li> <li>2) The foundation recommendations supplied by the geotechnical engineers must be adhered to.</li> <li>3) Detailed foundation investigations should be done for large structures because residual dolomite material may experience settlements under load or be collapsible.</li> </ol>		Individual Developer Engineer	-	
			The NHBRC precautionary measures for development in dolomitic areas must be implemented.	The EMP is included as part of the tender documentation	Engineer Individual Developer	-	
			1) A dolomite risk management plan must	Dolomite Risk	Engineer		

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<b>TYPE</b>	<b>Environmental risk or issue</b>	<b>Objective or requirement</b>	<b>Mitigation measure</b>	<b>Performance indicator</b>	<b>Responsibility</b>	<b>Frequency of Action</b>	<b>Applicable Act no.</b>
			<p>be compiled for this township in general and copies must be submitted to the Council for Geoscience and the NHBRC. This system must be practical with detailed requirements applicable to the township. This can, however, only be done after the township to be established has been approved.</p> <p>2) The application of strict water precautionary measures for the development is essential. Stormwater management on the study area is extremely important to prevent the concentration of stormwater. No accumulation of surface water is to be permitted and the entire development must be properly drained.</p> <p>3) The normal drainage precautionary measures and special installation measures for underground wet services, applicable to dolomitic terrain and in compliance with the Tshwane Metropolitan Municipality should be adhered to.</p> <p>-</p>	Management Plan compiles			
	<b>Storm water design</b>	To prevent and restrict erosion, siltation and groundwater pollution	1) A detailed storm water management plan must be approved by the Local Authority and Council for Geoscience prior to commencement of construction activities. Such approval must be submitted to DWA together with a copy of the original stormwater management plans. Must be implemented according to guidelines provided by the relevant Local Authority Departments.	Compilation and approval of storm water management plan	Engineer Individual Developer	-	9

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<i><b>TYPE</b></i>	<i><b>Environmental risk or issue</b></i>	<i><b>Objective or requirement</b></i>	<i><b>Mitigation measure</b></i>	<i><b>Performance indicator</b></i>	<i><b>Responsibility</b></i>	<i><b>Frequency of Action</b></i>	<i><b>Applicable Act no.</b></i>
			<p>2) The storm water design for the proposed development must be designed to:</p> <p>Reduce and/ or prevent siltation, erosion and water pollution.</p> <p>3) Storm water runoff should not be concentrated as far as possible and sheet flow should be implemented.</p> <p>5) Energy dissipaters must be installed on the study area to break the speed of the water.</p> <p>6) Surface storm water generated as a result of the development must not be channeled directly into any natural drainage system or wetland.</p> <p>7) The storm water management plan should be designed in a way that aims to ensure that post development runoff does not exceed predevelopment values in:</p> <ul style="list-style-type: none"> <li>- Peak discharge for any given storm;</li> <li>- Total volume of runoff for any given storm;</li> <li>- Frequency of runoff; and</li> <li>- Pollutant and debris concentrations reaching water courses.</li> </ul> <p>8) No natural channels will be allowed. All open channels and attenuation ponds must be lined with concrete.</p> <p>9) Concentrated surface drainage is not permitted.</p> <p>10) Stormwater polluted by refuse, sewage and other surface pollution should be kept from coming into contact with public streams / clean water systems.</p>				
			The developer must ensure that no wastewater may run freely into any of the	Correct positioning of construction	Engineer		



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			surrounding streets or naturally vegetated areas and also ensure the correct positioning of construction camps and their sanitation facilities.	camps			
	<b>Light pollution</b>	To minimise light pollution	The generation of light by night events, security lighting and other lighting shall be effectively designed so as not to spill unnecessary outward into the oncoming traffic, or into the yards of the neighbouring properties or open spaces.	Lighting effectively designed.	Architect	-	
	<b>Visual impact</b>	To minimize the visual impact of the proposed development.	Architectural guidelines to minimize the visual impact: The proposed development will be seen from a distance and therefore the roofs should not reflect the sun or be covered with roofing materials that have bright colours. Black or charcoal coloured roofs will blend in tastefully with the surrounding environment. Suitable plant materials should be used at strategic points to screen off impacts caused by roofs and cars in large parking areas. Existing trees and vegetation clumps should be retained as far as possible. The trees and vegetation will instantly soften the impact of the proposed permanent structures and they will bring the scale of the structures within the urban context down to a more human scale. The colour scheme should be taken from the palette of colours in the natural surroundings. The Schurweberg in the background should be taken into consideration during the design phase of the project.	Architectural guidelines minimizes visual impact	Architect	-	
	<b>Noise impact</b>	To minimize noise	The alignment of the K52 must be taken				

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		impact from the K52	into consideration during the design of the proposed development.				
<b>Climate</b>	<b>Extreme change in micro climate temperatures</b>	To prevent the extreme change in micro climate temperatures	Where open parking bays are involved, one tree for every two parking bays shall be indicated on the Site Development Plan which shall be approved by the Local Authority and Design Review Committee, if any.	Landscape Development Plan complies	Landscape Architect	-	
<b>Geology and Soils</b>	<b>Unsuitable Geotechnical conditions</b>	To prevent unsuitable Geotechnical conditions	The special precautionary measures, as indicated within the Geotechnical Report must be adhered to at all times. 1) A storm water management plan must be implemented on the study area to prevent the erosion of soil. 2) A pro-active maintenance strategy for water bearing services and other infrastructure should be implemented.	Precautionary measures implemented	Geotechnical engineer Dolomite Risk Manager	-	9
<b>Fauna and flora</b>	<b>Floral biodiversity and ecological health</b>	To ensure that the species introduced to the area, are compatible with the current and future quality of the ecological processes.	1) The site development plan for the proposed development shall be submitted to the local authority for approval. 2) It is important that all the plant positions, quantities and coverage per m <sup>2</sup> be indicated on a plan. 3) The proposed planting materials for the areas to be landscaped shall be non-invasive, and preferably indigenous and /or endemic. 4) As much of the existing indigenous trees, vegetation clumps and natural grassland will have to be incorporated within the proposed formal landscaping. 5) The vegetation around the Drainage channel must be retained and rehabilitated where necessary. 6) Buffer zones should be adhered to.	The landscape development plan submitted to the local authority for approval.	Landscape Architect	-	10,11,13
			The removal of Category 1 Declared invaders from the property is mandatory	Category 1 and 2 declared Invaders	Contractor ECO		3,8

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<b>TYPE</b>	<b>Environmental risk or issue</b>	<b>Objective or requirement</b>	<b>Mitigation measure</b>	<b>Performance indicator</b>	<b>Responsibility</b>	<b>Frequency of Action</b>	<b>Applicable Act no.</b>
			and Category 2 Declared invaders must be controlled.	removed			
	<b>Loss of sensitive vegetation</b>	To ensure protection of orange listed plants	The Orange- listed <i>Hypoxis hemerocallidea</i> (African potato) should be relocated to a safe, suitable area approved by GDARD.	Orange listed plants rescued prior to construction	Qualified specialist		
<b>Preparing Site Access</b>	<b>Environmental integrity</b>	To avoid erosion and disturbance to indigenous vegetation	Designated 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 and pedestrians. 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 site is erosion free.  Minimum disturbance to surrounding vegetation.  Vehicles make use of established access routes.	Contractor	Continuous	
	<b>Waste storage</b>	To control the temporary storage of waste.	Temporary waste storage points 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/in areas where the wind direction will carry bad odours across the properties of adjacent tenants or landowners.		Contractor ESO	-	
		Ensure waste storage area does not generate pollution	Build a bund around waste storage area to stop overflow into storm water.		Contractor	-	
		To prevent water pollution	-The storage and use of fuel and other chemicals on site must be adequately managed to prevent soil and water pollution. -Containment areas must be provided for		Developer Contractor		

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<i><b>TYPE</b></i>	<i><b>Environmental risk or issue</b></i>	<i><b>Objective or requirement</b></i>	<i><b>Mitigation measure</b></i>	<i><b>Performance indicator</b></i>	<i><b>Responsibility</b></i>	<i><b>Frequency of Action</b></i>	<i><b>Applicable Act no.</b></i>
			handling of potential pollutants at refuelling depots - Transport, storage, handling and disposal of hazardous substances must be adequately controlled and managed.				
			No wastewater may run freely into any of the surrounding streets or naturally vegetated areas.		Contractor		

## 4.2 Construction Phase

<b>TYPE</b>	<b>Environmental risk or issue</b>	<b>Objective or requirement</b>	<b>Mitigation measure</b>	<b>Performance indicator</b>	<b>Responsibility</b>	<b>Frequency of Action</b>	<b>Applicable Act no.</b>
<b>Contractor's Camp</b>	<b>Loss of Vegetation and topsoil</b>	To minimize damage to and loss of vegetation and retain quality of topsoil	Site to be established under supervision of ECO/ESO.	Minimal vegetation removed/ damaged during site activities.	Contractor	Before any construction activity commences and as and when required	5, 10, 11, 13
	<b>Surface and ground water pollution</b>	To minimize pollution of surface and Groundwater resources.	<p>1) Sufficient and temporary facilities including ablution facilities must be provided for construction workers operating on the site.</p> <p>2) A minimum of one chemical toilet shall be provided per 10 construction workers. The contractor shall keep the toilets in a clean, neat and hygienic condition. Toilets provided by the contractor must be easily accessible and a maximum of 50m from the works 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.</p> <p>3) No person is allowed to use any other area than chemical toilets.</p> <p>4) No French drain systems may be installed.</p> <p>5) No chemical or waste water must be allowed to contaminate the run-off on site. This could possibly contaminate the drainage channel.</p> <p>6) The chemical toilets may not be placed in</p>	<p>Effluents managed Effectively.</p> <p>No pollution of water resources from site.</p> <p>Workforce use toilets provided.</p>	Contractor ESO	As and when required	

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<b>TYPE</b>	<b>Environmental risk or issue</b>	<b>Objective or requirement</b>	<b>Mitigation measure</b>	<b>Performance indicator</b>	<b>Responsibility</b>	<b>Frequency of Action</b>	<b>Applicable Act no.</b>
			close proximity of the adjacent dwellings to prevent odors from causing uncomfortable situations. 7) Avoid the clearing of the site camp (of specific phase) or paved surfaces with soap. This could drain into the drainage channel on site and contaminate to open space system in the area.				
		To minimize pollution of surface and Groundwater resources due to spilling of materials.	1) Drip trays and/ or lined earth bunds must be provided under vehicles and equipment, to contain spills of hazardous materials such as fuel, oil and cement. 2) Repair and storage of vehicles only within the demarcated site area. 3) Spill kits must be available on site. 4) Oils and chemicals must be confined to specific secured areas within the site camp. These areas must be bunded with adequate containment (at least 1.5 times the volume of the fuel) for potential spills or leaks. 5) All spilled hazardous substances must be contained in impermeable containers for removal to a licensed hazardous waste site. 6) No leaking vehicle shall be allowed on site. The mechanic/ the mechanic of the appointed contractor must supply the environmental officer with a letter of confirmation that the vehicles and equipment are leak proof. 7) No bins containing organic solvents such as paints and thinners shall be cleaned on site, unless containers for liquid waste disposal are placed for this purpose on site.	No pollution of the environment	Contractor ESO	Daily	
		To minimize pollution of surface and	The mixing of concrete shall only be done at specifically selected sites, as close as possible to the entrance, on mortar boards	No evidence of contaminated soil on the	Contractor ESO	Daily	



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		groundwater resources by cement	or similar structures to prevent run-off into drainage line, streams and natural vegetation.	construction site.			
		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 ground water resource.	No evidence of contaminated water resources.	Contractor ESO	Daily	
	<b>Pollution of the environment</b>	To prevent unhygienic usage on the site and pollution of the natural assets.	<p>1) Weather proof waste bins must be provided and emptied regularly.</p> <p>2) The contractor shall provide laborers to clean up the contractor's camp and construction site on a daily basis.</p> <p>3) Temporary waste storage points on the site should be determined. THESE AREAS SHALL BE PREDETERMINED AND LOCATED IN AREAS THAT IS ALREADY DISTURBED. These 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:</p> <ul style="list-style-type: none"> <li>• Skips for the containment and disposal of waste that could cause soil and water pollution, i.e. paint, lubricants, etc.;</li> <li>• Small lightweight waste items should be contained in skips with lids to prevent wind littering;</li> <li>• Bunded areas for containment and holding of dry building waste.</li> </ul> <p>4) No solid waste may be disposed of on the</p>	<p>No waste bins overflowing</p> <p>No litter or building waste lying in or around the site</p>	Contractor ESO	Daily Weekly	5,13

Draft Environmental Management Plan for proposed Monavoni X 44 development

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			site. 5) No waste materials shall at any stage be disposed of in the open veld of adjacent properties or within the drainage lines (No-Go areas). 6) The storage of solid waste on the site, until such time as it may be disposed of, must be in a manner acceptable to the local authority and DWA. 7) Cover any wastes that are likely to wash away or contaminate storm water.				
		<b>Recycle material where possible and correctly dispose of unusable wastes</b>	1) Waste shall be separated into recyclable and non-recyclable waste, and shall be separated as follows: <ul style="list-style-type: none"> <li>• General waste: including (but not limited to) construction rubble,</li> <li>• Reusable construction material.</li> </ul> 2) Recyclable waste shall preferably be deposited in separate bins. 3) All solid waste including excess spoil (soil, rock, rubble etc) must be removed to a permitted waste disposal site on a weekly basis. 4) No bins containing organic solvents such as paints and thinners shall be cleaned on site, unless containers for liquid waste disposal are placed for this purpose on site. 5) Keep records of waste reuse, recycling and disposal for future reference. Provide information to ESO.	Sufficient containers available on site  No visible signs of pollution	Contractor ESO	Daily Weekly	
			-The storage and use of fuel and other chemicals on site must be adequately managed to prevent soil and water pollution. -Containment areas must be provided for handling of potential pollutants at refuelling depots	Correct storage and use of fuel.  Containment areas provided for handling of	Contractor		

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<b>TYPE</b>	<b>Environmental risk or issue</b>	<b>Objective or requirement</b>	<b>Mitigation measure</b>	<b>Performance indicator</b>	<b>Responsibility</b>	<b>Frequency of Action</b>	<b>Applicable Act no.</b>
			- Transport, storage, handling and disposal of hazardous substances must be adequately controlled and managed.	potential pollutants at refuelling depots.			
			<b>If any pollution incident is experienced, DWA must be notified immediately.</b>	Contractor			
	<b>Increased fire risk to site and surrounding areas</b>	<b>To decrease fire risk.</b>	1) Fires shall only be permitted in specifically designated areas and under controlled circumstances. This area may not be located in close proximity of the power lines as the natural grass within this area can easily take flame and could spread to surrounding open space system. 2) Food vendors shall be allowed within specified areas. 3) Fire extinguishers to be provided in all vehicles and fire beaters must be available on site. 4) Emergency numbers/ contact details must be available on site, where applicable.	No open fires on site that have been left unattended	Contractor	Monitor daily	6
<b>Construction site</b>	<b>Geology and soils</b>	To prevent the damaging of the existing soils and geology.	1) The top layer of all areas to be excavated for the purposes of construction shall be stripped and stockpiled in areas where this material will not be damaged, removed or compacted. 2) 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.	Excavated materials correctly stockpiled  No signs of erosion	Contractor	Monitor daily	
		To prevent the loss of topsoil  To prevent siltation & water pollution.	1) Stockpiling will only be done in designated places where it will not interfere with the natural drainage paths of the environment. 2) In order to minimize erosion and siltation and disturbance to existing vegetation, it is	Excavated materials correctly stockpiled  No visible signs of	Contractor of Developer	Monitor daily	4,9

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TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>recommended that stockpiling be done/ equipment is stored in already disturbed/exposed areas.</p> <p>3) Cover stockpiles and surround downhill sides with a sediment fence to stop materials washing away.</p> <p>4) Remove vegetation only in areas designated during the planning stage and for the purpose of construction.</p> <p>5) Rehabilitation/ landscaping to be done immediately after the involved works are completed (will prevent erosion of the topsoil layer on site).</p> <p>6) All compacted areas should be ripped prior to them being rehabilitated/landscaped by the contractor.</p> <p>7) The top layer of all areas to be excavated must be stripped and stockpiled in areas where this material will not be damaged, removed or compacted. This stockpiled material should be used for the rehabilitation of the site and for landscaping purposes.</p> <p>8) Strip topsoil at start of works and store in stockpiles no more than 1,5 m high in designated materials storage area.</p> <p>9) During the laying of any cables, pipelines or infrastructure (on or adjacent to the site) topsoil shall be kept aside to cover the disturbed areas immediately after such activities are completed. Rehabilitation of these areas shall be done directly after infill of the trenches. No rocks shall be placed on the topsoil after re-filling.</p>	<p>erosion and sedimentation</p> <p>Minimal invasive weed growth</p> <p>Vegetation only removed in designated areas</p>			
	<b>Erosion and siltation</b>	To prevent erosion and siltation	<p>1) It is recommended that the construction of the development be done in phases.</p> <p>2) Each phase should be rehabilitated immediately after the construction for that</p>	<p>No erosion scars</p> <p>No loss of topsoil</p>	Contractor ESO	Monitor daily	

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TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>phase has been completed. The rehabilitated areas should be maintained by the appointed rehabilitation contractor until a vegetative coverage of at least 80% has been achieved.</p> <p>3) Mark out the areas to be excavated.</p> <p>4) Large exposed areas during the construction phases should be limited. Where possible areas earmarked for construction during later phases should remain covered with vegetation coverage until the actual construction phase. This will prevent unnecessary erosion and siltation in these areas.</p> <p>5) Unnecessary clearing of flora resulting in exposed soil prone to erosive conditions should be avoided.</p> <p>6) All embankments must be adequately compacted and planted with grass to stop any excessive soils erosion and scouring of the landscape if required.</p> <p>7) The eradication of alien vegetation should be followed up as soon as possible by replacement with indigenous vegetation to ensure quick and sufficient coverage of exposed areas.</p> <p>8) Storm water outlets shall be correctly designed to prevent any possible soil erosion.</p> <p>9) All surface run-offs shall be managed in such a way so as to ensure erosion of soil does not occur.</p> <p>10) Implementation of temporary storm water management measures that will help to reduce the speed of surface water by the individual erf owner / developer.</p> <p>11) All surfaces that are susceptible to</p>	<p>All damaged areas successfully rehabilitated</p>			

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			erosion shall be covered with a suitable vegetative cover as soon as construction is completed by the individual erf owner / developer.				
	<b>Stability of structures due to geology</b>	To ensure stability of structures.	1) A risk management plan must be designed and implemented. 2)The precautionary measures for construction on dolomite must be implemented 3) The foundation recommendations supplied by the geotechnical engineers must be adhered to. 4) It is recommended that excavations (for foundations and underground services) be inspected on the site to ensure that conditions at variance to that described can be noted and the necessary adjustments made. 5) Detailed foundation inspections should be carried out at the time of construction to identify variances and adjust foundation designs accordingly if need be.		Engineers / Contractor / Individual Developer	When required	
			The normal drainage precautionary measures and special installation measures for underground wet services, applicable to dolomitic terrain and in compliance with the Tshwane Metropolitan Municipality requirements, should be adhered to.	Drainage precautions implemented	Engineers Contractors		
	<b>Blasting</b>	Safety during blasting operations	Blasting may only be done by specialists in the field and should be limited to localised areas.  Surrounding land-owners of properties in close proximity of blasting exercises must be	Blasting done by specialists  Surrounding land owners informed	Contractors		



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			<p>informed/ warned (at least one week in advance) of blasting exercises that will take place on the study area.</p> <p>Warning signs to warn site workers and members of the public of blasting exercises must be erected at strategic points on the study area and the area where the blasting exercises will take place must be fenced off with barrier tape.</p> <p>Blasting operations should be carefully controlled and the necessary safety precautions must be implemented.</p>	<p>in advance</p> <p>Warning signs erected and barrier tape in place.</p>			
	<b>Hydrology</b>	Groundwater management	1) Ongoing monitoring of groundwater levels on and in the immediate vicinity of the site is recommended.	No deviation from baseline data during regular sampling	Engineer	Monthly	
		To minimise pollution of soil, surface and groundwater	<p>1) Increased run-off during construction must be managed using berms and other suitable structures as required to ensure flow velocities are reduced.</p> <p>2) The contractor shall ensure that excessive quantities of sand, silt and silted water do not enter the storm water system.</p>	<p>No visible signs of erosion.</p> <p>No visible signs of pollution</p>	Contractor	Monitor daily	
	<b>Fauna and flora</b>	To protect the existing fauna and flora.	<p>1) All exotic invaders and weeds must be eradicated on a continuous basis.</p> <p>2) Exotic invaders must be included in an alien management program for the site. Eradication must occur every 6 months.</p> <p>3) No plants not indigenous to the area, or exotic plant species, especially lawn grasses and other ground-covering plants, should be introduced in the communal landscaping of the proposed site, as they will drastically</p>	No exotic plants used for landscaping	Contractor ESO / Design Review Committee	<p>As and when required</p> <p>Every 6 months</p>	10,11,13

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			interfere with the nature of the area				
		To protect the existing fauna and flora.	<p>1) Trees that are intended to be retained shall be clearly marked on site.</p> <p>2) Snaring and hunting of fauna by construction workers on or adjacent to the study area are strictly prohibited and offenders shall be prosecuted.</p> <p>3) Should hedgehogs be encountered during the development, these should be relocated to natural grassland areas in the vicinity;</p> <p>4) Should the Harlequin snake be encountered during the construction phase of the development, it must be properly recorded, sent to the Transvaal Museum (if dead) or moved to other areas suitable for its preservation.</p> <p>5) Wood harvesting of any trees or shrubs on the study area or adjacent areas shall not be allowed, especially within the Non-perennial drainage line. OFFENDERS WILL BE PROSECUTED AND A FINE WILL BE ISSUED IN ACCORDANCE WITH THE GDARD.</p> <p>6) Where possible, work should be restricted to one area at a time.</p> <p>7) Noise should be kept to a minimum and the development should be done in phases to allow faunal species to temporarily migrate into the conservation areas in the vicinity.</p> <p>8) The contractor must ensure that no fauna species are disturbed, trapped, hunted or killed during the construction phase. Conservation-orientated clauses should be built into contracts for construction personnel, complete with penalty clauses for non-compliance;</p>	No measurable signs of habitat destruction	Contractor ESO	As and when required	5,10,11,13, 16

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			<p>9) Vegetation clumps and natural grassland areas to be retained and incorporated within the proposed development formal landscaping, must be marked and demarcated before any commencement of construction activities. These areas must be fenced off (will be seen as "No-Go" areas).</p> <p>10) The trenches for the water pipelines and sewage lines should be as narrow as possible. Environmental damage caused by these trenches may be kept to a minimum by good forward planning and thereby reducing the actual length of time that they are open. Possible damage to wildlife is in direct proportion to the time that these trenches are open and may destroy amphibian and reptilian species.</p>				
			<ul style="list-style-type: none"> <li>• Alien and invasive plants must be removed from areas to be excluded from development and the area rehabilitated with vegetation endemic to the area;</li> <li>• No plants not indigenous to the area, or exotic plant species, especially lawn grasses and other ground covering plants, should be introduced in the landscaping of the proposed development, as they might spread into the areas of natural vegetation;</li> <li>• Forage and host plants required by pollinator species in the area should also be used in landscaped areas;</li> <li>• Dumping of builder's rubble and other waste in the areas</li> </ul>		Contractor ESO	As and when required	5,10,11,13,16

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			<p>earmarked for exclusion must be prevented through fencing or other management measures;</p> <ul style="list-style-type: none"> <li>• Entrance by vehicles, especially off-road cars and bakkies, off-road bicycles and quad bikes to the areas to be excluded should be prohibited, both during the construction phase and during the lifespan of the project;</li> <li>• Foot paths should be restricted to areas where erosion can be controlled and damage to vegetation can be kept to a minimum;</li> <li>• The areas earmarked for exclusion from development must be fenced off during the construction phase to ensure that the developer and his contractors do not damage these areas or do not cover them with soil, builder's rubble or waste.</li> <li>• It is suggested that the building restrictions under the high tension power lines which transect the entire site, be used as a conservation feature by managing the grassland to attain as close as possible climax status;</li> <li>• Large indigenous trees should be left as part of the landscaping; and</li> <li>• Proper Veld Management Practices, such as fire management, should be implemented in the conservation areas.</li> </ul>				

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<b>Social</b>	<b>Noise impact</b>	To maintain noise levels below "disturbing" as defined in the national Noise Regulations.	1) Site workers must comply with the Provincial noise requirements as outlined. 2) Noise activities shall only take place during working hours	No complaints from surrounding residents and I & AP	Contractor	Monitored daily	16
	<b>Dust impact</b>	Minimise dust from the site	1) Dust pollution could occur during the construction works, especially during the dry months. Regular and effective damping down of working areas (especially during the dry and windy periods) must be carried out to avoid dust pollution that will have a negative impact on the surrounding environment. 2) When necessary, these working areas should be damped down in the mornings and afternoons.	No visible signs of dust pollution  No complaints from surrounding residents and I & AP	Contractor	Monitored daily	2
	<b>Safety and security</b>	To ensure the safety and security of the public.	1) Although regarded as a normal practice, it is important to erect proper signs indicating the operations of heavy vehicles in the vicinity of dangerous crossings and access roads or even in the development site if necessary. 2) With the exception of the appointed security personnel, no other workers, friend or relatives will be allowed to sleep on the construction site (weekends included) 3) Construction vehicles and activities to avoid peak hour traffic times 4) Presence of law enforcement officials at strategic places must be ensured 5) Following actions would assist in management of safety along the road <ul style="list-style-type: none"> <li>▪ Adequate road marking</li> <li>▪ Adequate roadside recovery areas</li> <li>▪ Allowance for pedestrians and cyclists where necessary</li> </ul>	No incidences reported	Contractor ECO	Monitored daily	

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			<ul style="list-style-type: none"> <li>Although regarded as a normal practice, it is important to erect proper signs indicating the danger of the excavation in and around the development site. Putting temporary fencing around excavations where possible.</li> </ul>				
	<b>Influx of people from other areas</b>	In order to limit the influx of people from other areas	It is recommended that (where possible) only people from the local communities in and around the application site are employed.	People from local community employed.	Contractor	When required	
	<b>Infrastructure and services</b>		The road and services upgrading as recommended by the involved engineers to be implemented.	Road and services upgrading according to recommendation	Engineers	When required	4,15
		Installation of services	Determine areas where services will be upgraded and relocated well in advance. Discuss possible disruptions with affected parties to determine most convenient times for service disruptions and warn affected parties well in advance of dates that service disruptions will take place	No complaints from I & AP	Contractor ESO	When required	4,9
	<b>Cultural Resources</b>		<p>1) It should be noted that in terms of the South African Resources Act (Act 25 of 1999) Section 35(4) no person may, without a permit issued by the responsible heritage resources authority destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or material</p> <p>2)- Also important is that Section 34(1) of this act states that no person may alter or demolish any structure or part of a structure, which is older than 60 years without a permit, issued by the relevant provincial heritage resources authority.</p>	No destruction of or damage to archaeological sites	Contractor ECO	Monitor daily	7



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			3) If archaeological sites or graves are exposed during the construction work, it should be reported to a museum immediately, preferably to a museum with an archaeologist available, so that an investigation and evaluation of the finds can be made.				
	<b>Visual impact</b>	In order to minimise the visual impact	1) The disturbed areas shall be rehabilitated immediately after the involved construction works are completed. 2) Shade cloth must be used to conceal and minimise the visual impact of the site camps and storage areas 3) All equipment and materials should be stored in a designated area indicated by the ECO. 4) All areas must be kept neat and tidy and waste should be stored in the designated areas and removed on a weekly basis.	Visual impacts minimized	Contractor ESO	Monitor daily	
	<b>Vegetation</b>	Landscaping	1) When planting trees, care should be taken to avoid the incorrect positioning of trees and other plants, to prevent the roots of trees planted in close proximity to the line of water-bearing services from causing leaking in, or malfunctioning of the services. 2) The proposed planting materials for the areas to be landscaped should preferably be endemic and indigenous. 3) All new trees and shrubs to be planted on the study area shall be inspected for pests and diseases prior to them being planted. 4) The inspection shall be carried out by the maintenance contractor at the property of the supplier and not on the study area.	Landscaping done according to landscape development plan	Landscape architect Contractor	When required	

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			<p>5) All trees to be planted shall be in 20L containers with a height of approximately 1,8 metres and a main stem diameter of approximately 300 mm.</p> <p>6) Rehabilitation of the drainage channel with indigenous vegetation should be done after construction has been completed on site.</p>				
		Loss of plants	<p>1) Aerate compacted soil and check and correct pH for soils affected by construction activities.</p> <p>2) Make sure plant material will be matured enough and hardened off ready for planting. Water in plants immediately as planting proceeds.</p> <p>3) Apply mulch to conserve moisture Plant according to the layout and planting techniques specified by the Landscape Architect in the Landscape Development plans for the site.</p>	Landscaping done according to landscape development plan	Landscape architect Contractor	When required	
		Spread of weeds	<p>Ensure that materials used for mulching and topsoil/ fertilisers are certified weed free. Collect certifications where available. Control weed growth that appears during construction.</p>	Weed growth controlled	Landscape architect Contractor	When required	
		To ensure rehabilitation of the site	<p>1) Compacted soils shall be ripped at least 200mm.</p> <p>2) All clumps and rocks larger than 30mm diameter shall be removed from the soil to be rehabilitated</p> <p>3) The soil shall be leveled before seeding</p> <p>4) Hydro-seed the soil with Potch mixture or plant with suitable indigenous ground covering as specified)</p> <p>5) Watering shall take place at least once per day for the first 14 days until germination of seeds have taken place</p>	Grass have hardened off	Landscape architect Contractor	Once a day Then every 4 days	

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			6) Thereafter watering should take place at least for 20 minutes every 4 days until grass have hardened off.				

### 4.3 Operational Phase

<b>TYPE</b>	<b>Environmental risk or issue</b>	<b>Objective or requirement</b>	<b>Mitigation measure</b>	<b>Responsibility</b>	<b>Frequency of Action</b>	<b>Applicable Act no.</b>
<b>SITE CLEAN UP AND PREPARED FOR USE</b>	<b>Storm water pollution</b>	Do not allow any materials to wash into the storm water system.	Remove erosion and sediment controls only if all bare soil is sealed, covered or re-vegetated. Sweep roadways clean and remove all debris from kerb and gutter areas. Do not wash into drains.	Contractor	-	
		Minimise waste	Decontaminate and collect waste in storage area ready for off-site recycling or disposal. Arrange for final collection and removal of excess and waste materials.	Contractor	-	
<b>ESTABLISHING PLANTS</b>	<b>Slow or no re-vegetation to stabilise soil; loss or degradation of habitat</b>	To ensure re-vegetation to stabilize soil	Agreed schedule for regular follow-up watering, weed control, mulch supplements and amenity pruning, if needed. Replace all plant failures within three month period after planting.	Contractor	To be agreed	
<b>MATERIALS FAILURE</b>	<b>Structural damage. Loss of site materials.</b>		Inspect all structures monthly to detect any cracking or structural problems. Confirm with designer if there are design problems. Rectify with materials to match, or other agreed solution.	Contractor	-	
<b>DRAINAGE FAILURE</b>	<b>On-site and downstream drainage pollution or flooding</b>	Storm water management plan	Inspect all site drainage works and repair any failures. Confer with design engineer and to correct site problems.	Contractor	-	
<b>SITE AUDIT</b>	<b>Eventual project failure</b>	Successful project establishment	Routinely audit the works and adjust maintenance schedule accordingly.	Contractor	-	

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<b>GENERAL</b>			Open fires and smoking during maintenance works are strictly prohibited.	Contractor	-	6
<b>GEOLOGY</b>	<b>Erosion of topsoil</b>	Prevent topsoil erosion	Due to lose topsoil, the soil must be covered by means of re-seeding and vegetation with suitable ground covering.	Engineer / Contractor /	Once off	
			A risk management plan must be designed and implemented. After completion it will become the responsibility of the Owners' Association. Infrastructure and ground-surface monitoring should be integral part of the risk management plan. Maintenance checks of infrastructure, the inspection of buildings, and the detection and repair/remediation of leaking services are amongst the tasks that will need to be undertaken at local council level. Findings should be recorded and entered into a database. Inspectors need to be aware or educated as to what to look for (ponding of water, cracks in the ground). Inspectors should be aware of the procedures to be followed in the event of an emergency.	Dolomite risk management plan compiled	Engineer	
<b>REHABILITATION</b>		To ensure alien and weeds are eradicated	A Rehabilitation Plan should be implemented after construction and should aim to prevent erosion and aid in the return of natural, endemic and indigenous vegetation cover to at least 80% of the rehabilitated area.	Contractor/ each home owner	Every 6 months	
	<b>Open Space System</b>	To ensure the proper management of the open space system	- Only indigenous plant species, preferably species that are indigenous to the natural vegetation of the area, should be used for landscaping in communal areas. As far as possible, plants naturally growing on the development site, but would otherwise be destroyed during clearing for development purposes, should be incorporated into landscaped areas. Forage and host plants required by pollinators should also be planted in landscaped areas.	Contractor HOA		

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			<p>- In order to minimize artificially generated surface stormwater runoff, total sealing of paved areas such as parking lots, driveways, pavements and walkways should be avoided. Permeable material should rather be utilized for these purposes.</p> <p>- Proper Veld Management Practices, such as fire management, should be implemented in the open space areas.</p> <p>- Corridors of Natural primary grassland must be included as part of the Monavoni Development Framework. These Open Space Areas must be properly managed throughout the lifespan of the project in terms of fire, eradication of exotics etc. to ensure continuous biodiversity.</p>			
			<p>The DWA must be notified of any deviations from the conditions and commitments.</p>			

## **5 Procedures for environmental incidents**

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### **5.1 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.

### **5.2 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.

### **5.3 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.

### **5.4 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.

### **5.5 Discovery of archeological or heritage items**

- Stop work.
- Do not further disturb the area.
- Notify ECO.
- ECO to arrange appraisal of specimen.
- If confirmed significant, 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.

## **6 EMP review**

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